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HOW TEACHERS EVALUATE A CURRICULUM DEVELOPED IN-HOUSE:
FOCUSED INTERVIEWS WITH SIX TEACHERS

by
Jeffrey Hunter Uecker

A Dissertation Submitted to the Faculty of the
DEPARTMENT OF TEACHING AND TEACHER EDUCATION
In Partial Fulfillment of the Requirements
For the Degree of
DOCTOR OF EDUCATION
In the Graduate College
THE UNIVERSITY OF ARIZONA

1996
As members of the Final Examination Committee, we certify that we have read the dissertation prepared by Jeffrey Hunter Decker entitled How Teachers Evaluate a Curriculum Developed In-house: Focused Interviews with Six Teachers and recommend that it be accepted as fulfilling the dissertation requirement for the Degree of Doctor of Education.

Walter Doyle
Kathy Carter
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Final approval and acceptance of this dissertation is contingent upon the candidate's submission of the final copy of the dissertation to the Graduate College.

I hereby certify that I have read this dissertation prepared under my direction and recommend that it be accepted as fulfilling the dissertation requirement.

Walter Doyle
Dissertation Director
Walter Doyle
STATEMENT BY AUTHOR

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SIGNED: [Signature]
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I owe a debt of gratitude to the mathematics teachers at “Ocotillo High School, an urban high school in Arizona”. They were more than collaborators in this project, they were more than my colleagues, they are like family.

Finally, I extend my special loving thanks to my wife, Anne, and my daughters, Kirstin and Stephanie, who sacrificed countless hours of family time throughout eight years of graduate school to make this possible.
DEDICATION

To my dad, Walter Uecker, who worked full-time during the day and went to school at night for nearly 20 years to earn his high school diploma, bachelor’s degree, and master’s degree. And to my mom, Margaret Uecker, who, at the age of 67, went to nursing school in order to fulfill a life-long dream. Two wonderful parents who showed me the value of education.
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# A Model of Teachers' Evaluative Framework

- Introduction
  - Teacher Participation
- A Closer Look at the Teacher's Evaluative Framework
- Implications for Further Research
- Conclusion

# VII. DISCUSSION

## Introduction

## Findings

### Topics from the Evaluation Literature

- Role of Measurement and Testing
- Quest for Technical Quality
- Role of Objectives
- Politics, Justice, and Stakeholders
- Impact of Constructivism

### Topics from the Change Literature

- Predisposition of Teachers toward Change
- Fit with System of Beliefs
- Clarity and Explicitness
- Amount of Work and the Work-Benefit Ratio
- Belief That Learning Is Taking Place
- Effect on Classroom Management
- Amount of Pressure and Support

## A Closer Look at the Teacher's Evaluative Framework

## Implications for Further Research

## Conclusion

# VII. APPENDIX A: THE PRE-ALGEBRA CURRICULUM

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ABSTRACT

Over the years the field of evaluation has developed many models for evaluating curricula. These models suggest that teachers ought to be concerned about testing and measurement, technical quality, objectives, equity, and the views of stakeholders (Guba & Lincoln, 1989). The curriculum and teacher change literatures (Doyle & Ponder, 1977; Fullan, 1982; Hawthorne, 1992), on the other hand, have suggested that teachers are guided by a different set of concerns: student learning and classroom management, the amount of work involved, the pressure and support provided, the fit of the new curriculum with the teacher's system of beliefs, its clarity and explicitness, and so forth. Those studies, however, were based on curriculum innovations which were developed outside the school and implemented from the top-down. The purpose of the present study was to investigate the evaluative framework teachers used when they evaluated a curriculum developed within their own department. Focused interviews were conducted with six high school mathematics teachers. The teachers had been involved to varying degrees in the development of their own Pre-algebra course in which they replaced the textbook with an activity-based curriculum. The study found that the teachers, in general, considered those criteria suggested by the change literature to be of greater importance for evaluation than those suggested by the evaluation literature. The study also found that the teachers' views of the importance of the individual evaluation criteria was not uniform, but that the teachers' views were mediated by the degree to which they had participated in the development of the curriculum. A model of the teachers' evaluative framework was developed, but further research is needed to illuminate the role of the teacher participation. This study is of particular interest to those concerned with curriculum development, implementation, and evaluation.
INTRODUCTION

Overview

When a new curriculum is implemented, those who are affected by it—students, teachers, administrators, parents, and school board members—begin to assess its value. That is, they become engaged, if only passively or episodically, in some sort of evaluative process. Because each stakeholder group has its own set of values and goals, and each group has access to different kinds of information, there are likely to be substantial differences in the way each group evaluates the new curriculum. Likewise, the evaluative processes employed by these groups would certainly differ from the standard practices of professional evaluators.

According to Hill (1986) curriculum and curriculum evaluation "...in the praxis tradition, practice into theory into practice, is the intuitive and low technical approach, which makes great sense to teachers, principals, and educators who must make sense or meaning out of the learning environment..." (p. x). This view of curriculum evaluation as a meaning-making enterprise is not universally shared. Rather, the field of curriculum evaluation has largely been concerned with the measurement, accountability, and rational approach to decision-making. (Hill, 1986; Guba & Lincoln, 1989). The field of evaluation has generally been reluctant to consider the informal, 'intuitive and low technical' assessments of educational programs by participants as 'evaluations'. Popham (1988) sought to "divorce our focus from the informal, everyday evaluative acts" (p. 7). He stressed that educational programs should be appraised using systematic and formal processes. To this end, the field of educational evaluation has looked outside the educational community, to other fields of study—natural science, psychology, anthropology, sociology, and art criticism—for its ontological, epistemological, and methodological roots.
This is not to imply, however, that the field has ignored the views of stakeholders. Indeed, the field has been very sensitive to ethical concerns which demand that the voices of those who are impacted by a program be heard. Stakeholder participation has also been seen as a way to solve a chronic practical problem—the problem of the non-utilization of formal evaluation. As ethics and practicality concerns opened the evaluation process to educators, new models were developed to facilitate their participation. These included stakeholder evaluation, responsive evaluation, participatory evaluation, and collaborative evaluation, to name a few. These new models, however, absorbed the educators into the existing evaluation paradigm rather than build upon the educators' own ways of worldmaking. The role of educators was limited to suggesting areas of exploration, providing data, and negotiating the contents of the evaluation report. None of these models caused a major restructuring of the ontological, epistemological, or methodological norms of the field; they did not challenge the dominant paradigm of normal evaluation practice.

Educational researchers have, from time to time, focused their attention on understanding teacher behavior, teacher thinking and teacher decision-making (Clandinin, 1986; Doyle & Ponder, 1977; Elbaz, 1983; Fullan & Pomfret, 1977; Hawthorne, 1992; Lortie, 1975), but their interests have involved other domains of education, such as pedagogy, curriculum, and teacher education. To my knowledge, studies of how the common, everyday evaluation practices of teachers might inform evaluation theory have not been pursued. This study sought to discover how a group of high school mathematics teachers who developed their own mathematics curriculum informally evaluated it.

Emergence of the Study

In March, 1992, the teachers in a high school mathematics department were given permission by the school district's central administration to rewrite its entry-level
mathematics course. From the start, the teachers decided not to use a textbook or standard curriculum. Instead, they chose to create a course from scratch which would incorporate the findings of recent research in mathematics education, as well as the recommendations of the National Council of Teachers of Mathematics (NCTM, 1989) in *Curriculum and Evaluation Standards for School Mathematics*. I was then, and am still, a member of that mathematics department and a part of an ongoing process of curricular reform.

The track record of such attempts at curricular reform has been dismal at best. When we began to write the curriculum, I believed that the new course would inevitably be evaluated, formally or informally, by all of the various stakeholders (students, parents, teachers, administrators, and the school board), and I believed that the fate of the new course would be determined in a political arena according to the extent to which they perceived that the new curriculum was working.

At the beginning of the project my impression, right or wrong, was that many of the stakeholders would evaluate the new Pre-algebra course according to two criteria: (1) whether or not there was an increase in the rate at which students successfully completed their mathematics course requirements, and (2) whether or not there was an increase in their standardized test scores. I was somewhat surprised, however, that there were never any formal procedures established to evaluate the effects of the curriculum. To my knowledge, neither the central administration nor the site administration nor the mathematics department, collect any data other than which was generally available—standardized test scores and student grade distribution.

At some point during the process of data collection, I realized that even if the students enrolled in the new curriculum scored significantly higher on every indicator than the students enrolled in the old curriculum, it could not be concluded that those
differences were due to the new curriculum. There was no way to adequately control for variations in the student population. As high school teachers, we often received advance warning from the middle school teachers about those yearly variations in the attitude and ability of a class of students. That is, they informed us that next year’s freshman class would be smarter, but more “behaviorally-challenged” than the previous freshman class, and the like.

Changes in attendance and tardy policies, changes in the norming of the standardized test scores, changes in the school or central administration, and a host of other differences routinely occurred, any one of which could have had a major impact on student performance. And so I came to the realization that these anomalies were not merely limitations of the study. Rather, they formed a set of intractable alternative hypotheses which could not be easily discounted. Simply acknowledging them as limitations of the study would not miraculously make the findings valid. I found that even though I could achieve statistically significant differences, those results would be without meaning. Robert Pirsig (1984) seems to capture this sentiment. Writing in the third person, Pirsig described his laboratory experiences as a student in biochemistry in the following way:

As he was testing hypothesis number one by experimental method a flood of other hypotheses would come to mind, and as he was testing these, some more came to mind, and as he was testing these, still more came to mind until it became painfully evident that as he continued testing hypotheses and eliminating them or confirming them their number did not decrease. It actually increased as he went along.

At first he found it amusing. He coined a law intended to have the humor of a Parkinson’s law that ‘The number of rational hypotheses than can explain any given phenomenon is infinite’ (p. 99-100, emphasis in original).

As a result of this experience, I began to question the validity of much that underlies traditional, standard, formal curriculum evaluation practice. At the same time, I
was struck by the perception that not only did the other teachers lack interest in establishing some sort of evaluation mechanism by which to assess the new curriculum, but they also seemed to be only politely interested in the data on success rates that I was gathering. As I reflected upon my own experience with the new curriculum, I discovered that own intuitive knowledge about the level of success of the students in my classes was almost as accurate as that which came from my painstaking efforts at data collection and analysis. I found that through my day-to-day interactions with students and sensitivity to the classroom environment, I could get a deeper and more continuous understanding of student achievement and interest in mathematics than I could from any standard evaluative instrument.

Although their evaluative methodologies may fall short of the standards adopted by the field of evaluation, throughout the entire process of curriculum design and implementation, every teacher in the department had an opinion or assessment of the new program, based on his/her own criteria and ways of knowing. What I did not understand was the extent to which our personal assessments were shared, negotiated, or idiosyncratic, nor whether the cognitive processes which guided my own assessment were similar to those of the other teachers.

What began as a formal evaluation of a new mathematics curriculum evolved into an attempt to understand my own informal evaluative processes, as well as those used by the other teachers.

**Purpose of the Study**

The purpose of this dissertation was to explore the informal evaluative processes used by a group of teachers to assess a curriculum developed within the department. I investigated what the teachers value in a new curriculum, how teachers sought to
maximize those values in the design and implementation of the innovation, and how they determined whether those values are present.

Significance of the Study

In 1989, the National Council of Teachers of Mathematics (NCTM) published Curriculum and Evaluation Standards for School Mathematics, in which it described its vision of mathematics education. As a result, teachers have been encouraged to think about curricular issues, and increasingly, many teachers have found the textbook-driven curriculum to be grossly inadequate. In some schools teachers have supplemented their curricula with activities from alternative sources. In other schools teachers have gone a step further; they have thrown out the textbook and have developed their own curriculum.

There is an African proverb which says, “New king, new law”. In the past, models of evaluation have been aimed at, and tailored toward, collecting and analyzing that data which has been most valued by the decision-makers. Decision-makers who were, by and large, the publishers of textbooks and site and district administrators. The emergence of grassroots, bottom-up, approaches to curriculum development, and the increased participation of teachers in the decision-making process, will likely have a powerful impact on the field of evaluation. As stated before, because teachers and administrators have different values, access to different information, and different political realities with which they must deal, they assess curriculum differently. So, as teachers become more involved in curricular decision-making, the field of evaluation will need to become more cognizant than ever before of the ways teachers view curriculum. “New king, new law.”

A second phenomenon which will likely reshape curricular evaluation is the knowledge explosion and the need for a dynamic curriculum. The amount of knowledge has been growing exponentially—doubling every ten years (Dyer, 1984). By the time textbooks are written, published, adopted, and implemented, they are out-of-date. For
example, if the magnitude of change in world affairs over the past decade is any indication of the rapidity of change which is likely to occur in the years to come, who dares write, or even adopt and purchase a new social studies textbook?

In a rapidly-changing world, adaptability is the key to survival. Following World War II, Americans, with their new-found prosperity, would hop into their automobiles and travel to different parts of the country along two-lane roads. Travelers would have to slow down, and occasionally stop, as these roads passed through the numerous small towns and hamlets which dotted their route. Diners, cottage motels, and Burma Shave signs sprang up along heavily traveled roads, such as Route 66. Then came the Interstate Highway system, fast food franchises, and places where they leave the light on for you; today Route 66 does not exist. Now, a new superhighway, the Information Superhighway, is being built, and if the field of evaluation is to continue to exist, it will need to become as dynamic as the curricula it will be called upon to evaluate.

As schools begin to travel the new “Information Superhighway”, books will be replaced by on-line sources of information. Adoption of textbooks and their corresponding curriculum for six years at a time will be replaced by the “curriculum de jour”. This reduction in the interval between the adoption of one curriculum and the necessity of adopting a new one makes formal evaluation as it now exists technically infeasible, and the cost of doing formal evaluations on such curricula prohibitive.

The transformation of curriculum as something which is seen to be relatively static to something which is viewed as dynamic has been facilitated by another factor. In recent years there has been wide-range acceptance of constructivist philosophy by mathematics educators. The Tyler Rationale, once the blueprint for curriculum design, has been replaced with less structured methods. The a priori establishment of behavioral objectives has been replaced with post hoc, negotiated objectives. Objectives are provisional,
evolving, dynamic. Therefore, traditional approaches to curriculum evaluation which assess whether a program has met the previously-stated objectives may be of little value.

Teachers are constantly involved in curricular evaluation. They make hundreds of curricular decisions each day (Hawthorne, 1992; Jackson, 1968). New models of evaluation need to be developed which utilize the more informal, constructive methodologies of teachers, and, at the same time, provide the timely, accurate, and reliable assessments demanded by the profession (Joint Committee on Standards for Educational Evaluation, 1981). Understanding the criteria and the processes used by teachers to evaluate curricula may provide the field of evaluation with a practical starting point in that endeavor. Fullan (1982) wrote, "Educational change depends on what teachers do and think—it's as simple and complex as that" (p. 107).
REVIEW OF THE LITERATURE

Introduction

In the introduction I discussed the need for a better understanding of the processes involved in informal evaluation. So, at this point, I would like to offer as a working hypothesis that when teachers informally judge the value or worth of a curriculum, their evaluations reflect a syncretism of educational theory and practice. This view is not without warrant—it is simply an extension of what researchers have found in their investigations of teachers and teaching (Elbaz, 1983; Schön, 1983; Shulman, 1987).

Throughout their careers, teachers are exposed, directly or indirectly, to educational research and educational theory about curriculum and evaluation. The information may come from their pre-service training, inservice and staff development programs, their graduate and post-graduate studies, or it may come from their own professional reading. But, whatever its source, educational theories often carry with them a sense of "oughtness"; that is, they make claims that a particular method of instruction or curriculum or evaluation is the way it "ought" to be done. In the first of three sections, I surveyed the literature of the field of evaluation in order to identify those themes which are seemed to be pervasive and powerful enough to command that sense of "oughtness".

Because the study examined the evaluative framework of a group of high school mathematics teachers involved in designing and implementing a department-made curriculum, the second section of this review focused on the standards and practice of evaluation within the field of mathematics education. Specifically, I presented the educational priorities and the evaluation standards promoted by the National Council of Teachers of Mathematics (NCTM).

In the third and final section of this review, I explored several diverse bodies of literature which served as a framework for investigating the practical or experiential
dimension of the informal evaluative processes used by teachers in assessing a curriculum of their own making.

Change itself produces outcomes which have been investigated extensively in the expert-novice literature, the teacher-change literature, and the literature pertaining to curriculum innovation and implementation. The literature on teacher thinking and teacher decision-making showed that the values and beliefs which teachers hold impact their teaching. This literature revealed much about the ways teachers gather and process information as they make curricular decisions everyday in their classrooms. The investigation of these literatures proved to be informative about the experiential dimension of teachers' evaluative processes.

The Evolution of Evaluation

It has now been thirty years since Congress passed the Elementary and Secondary Education Act of 1965 (ESEA). The ESEA funneled millions of dollars into educational and social programs, but it also demanded accountability. The ESEA mandated that "effective procedures, including provision for appropriate objective measurements of educational achievement, will be adopted for evaluating at least annually the effectiveness of the programs in meeting the special educational needs of educationally deprived children" (Elementary and Secondary Education Act of 1965, §202, 2 U.S.C.).

Yet in 1965, there were neither standard procedures for conducting an evaluation, nor established standards for evaluating the evaluations. In fact, there was no professional organization of evaluators, no body of literature dedicated to the study of evaluation, and no professional journals. Passage of the ESEA, according to McLaughlin and Phillips (1991), "served as catalyst for the development of a professional cadre of experts in the evaluation of educational and social programs" (p. ix).
Despite its recent emergence as a field of study, evaluation and assessment have been a part of the educational landscape from the beginning. Guba and Lincoln (1989) viewed the present state of evaluation as the result of a developmental process. They identified four generations of evaluation which have evolved, each containing one or more evaluation models. These included the measurement-oriented evaluation, description-oriented evaluation, judgment-oriented evaluation, and most recently, what Guba and Lincoln referred to as the fourth generation evaluation or responsive-constructivist evaluation.

**Measurement-oriented Evaluation**

According to Guba and Lincoln (1989), chief among the earliest influences on evaluation was the measurement of various attributes of school children. School tests have been used for centuries to determine whether students had mastered the subject matter, as well as to assess and sort students, but it was not until the end of the nineteenth century that school tests began to be used for the purposes of instructional and curricular evaluation. In 1897, Joseph Mayer Rice questioned the value of schools allocating large portions of the school curriculum for the study of spelling. In one of the earliest examples of educational research, Rice administered spelling tests to over 16,000 students; he found that spending extra time on spelling did not improve scores (Cronbach & Suppes, 1969).

At the turn of the century, Thorndike and other educational psychologists used mental tests to investigate the way children learn. As a consequence of their studies, not only were the prevailing notions regarding faculty psychology, mental discipline, and transfer of training challenged, but also became the means by which the efficacy of a curriculum was determined.

In the 26th *Yearbook of the National Society for the Study of Education* (NSSE, 1926), the Committee on Curriculum-Making conceded that use of standardized tests was
widespread and that those tests wielded an inordinate and unwarranted amount of control over the curriculum. There are many people in education today who would concur with what the Committee determined seventy years ago when it wrote:

49. One of the most potent forms of curriculum-control is measurement by means of uniform examinations and standardized tests. Teachers and pupils will inevitably work for the elements represented in the instruments by which their success is measured; therefore, it is of utmost importance that changes in goals and methods be accompanied by the development and use of new tests and examinations corresponding in type to the advances made in the curriculum....

50. This Committee condemns emphatically the evaluation of the product of educational effort solely by means of subject-matter types of examinations now prevalent in state and local school systems. We have reference specifically to the rigid control over the school curriculum exercised by those administrative examinations which overemphasize the memory of facts and principles and tend to neglect the more dynamic outcomes of instruction (p. 25).

Despite the prevalence and power of standardized tests, curricular evaluation was not considered to be an important part of the curricular reform process. In fact, it was not uncommon for educators to argue for adopting a curricular or instructional innovation without discussing whether the innovation had worked in the past and without discussing how its effectiveness could be determined (Bobbitt, 1924, Stevenson, 1922; Stockton, 1920). When a curriculum was formally evaluated, however, it was likely that standardized test scores would be the criteria used. For example, when Collings (1923) evaluated the Project Curriculum he employed a quasi-experimental, matched-pair design with scores on standardized tests used as the basis of comparison.

Description-oriented Evaluation

Guba and Lincoln (1989) categorized the second generation in the evolution of evaluation as descriptive-oriented evaluation. During the 1920s and 1930s, criticism grew concerning the injudicious use of standardized testing. This led administrators and
accreditation organizations to utilize more descriptive measures, such as size of budget, student-staff ratio, and the like, to judge the adequacy of a school (Cronbach, 1963).

The move toward description-oriented evaluation was also seen in the evaluation of curricular projects. During the 1930s, the Progressive Education Association had received tremendous support for its innovative approaches to education. However, many reform-minded schools would not adopt those innovative practices because, in doing so, their graduating students would not comply with college admission requirements. In 1932, the Progressive Education Association secured an agreement with a number of universities to waive their entrance requirements for the graduates of the schools which were participating in what would become known as the Thirty Schools Project.

Ralph Tyler was responsible for the evaluation of the project. Evaluation was complicated by the fact that each school had its own set of objectives and its own curriculum. Tyler believed that a single aggregated standardized test score designed to differentiate students would not indicate whether a program had attained its intended objectives. So Tyler worked with personnel from each of the participating schools to design tests whose results could be analyzed to determine whether the specific objectives of each school had been attained.

The colleges and universities that participated in the pilot required different information. So, as part of the evaluation, Tyler conducted a longitudinal study of the students who graduated from the progressive schools and entered college with the graduates from traditional programs acting as control subjects. Data were collected for 1475 matched pairs of students, and Tyler found that when compared to the students from the comparison group, the graduates of the Thirty Schools:

...earned a slightly higher total grade average; earned higher averages in all subject fields except foreign language; specialized in the same academic fields as did the comparison students; did not differ from the comparison group in the number of
times they were placed on probation; received slightly more academic honors in each year; were more often judged to possess a high degree of intellectual curiosity and drive; were more often judged to be precise, systematic, and objective in their thinking;...and demonstrated a more active concern for what was going on in the world (Aiken, 1942, in Willis et al., 1993, p. 294).

It was also reported that “the graduates of the most experimental schools were strikingly more successful than their matches....Conversely, there were no large or consistent differences between the least experimental graduates and their matches” (Aiken, 1942, in Willis et al., 1993, p. 295).

Descriptive-oriented evaluation provided a much fuller picture of the success or failure of a program than could be obtained from the results of standardized test scores. Guba and Lincoln (1989) noted that this stage could have been termed ‘objectives-oriented evaluation’ because during this period, the purpose of evaluation was to determine the degree to which the intended program objectives were attained.

Bobbitt (1924), Charters (1923), and Rugg (1926) had each emphasized the importance of establishing educational objectives in the development of curriculum. Rugg (1926) listed the three jobs involved in the task of curriculum-making:

First: The determination of fundamental objectives, the great purposes of the curriculum as a whole and of its several departments.
Second: The selection of activities and other materials of instruction, choice of content, readings, exercises, excursions, topics for open-forum discussion, manual activities, health and recreational programs.
Third: The discovery of the most effective organizations of materials and their experimental placement in the grades of public schools (p. 51).

Ralph Tyler (1950), in what has become known as the Tyler Rationale, essentially retained those three jobs, but added a fourth. Tyler identified the four fundamental questions which must be answered in developing any curriculum and plan of instruction.

1. What educational purposes should the school seek to attain?
2. What educational experiences can be provided that are likely to attain these purposes?
3. How can these educational experiences be effectively organized?
4. How can we determine whether these purposes are being attained? (Tyler, 1950, pp. 1-2)

Tyler recognized the importance of evaluating a curriculum in order to identify its strengths and weaknesses. He did not limit the evaluation to pencil-and-paper tests, but stated that any valid evidence is appropriate. He included the use of observations of children, interviews, questionnaires, collections of the products made by students, and school records, such as which books had been checked out of the school library.

Tyler’s formulation of objectives was much broader in scope than those suggested by subsequent educators. Things such as, “Familiarity with Dependable Sources of Information on Questions Relating to Nutrition”, or “To Develop an Appreciation of the Modern Novel” (Tyler, 1950, p. 30) were cited as examples of objectives. For Tyler the purpose of formulating the objectives in this manner was to guide the planning of instruction and the selection of learning experiences. And because Tyler’s vision of evaluation allowed for many different forms of valid evidence, finely-nuanced specification of objectives was not critical.

But loosely-worded objectives made it difficult for developers of pencil-and-paper tests to match test items with the objectives. Bloom (1956, 1963), who was a university examiner, urged evaluation specialists to work together with teachers to further define and clarify the objectives. This created a fundamental shift in curriculum development. Heretofore, an evaluation instrument was designed to fit the objectives of the curriculum, now the objectives were being changed to facilitate the development of the evaluation instrument.

The trend toward greater specification of behavioral objectives was fostered by those involved with programmed instruction (Mager, 1962), and it reached its reductionist extreme with the task analysis approach suggested by Gagne (1965, 1967). In the early
1960s, Popham, a member of the faculty at UCLA, attempted to gather popular support for the cause by having bumper stickers printed which read, "HELP STAMP OUT NONBEHAVIORAL OBJECTIVES!" (Popham, 1972). The plan obviously had its intended effect—a short time later Atkin (1968) reported spotting the bumper stickers in Urbana, Illinois.

The use of behavioral objectives pervaded the culture. Teacher-training institutions devoted a considerable portion of the curriculum to the construction of behavioral objectives. Classroom teachers were required to submit daily lesson plans specifying the objective to be learned in behavioral terms as well as the criterion level. Textbook publishers printed teachers' editions of school textbooks with the objectives for each lesson and the scope and sequence of those objectives. For a time it seemed as if every book intended for an audience of educators carried an obligatory statement at the beginning of each chapter about what the reader would be able to do after reading the chapter. And in many books each chapter concluded with a set of questions to answer so that readers would be able to determine whether they had learned what the author intended.

But by the early 1960s, problems with the use of pre-ordinate objectives were being identified. Atkin (1963, 1968) questioned the value of formulating behavioral objectives in the early stages of the curriculum development process. As co-director of the Illinois Elementary Science Project, Atkin noted how the scientists involved in the project employed less conventional strategies to develop curriculum. Predating Scriven's Goal-Free Evaluation model, Atkin (1963) described how the Project personnel used classroom observations to identify unexpected behavioral changes.

Louise Tyler (1969) cited eight reasons given by teachers for resistance to specifying objectives:
First, teachers are accustomed to thinking in terms of what they do, i.e., how they select films, how they distribute books, or how they mark papers. Second, teachers are convinced that the difficult task in teaching is to motivate students. Third, most teachers think behavioral objectives are highly specific and usually insignificant. Fourth, teachers believe it is an overwhelming task to formulate objectives for all the students in classes—yet this must be done if individual differences are to be considered. Fifth, teachers believe that what is presented is less important than how. Sixth, prespecification of objectives makes it difficult for a teacher to pursue ideas which emerge spontaneously in classrooms. Seventh, if objectives are prescribed, learners are not involved in the formulation, and according to some teachers, they should be. Eighth, some objectives do not lend themselves to measurement, yet they may be more important than those that are measurable (pp. 100-101).

Despite these and other problems, behavioral objectives remain a powerful influence in education today, and programs such as the Essential Elements of Instruction (EEI) continue to prescribe their use.

**Judgment-oriented Evaluation**

Cronbach (1963) recognized that curriculum development in the post-Sputnik era, with its emphasis on large-scale science and mathematics curriculum projects, would require a re-thinking of the proper role of evaluation. Cronbach defined educational evaluation as, “the collection and use of information to make decisions about educational programs” (p. 672). Cronbach saw that the purpose of evaluation was not solely to determine whether the program was effective, but also to provide feedback to the curriculum developers for the purpose of curriculum improvement. Shortly thereafter, Scriven (1967) coined the terms, “summative evaluation” and “formative evaluation” to distinguish between these two functions of evaluation.

Following the passage of the ESEA, the emerging field of evaluation began to forge and define its identity. Much of the discussion centered on fundamental issues, such as the role and purpose of evaluation. Scriven (1967) wrote:
One of the reactions to the threat of evaluation, or perhaps to the use of over-crude evaluation procedures, was the extreme relativization of evaluation research. The slogan became: How well does the course achieve its goals? instead of How good is the course? but it is obvious that if the goals aren't worth achieving then it is uninteresting how well they are achieved.

Thus evaluation proper must include, as an equal partner with the measuring of performance against goals, procedures for the evaluation of the goals (pp. 51-52).

Similarly, Atkin (1968) argued that objectives are based upon values and that the field must concern itself with assessing the worth of the goals, not merely measuring the progress toward those goals. Atkin wrote:

The behavioral analyst seems to assume that for an objective to be worthwhile, we must have methods of observing progress. But worthwhile goals come first, not our methods for assessing progress toward these goals. Goals are derived from our needs and philosophies. It borders on the irresponsible for those who exhort us to state objectives in behavioral terms to avoid the issue of determining worth. Inevitably there is an implication of worth behind any act of measurement (p. 30).

The clarion call to the field to adopt the judgment orientation was echoed by other members of the field.

Stake (1967a): "Both description and judgment are essential—in fact, they are the two basic acts of evaluation....To be fully understood, the educational program must be fully described and fully judged" (p. 525).

Stufflebeam, et al. (1971): "Educational evaluation is the process of delineating, obtaining, and providing useful information for judging decision alternatives" (p. xxv).

The measurement-oriented evaluation sought to determine the output of an educational program; description-oriented evaluation was concerned with inputs as well as outputs; but in order to judge a program, evaluators had to find out what was happening inside the black box. Reflecting the important lessons evaluators learned during the 1960s, Streich (1986) stated, tongue-in-cheek, that an evaluation model:

...requires the three basic questions of a formative evaluation for a program change to be answered: 1. Were the books ordered? 2. Did they arrive? 3. Were the
boxes opened? If the answer to those three questions is "yes", the fourth question is always, "Is anyone using them?" (p. 6).

The Context-Input-Process-Product (CIPP) model (Stufflebeam, et al., 1971) was built around, and extended, the framework of the Tyler Rationale. However, rather than merely determining whether the objectives had been accomplished, the CIPP model evaluates the objectives, the activities, the ordering of the activities, as well as the learning.

As the field of evaluation assumed the additional responsibility of judging programs, four recurring themes dominated the literature: 1) the ongoing quest for technical quality, 2) concerns regarding the non-utilization of evaluation reports, 3) the growing awareness of the importance of justice, and 4) the need for evaluation standards.

With its roots in psychometrics, the field of evaluation had developed a strong tradition of maintaining high standards in technical quality. But as the field evolved from measurement to description to judgment orientations, evaluation research design changed as well. The statistical analyses, which had been used up to that point, were based on mathematical theories of probability which required random distribution. But randomization and experimental designs developed for laboratories were seldom possible for evaluation studies in education. As mentioned in the Introduction, a host of problems can arise which undermine the technical quality of evaluations (Achilles, 1982, Borg, 1984).

Campbell and Stanley (1963) argued that valid findings could be attained through the use of quasi-experimental designs, but that researchers needed to be aware of twelve factors which could threaten the internal and external validity of a study, and how these threats could be reduced. Later, several additional threats to validity were identified (Campbell, 1975).
Yet despite their continuing efforts to improve the technical quality of evaluations, evaluators expressed concern that their recommendations were not being utilized. As researchers examined the process by which decisions were made, they found that evaluation was an activity enmeshed in politics (Chelimsky, 1987; Cronbach et al., 1985; House, 1974, 1993; Palumbo, 1987; Weiss, 1970, 1975). Weiss (1975) stated that political considerations intrude into the evaluation process in three ways. First, the policies and programs with which evaluation deals are proposed, defined, debated, enacted, and funded through political processes, and in implementation they remain subject to those same political pressures. Second, an evaluation report is just one factor among many which influence the decision-making process, and its relative weight among all the other forces is determined within a political context. And third, evaluation inevitably makes both explicit and implicit political statements about policy and program formation. House (1972) put it succinctly, "Evaluation is political because it involves allocation of resources, which means that some people gain and some lose" (p. 413).

The non-utilization of evaluation reports also led evaluators to investigate the distribution of power in the decision-making process. Weiss (1983a) wrote:

Critics charge that evaluation is narrow because it focuses on only a small subset of questions of importance to program people; unrealistic because it measures the success of programs against unreasonably high standards; irrelevant because it provides answers to questions that no one really cares about; unfair because it is responsive to the concerns of influential people, such as bureaucratic sponsors, but blind to the wants of others lower in the hierarchy, such as front-line staff and clients; and unused in councils of action where decisions are made (pp. 3–4).

The field wrestled with this problem, and the numerous approaches which were developed in an attempt to solve it testify to the diversity of opinion which this issue engenders. In the first approach, models were developed to identify the key players. For example, the Context-Input-Process-Product (CIPP) model (Stufflebeam, et al., 1971)
emphasized the central role of the decision-maker, whereas the Utilization-Focused Evaluation model (Patton, 1986) targeted the potential users of the evaluation report.

A second approach attempted to avoid knowledge of the preordinate goals, aims, intentions, and objectives of the program in order to better identify the effects of the program—both intended and unintended. Scriven’s (1973) Goal-Free model and Scriven’s (1983) Consumer Evaluation are examples of this approach. Likewise, in Eisner’s (1979, 1985, 1991) Connoisseurship model, the evaluator did not adopt the values of the decision-maker or any other stakeholder, but rather, used the socially-constructed values of the educational connoisseur and critic.

A third approach attempted to increase utilization by taking into account the needs and concerns of all who are affected by the evaluation. Responsive Evaluation (Stake, 1975, 1976) and Stakeholder Evaluation (Bryk, 1983; Gold, 1981, 1983; Greene, 1987, 1988; Weiss, 1983a, 1983b) incorporated this approach.

A fourth approach expanded the role of stakeholders from one in which the stakeholders were considered to be merely sources of information to one in which they actively participated in setting the parameters of the study. Examples of this approach are Participatory Evaluation (Cousins & Earl, 1992; Streich, 1986) and Collaborative Evaluation (Booth, 1987). It is interesting to note that initially the primary reason for increasing stakeholder participation in the evaluation process was to increase evaluation utilization, and not, as it might seem appropriate today, to promote justice.

For decades, sociologists of education had been interested in the political nature of education—Whose voice was heard and whose voice was not?, Who was enfranchised and who was disenfranchised through the evaluation process?, Who in the end was empowered and who was disempowered? But the emerging field of evaluation did not have a tradition of asking those kinds of questions. And when it did, the purpose was
distinctly utilitarian. In traditional evaluation research, ethics and values had no place. Neither the measurement-oriented evaluator, nor the description-oriented evaluator, realized the extent to which the selection of the test items or the selection of the objectives was a value-laden endeavor. House (1993) wrote:

Evaluations are used for purposes of effectiveness, efficiency, and accountability within the democratic bureaucratic hierarchies and political ideologies, without questioning the overall social structure. The evaluation categories used by evaluators are ordinarily those of the status quo, and the measures employed are allied to the power structures (pp. 170-171).

The field seemed ready to accept that evaluation is value-laden and that moral discourse should be a part of evaluation (Schwandt, 1989), and soon began to concern itself with issues of justice and fairness. House (1972, 1976, 1978, 1991) argued that evaluators should determine the moral impact of a program based on Rawls’ two principles of justice. House (1993) wrote:

Thus, although Rawls’ two principles permit equality of persons and unequal distribution to exist side-by-side, they do so in a way that differs from utilitarianism. His concept of equality is identified with “equal respect” rather than the utilitarian “equal treatment”. To treat an individual with respect requires responding to needs and thus sometimes requires unequal treatment (p. 123).

Critical theorists (Apple 1980, 1990; Lather, 1986; Willis, 1977) have asserted that schools serve to perpetuate the social structures which have contributed to the inequitable treatment on the basis of gender, race, and class. They argued that evaluators should not only examine those social structures but also endeavor to transform them. For critical theorists, the purpose of evaluation is not only to measure, describe, and judge, but also to educate and transform. Lather (1986) proposed the use of catalytic validity as, “the degree to which the research process reorients, focuses, and energizes participants toward knowing reality in order to transform it” (p. 272).

Fourth Generation Evaluation
For the past three decades, the research community, as well as the evaluation community, have debated the comparative worth of quantitative and qualitative methodologies. To the traditionalist, the qualitative methodology was perceived as being too subjective and incapable of arriving at reliable and valid judgments. On the other hand, those who used the tools of sociology and anthropology believed that studies based upon quantitative methodology could never attain relevance.

If the debate had been confined to methodological issues, reconciliation might have been achieved; but Thomas Kuhn's (1970) *The Structure of Scientific Revolutions* polarized the two sides. Rather than continuing to build bridges through the use of mixed-method designs, the positions came to be viewed as incommensurable paradigms. As the focus of debate shifted from methodology to ontology and epistemology, each side hardened its stance and drew battle lines in the sand. At times the debate became so vitriolic that Gage (1989) described it as the “Paradigm Wars”.

Guba and Lincoln (1989) referred to this stage in the evolution of evaluation simply as the Fourth Generation Evaluation. It was based upon a constructivist epistemology and ontology. Constructivism has been the dominant influence in the philosophy of mathematics education for more than a decade and it has played a major role in the recent curricular reform of mathematics. Constructivism has not, however, received such widespread support in the field of evaluation.

Constructivism is more easily described when it is compared to the positivist paradigm which dominated the philosophy of science from the Enlightenment until the beginning of this century. The positivist ontology was founded on the premise that there exists a single reality “out there”, which is governed by immutable, natural laws. Reality had an existence independent of the knower. The positivist epistemology consisted of an object-subject dualism where the validity of findings ultimately depended on its
correspondence to the external reality. It asserted that if one could remove all experimenter bias and experimental error, and if one could perceive and understand perfectly, then one could see the world as it really existed. This was the meaning of the correspondence theory of truth.

The constructivist ontology made no such claim of a single reality existing outside the knower; rather, it held the view that there were multiple, socially-constructed realities. What some considered to be 'reality' was, to the constructivist, a human mental framework or construction. Perception and social interaction shaped the mental frameworks, which then, in turn, shaped perception and social interaction. They were constantly being negotiated. Guba (1992) wrote:

The best we can do is to come to some consensus (or as near to it as possible) that can be managed given the level of information and sophistication that we have. The construction to be "believed" is that one which, in the opinion of those best able to make such a judgment, is the most informed and sophisticated. All constructions, even under perfect consensus, thus remain problematic and may be refined, or even totally abandoned, in the light of new information or heightened sophistication (p. 20).

Consensus does not imply a greater degree of reality for whatever is agreed upon, however; it simply means that those in agreement have come to share a construction that has reality for them. Furthermore, the consensus is the product of human conceptual exchange in a particular setting; it is thus unlikely that this same consensus would necessarily help other persons make sense of their settings. (Guba & Lincoln, 1989, p. 9)

Consensus-making defined the constructivist methodology of evaluation, and the process was referred to as the hermeneutic dialog or the hermeneutic circle. The word was derived from the name of the Greek messenger god, Hermes. Hermeneutics was a form of inquiry which sought to understand the message or meaning of a text or an event. In the hermeneutic dialectic, the evaluator mediated the negotiation of stakeholder views until a consensus or shared meaning was attained.
Over the years the trend in evaluation had been to include the stakeholders to a greater and greater extent. The models or persuasions of evaluation evolved from those which focused exclusively on the needs of the decision-maker, to those which accounted for the needs of the user, to those which obtained stakeholder input, to those which permitted stakeholder participation, and finally to those which used the hermeneutical dialectic circle. Of all the persuasions of evaluation, constructivist evaluation was the most open to full participation by all stakeholder groups.

Stakeholder participation was particularly important to the hermeneutic dialog because it broadened the pool of knowledge. It provided opportunities to view the evaluand from many perspectives and thus provided additional solutions to potential problems. It was an educative process. In sharp contrast to the findings of conventional evaluations, the product of a constructivist evaluation was not a set of conclusions, recommendations, or value judgments, but rather an agenda for negotiation of those claims, concerns, and issues that had not been resolved in the hermeneutic dialectic exchanges.

In many ways the constructivist methodology could be considered a mixture of responsive evaluation, naturalistic evaluation, illuminative evaluation, utilization-focused evaluation, and adversarial evaluation all rolled into one. It shunned preordinate goals, and used qualitative methodology. A constructivist methodology sought to understand the meaning of the program; and because a consensus had been negotiated among the stakeholders, it was more likely to be used.

Responsive-constructivist evaluation matches well with the way that teachers informally evaluate a curriculum. Much of a teacher's day involves negotiation and consensus building. Teachers' interactions and negotiations with students determine the culture of the classroom. Teachers plan lessons together, give common exams, and share
ideas and insights, and, in doing so, they negotiate departmental policy and the culture of the department. Teachers' interactions and negotiations with administrators help determine the culture of the school. Consensus and shared meaning are most often reached informally.

Standards of evaluation

In 1981, the Joint Committee on Standards of Educational Evaluation (JCSEE) issued the *Standards for Evaluation of Educational Programs, Projects, and Materials*. The Joint Committee identified what it considered to be the four critical attributes of any evaluation—its Utility, Feasibility, Propriety, and Accuracy. The Joint Committee recognized that evaluations are worthless unless they are used, and that evaluations will not be used unless they are informative, timely, influential, and meet the needs of the various audiences. It was for this reason that the standards of Utility were created.

The standards of Feasibility require that evaluations be practical, that evaluators be cognizant of the political pressures which impinge upon their evaluations, and that evaluations be cost effective.

The Joint Committee was concerned that evaluations be "conducted legally and ethically, and with due regard for the welfare of those involved in the evaluation, as well as those affected by the results" (JCSEE, 1981, p. 14). As a result it created the standards dealing with Propriety.

Finally, the standards of Accuracy were included to ensure that the evaluations provide sound information. It deals with the more technical aspects of evaluations, such as reliability and validity.

The Joint Committee then developed thirty standards to help define those four attributes. The Joint Committee stated that it "is satisfied that standards which shape an evaluation so that it has these four characteristics are necessary and sufficient for sound
evaluation in education” (JCSEE, 1981, p. 13). In other words, everything which is necessary to conduct a sound evaluation is subsumed by these four attributes—no more, no less.

Whereas the realists claimed that the findings of the constructivist evaluation were too subjective to be valid, several writers (Johnston, 1989; Messicic, 1980) asserted that the concept of validity held by the realists was itself a social construction whose meaning was based upon consensus. Smith (1985) pointed out that:

...in the end a judgment of validity is little more than a matter of socially and historically conditioned agreement. In other words, if the inquirers agree an inference or a test is valid, it is not because the facts compel such agreement but because the inquirers hold similar conceptual schemes or have defined reality in similar ways based on similar values, interests, and purposes (p. 6).

House (1978) also pointed to similar contradictions in the realists’ claims. He wrote:

The objectivism of the managerial evaluation models that tends to equate objectivity with quantification relies in intersubjective agreement as the exclusive indicator of objectivity. Scriven (1972) calls this the quantitative sense of objectivity. One person’s perception is regarded as subjective—the disposition of one individual. Being objective is what a number of observers experience (p. 7).

The technical quality of some qualitative research studies in education out of which constructivist evaluation emerged was not only criticized by psychometricians, but it was also criticized by social scientists. Several writers (Fetterman, 1982; Rist, 1980) expressed concerns about the inappropriate use of the anthropological methodologies by educational researchers untrained in their use. Rist (1980) condemned the use of what he called “blitzkrieg ethnographies”.

Guba and Lincoln (1989) recognized the need for criteria by which to judge the quality of a constructivist evaluation on its own terms. They described three criteria which should be used to judge the adequacy or goodness or quality of fourth generation
evaluation: 1) the parallel criteria (trustworthiness), 2) the hermeneutic process as its own quality control, and 3) the authenticity criteria. They shunned the use of terms such as reliability, internal validity, external validity, and objectivity because these terms were associated with a realist ontology. Instead, Guba and Lincoln used parallel terms such as dependability, credibility, transferability, and confirmability. These terms addressed the similar issues but they were modified to reflect the constructivist ontology, epistemology, and methodology.

Williams (1986) compiled a list of criteria, based loosely on a list suggested by Guba and Lincoln (1981), which could be used to judge the quality of naturalistic evaluations. The first category was titled, ‘Credible Results’, and included the following criteria: 1) prolonged engagement, 2) triangulation, 3) thick, contextual description, 4) no internal contradictions, 5) natives accept report as credible, 6) researcher not “native”, 7) inductive, emergent issues, 8) emic perspectives highlighted, 9) sensitive, perceptive and disciplined inquirer, 10) negative instances sought, and 11) alternative interpretations sought. The second category was Applicable Results and included the following criteria: 1) logical sampling strategy, 2) vicarious membership for reader, and 3) audit trail provided. The third category was Ethical Results and included: 1) ethical treatment, 2) naturalistic, unobtrusive, and 3) clear contribution.

There was some discussion concerning the compatibility of the constructivist-oriented evaluations with the Joint Committee on Standards for Educational Evaluation (1981) Standards. Guba and Lincoln (1989) stated that “while the Standards devised by the Joint Committee are not especially congenial to the posture of fourth generation evaluation, neither are they destructive of its aims and processes” (p. 230). This was confirmed by Williams (1986). He constructed a matrix to compare the thirty standards of the Joint Committee with the list of seventeen naturalistic criteria. Williams found that out
of the 510 comparisons, 220 (43%) were complementary, 277 (54%) were neither complementary nor conflictual, and that only the remaining 13 (3%) were conflictual.

On the other hand, Guba and Lincoln (1989) stated that, "The ERS Standards embody a series of assumptions—especially with respect to the evaluator role, and to some extent, the relative power of the client—that are unacceptable to fourth generation evaluators..." (p. 231).

It can be seen that when a set of standards were established which implied the use of a particular paradigm, the realist and idealist positions appeared to be incommensurable. However, when standards were written which did not favor a particular paradigm, accommodation seemed possible. Rapprochement had been found by those who described themselves as practitioners of evaluation rather than philosophers of evaluation. There was a great deal of agreement at the level of methodology (Firestone, 1987, 1990; Gage, 1989; Howe, 1988).

It was not very long ago that the North Central Association accreditation process involved the use of externally developed standards, relying heavily on standardized test results and descriptions of the school plant, teacher qualifications, and so forth. And, consequently, the final reports simply gathered dust until the next accreditation period. As a result of the thoughtful, frank, and open discussion about the nature of evaluation which have occurred over the past three decades, changes in the accreditation process have been made. Today, for instance, the accreditation process relies heavily on stakeholder participation. It includes, to varying levels of participation, students, parents, teachers, and administrators, in the process of selecting the goals and objectives to evaluate. The process also stresses a formative rather than a summative role. The reports are intended to be used as a framework for constant school renewal.
The call for considering justice as a criteria for evaluation has had an impact as well. It has virtually become a cultural norm to design evaluation studies so as to determine whether programs produce differential benefits according to race, gender, or class. Even though evaluators may still bemoan the fact that evaluations are not being fully utilized, the field has made a tremendous contribution to education and educational reform.

**Summary**

In the first section of the review, I discussed how evaluation evolved over the past century, and in the process five themes emerged which might have an impact on how teachers think an evaluation “ought to be done”. In other words, the following five themes might serve as a framework for understanding the theory dimension of a teacher’s concept of evaluation: 1) the role of measurement and testing, 2) the importance of technical quality, 3) the role of objectives, 4) politics, justice, and the role of stakeholders, and 5) the impact of constructivism. These five themes are not mutually exclusive; in fact, they are highly interactive.

Because this study focused on the views of mathematics teachers involved in curricular reform, it was important to examine evaluation and assessment from the perspective of the National Council of Teachers of Mathematics (NCTM). Therefore, in the next section of this review, I explored how these five themes were treated in the both in the evaluation literature as well as the mathematics education literature, and how they impacted teachers.

**Evaluation in Mathematics Education**

Unlike the Sputnik-era reformers in mathematics education, when NCTM embarked on its current reform, it recognized that curriculum reform could not survive without simultaneous reform in evaluation. NCTM has presented its vision of the role of

The Council’s perspective of evaluation lagged behind that of the field of evaluation. Even though NCTM’s views of curriculum and instruction were based upon a constructivist framework and incorporated the latest understandings of cognitive psychology, its views of program evaluation had not progressed much beyond the measurement-oriented and description-oriented stages.

NCTM (1989) wrote that, “...the role of evaluation emerges as a critical component of reform. Evaluation is a tool for implementing the Standards and effecting change systematically” (p. 189). The Council went on to state that evaluation “can indicate the steps that need to be taken so that a program aligns with the Standards. In a certain sense, the Program Evaluation Standards are a guide to creating a program that meets the challenge of the Standards” (p. 237). And later NCTM (1995) reaffirmed that the question for program evaluation of a school mathematics program to answer is, “How well does it achieve the vision of the Curriculum, Evaluation, Teaching, and Assessment Standards?” (p. 66).

These statements expressed a view that permeated the Standards and other writings of the Council, that the Standards themselves—their values, goals and objectives—were beyond the scrutiny of evaluation. The role of program evaluation, in its
view, was to ensure conformity to the Standards and not to question the value of the Standards themselves. In this sense, NCTM had not yet progressed to the stage of judgment-oriented evaluation. When NCTM discussed evaluation, it was primarily concerned with testing and assessment.

**Role of Measurement and Testing**

Tests were one of the earliest methods of curriculum evaluation and they persisted throughout the century. In districts which adopted an outcomes-based educational approach, in districts where performance on the state-mandated, norm-referenced exams had high priority, or in districts where student performance on college entrance examinations or advanced placement examinations was highly valued, there was considerable political pressure to adapt the curriculum to conform to the test. Standardized achievement testing had become a highly publicized and hence politicized event. Scores were used to compare schools and teachers, as well as to evaluate educational programs. As a result, they often had a tremendous impact on teaching (Smith, M. L., 1991; Stake, 1995a).

One consequence of changing the curriculum and instruction to match the examination was that it reduced the technical quality of the results. Validity was altered when some schools adopted changes in order to improve test scores and other schools did not. This lead to what Haladyna, Nolan, and Haas (1991) referred to as “test score pollution”. Several studies (Mehrens & Kaminski, 1989; Resnick, 1987; Shepard, 1990) revealed the widespread use of questionable and, in some cases, blatantly unethical practices to boost test scores.

NCTM was concerned that the political pressures which accompanied standardized testing would undermine the curricular reform which NCTM was promoting. In many ways standardized testing represents an impediment to change much like the college
entrance requirements constrained many schools from adopting the recommendations of the Progressive Education Association prior to the Thirty Schools project. Many educators who would have liked to change the way that they were teaching mathematics but were concerned about the effect that making a change would have on test scores. Even those who adopted the reform were concerned, given the political realities, about the pressure to keep standardized test scores high and that they would eventually be forced to abandon the reform.

In 1995, the Council published its *Assessment Standards for School Mathematics* in which it listed six standards which should be applied to all assessments, including standardized tests:

1- The Mathematics Standard - Assessment should reflect the mathematics that all students need to know and be able to do (p. 11).
2- The Learning Standard - Assessment should enhance mathematics learning (p. 13).
3- The Equity Standard - Assessment should promote equity (p. 15).
4- The Openness Standard - Assessment should be an open process (p. 17).
5- The Inferences Standard - Assessment should promote valid inferences about mathematics learning (p. 19).
6- The Coherence Standard - Assessment should be a coherent process (p. 21).

The Council stated that, “In an instructional environment that demands a deeper understanding of mathematics, testing instruments that call for only the identification of single correct responses no longer suffice” (NCTM, 1989, p. 192). To this end NCTM advocated the use of multiple sources of information and alternative assessment techniques. These included performance assessments, projects and investigations, open-ended questions, observations, interviews, portfolios, and student self-assessment. Many
of these alternatives were referred to as "authentic assessments". For Romberg (1995) that reference carried with it the political message that standardized tests were "inauthentic".

Tests also communicated most clearly to students, parents, teachers, administrators, and the community, those activities and learning outcomes that were most valued (Clarke, Clarke, & Lovitt, 1990). By working to change the tests, NCTM hoped to send a clear message about what it believed was to be valued in mathematics.

Schwartz (1992) raised concerns about the ethics inherent in the use of standardized tests. She pointed out that even though newspapers published local schools' standardized test scores, neither the media nor the community knew what was being asked on the examinations. The test publishers insisted that the tests must be kept secret in order to maintain their validity. Schwartz argued that the secrecy surrounding the standardized achievement tests raised ethical questions about the exclusion of the community from participation in the process. Tests are value-laden and, in her view, it was the responsibility of the community, not the test publishers, to determine what values should be tested. The Openness Standard addressed this problem.

It was unclear at the time of this writing what effect the use of multiple forms of assessment would have on those groups which have traditionally not performed well on the standardized tests. It was believed, however, that using a variety of forms of assessment would give students in these groups greater opportunity to demonstrate their understanding of mathematics.

Finally, the Council's recommendation for multiple forms of assessment was consistent with its constructivist philosophy about learning. The call for the use of many alternate forms of assessment gave the teacher greater flexibility in evaluating the students and the curriculum, it allowed for greater opportunity to determine the amount and nature
of learning, and it was complementary to teachers’ multiple sources of information and ways of knowing.

Politics, Justice, and Stakeholders

One of the major differences between the Sputnik-era reform and the recent reform revolved around issues of equity and access. Forty years ago the emphasis was on identifying and training the brightest students; more recently, the Council made it abundantly clear that the latter reform was intended for “all students”. In an attempt to redress previous inequity, NCTM (1989) stated that as part of a program evaluation:

Enrollment figures by gender, race, language, and cultural background should be maintained for all mathematics courses. As unacceptable patterns emerge, an evaluation should identify the barriers creating the situation and recommend action (p. 240):

It was ironic, then, that A Guide for Reviewing School Mathematics Programs, which was jointly published by NCTM and ASCD (Blume & Nicely, 1991), virtually ignored the issue of equity.

NCTM (1989) recommended that program evaluation should be completed using a team approach, and that the evaluation team should include “individuals with expertise and training in mathematics education, individuals with expertise and training in program evaluation, individuals who make decisions about the mathematics program, and users of the information from the evaluation” (p. 247). But historically NCTM had been wary of student and parent participation in the curriculum development process, so the motive behind NCTM’s call for user or stakeholder participation seemed to arise more out of NCTM’s awareness of the politics of curricular reform than from deeply-held moral or ethical concerns. NCTM (1989) recognized that teachers involved in the reform required the support of administrators to provide necessary resources, such as educational materials and technology, as well as professional development. Clearly NCTM, as an organization
of mathematics teachers, emphasized the central role of teachers in evaluating school mathematics programs.

**Quest for Technical Quality**

The quest for technical quality had always been of paramount importance to the field of evaluation. But in the 1980s, the field was challenged by the emergence of several problems which called into question the notion of test validity. The first issue was an outgrowth of the "Lake Wobegon effect". Cannell (1988) wrote that in 1985, every state reported that its students had scored above the median on a nationally-normed standardized test. Suddenly, the evaluation community was confronted with the two problems. First, it had to find out what went wrong; then it had to convince the policy makers, as well as the public, that the information provided by the test was valid and relevant.

Another issue which confronted the evaluation community concerned high-stakes, state-mandated testing and the impact on validity due to the problem of test score pollution caused by "teaching to the test". A third issue dealt with the validity of performance tests, portfolios, and other types of authentic assessment.

NCTM often sent mixed signals regarding its concern for technical quality. NCTM (1989, 1995) stated that acquiring valid and reliable information was important for program evaluation. But in *A Guide for Reviewing School Mathematics Programs* (Blume & Nicely, 1991), there was no discussion as to how the evaluation should be conducted so that technical quality might be achieved. NCTM (1989) suggested that the evaluation team include individuals with expertise and training in program evaluation, but it was ambivalent in its call for the use of outside, professional evaluators. It suggested that the use of outside experts might be more threatening and may actually lower the chances that the evaluation report would be utilized. NCTM conceded, however, that in
school districts where an insider-only evaluation creates credibility problems, an outsider's view might be warranted.

**Role of Objectives**

Discussion about the use of objectives in education seemed to wax and wane. Several years ago when the buzzwords such as back-to-basics, accountability, criterion-referenced tests, and Essential Elements of Instruction were in vogue, 'objective' was an important part of the lexicon. Recently there has been less concern expressed for establishing formal, pre-ordinate, behavioral objectives. Clarke, Clarke, & Lovitt (1990) stated that, “Desired learning behaviors will include skills and attributes that go beyond specific mathematical content, for instance, persistence, systematic working, efficient and effective organization, accuracy, conjecturing, modeling, creativity, and the ability to communicate ideas and procedures clearly” (p. 119). These were hardly objectives which lent themselves to valid measurement. The apparent cyclical nature of educational ideas indicate that objectives were important, at some level, to a significant number of teachers.

**Impact of Constructivism**

Even though constructivist philosophy was the bedrock upon which NCTM’s reform of curriculum and instruction had been built, NCTM had not adopted a constructivist stance toward evaluation. This was ironic because, on the one hand, NCTM had discussed at length the reasons it was important for instructional purposes to have a strong link between curriculum and evaluation (NCTM, 1989). But, at the very time NCTM had been urging teachers to adopt the constructivist philosophy for curriculum and instruction, it remained silent on the philosophical foundations of its view of evaluation. Indeed, the methodology of evaluation which it promoted seemed to be based on the very positivist philosophy it deplored when applied to curriculum and instruction.
What was critical to the evaluation process, from the constructivist point of view, was the dialog, the interpersonal communication by which stakeholders negotiate some shared meaning of the curricular innovation. Guba and Lincoln (1989) developed methods, such as the hermeneutic dialectic, which attempted to maximize the dialog. Thus, it would be anathema to encourage the use of a questionnaire on which teachers merely indicated their views on the meaning of an innovation using a three-point Likert scale as the primary source of information. Yet this was precisely what two recent guides to evaluation of mathematics programs (Blume & Nicely, 1991; Bright, Uprichard, & Jetter, 1993) suggested.

Summary

In the first part of the review I explored some aspects of formal evaluation which constituted the theory dimension of a teacher's concept of evaluation—that portion which accounts for what teachers think an evaluation "ought" to entail: 1) the role of measurement and testing, 2) the importance of technical quality, 3) the role of objectives, 4) politics, justice, and the role of stakeholders, and 5) the impact of constructivism. These five components were very much a part of the landscape in mathematics education as well. It seemed fitting, then, that they would play a role in a mathematics teacher's informal evaluation of a new curriculum. It also seemed reasonable to think that a significant number of teachers would believe that an evaluation ought to be based on standardized test scores, that an evaluation ought to describe the extent to which the objectives have been met, that an evaluation ought to be conducted so as to produce a report of high technical quality, that an evaluation ought to be sensitive to equity and justice, that it ought to contain significant input from stakeholders, and so forth.

The Experiential Dimension
In the foreword to *Teaching and Thinking about Curriculum: Critical Inquiries*, Nel Noddings (1990) wrote:

...this volume suggests at once that curriculum and teaching are not easily separable and that a thinking, teaching self cannot be deftly plucked out of either teaching or curriculum and set aside. Curriculum is thoroughly mixed up in teaching, and teaching is inextricable from teachers. In some circles, such blurring of boundaries is either heresy or nonsense. Here it is a refined form of common sense and, further, its acceptance adds enormous fascination to the field of study (p. ix).

I would like to apply this same refined form of common sense to curriculum evaluation. The way that teachers assess the value and merit of a new curriculum is inextricably connected to teachers and teaching, and, therefore, a blurring of boundaries is a feature of this section of the review as well. I looked at the literature pertaining to teacher characteristics, beliefs and values, teacher thinking, reflection and decision-making, and teacher negotiation of classroom events, all within a context of teacher and educational change. Examining these diverse areas of study contributed to a richer understanding of how teachers evaluate a curriculum of their own making.

A Constructivist View

In the years immediately following the post-Sputnik reform, researchers increasingly focused their attention on classrooms and teachers. They concluded that one major factor in the failure to adopt the curricular innovations of the era was that teachers, by and large, were conservative and resistant to change.

Subsequently, however, a different view of teachers and the change process has emerged. Rather than rejecting a curricular innovation outright, teachers restructured and transformed the innovation, often beyond recognition (House, 1974). Romberg and Pitman (1994) wrote, "Innovations tend to be assimilated into existing patterns of behavior and belief, frequently coming to function as little more than slogan systems that
legitimize the values and assumptions underlying the status quo” (p. 55). And Richardson (1990) stated that, “The filtering of a research-based practice through the teacher’s personality and/or belief system seemed to alter the practice quite dramatically, such that it could no longer really be viewed as the same practice” (p. 15).

These descriptions of teachers assimilating innovation into existing patterns, and the filtering of innovation through a teacher’s personality and experience, are consistent with a Piagetian, constructivist understanding of the interaction between teachers and an innovation. McLaughlin (1976) found that just as teachers modified the programs they were supposed to be implementing, the teachers were, in turn, changed by the new program. Their beliefs and values and teaching practices changed as a result of implementing the innovation. McLaughlin (1976) referred to the dynamic nature of the interaction between innovation and teacher as “mutual adaptation”.

According to Duffy and Roehler (1986), teachers restructure new information in terms of at least four filters—“their conceptual understandings of curricular content, their concept of instruction, their perception of the demands of the working environment, and their desire to achieve a smoothly flowing school day” (p. 57).

It seems clear that as teachers restructure a new curricular innovation based on their individual experiences, the innovation, as originally conceived by its developers, would no longer exist; instead, it would be replaced by many curricula. It would be impossible, therefore, for teachers to evaluate the worth of an innovation in realist or absolutist terms. Rather, teachers judge the worth of a curriculum according to how they perceive that it has worked (or will work) for them in their classroom.

**Teacher Personality and Change**

Although early researchers found teachers to be conservative and resistant to change, Marris (1974) claimed that conservatism and resistance are universal human
responses to change, not traits common only to those in the teaching profession. He noted that all change involves a loss—a loss of familiar patterns of behavior, a loss of continuity and predictability of life, and ultimately, a loss of meaning. This loss leads to anxiety, grief, and mourning. But Marris went on to state that the innovator "accepts the strain of change to escape from a more fundamental threat of loss" (p. 2).

Others suggested that teachers could be classified according to their willingness to change. Sieber (1972) made distinctions between teachers who were the rational type, the co-operator type, and the powerless type. Doyle and Ponder (1977) characterized teachers involved in change as either a rational adopter, a stone-age obstructionist, or a pragmatic skeptic.

Cardell (1994) drew a parallel between the settling of the American frontier by people of European descent and the implementation of a new curriculum. He described some teachers as trailblazers, some as pioneers, and some as settlers. Trailblazers, by their very nature, have a high tolerance for ambiguity and risk, but a low tolerance for structure and routine. Teachers who are trailblazers constantly try out new activities and approaches in their classrooms. The early pioneers were the ones who followed the trailblazers, and built the roads. Teachers who are pioneers need only a general understanding of the goals of a new curriculum in order to move forward. They can translate goals which are rather lofty and lack clarity into a form which is more user friendly to those teachers who require greater structure. At the other end of the continuum are the settlers. They have a low tolerance for ambiguity and risk, and a high desire for structure, order, and predictability. These teachers provide the stability needed for a curriculum to gain wider acceptance and respectability.

Cardell pointed out that most attempts to implement a new curriculum have failed because innovators have not fully understood the characteristics of each of these groups of
teachers, and thus, they have not fully utilized each group's strengths. Cardell recognized a dilemma faced by innovators. Namely, that even though trailblazers are the group least tied to their current curriculum and the most comfortable with change, they are also the group least likely to follow the curricular trails blazed by the innovators. The settlers, on the other hand, may be the group most likely follow the innovation without deviation, but they are also the ones most resistant to change their routine. Fortunately, just as the settling of America demonstrated that settlers did choose to move when the reasons to move outweigh the reasons to stay; so too, teachers, even those who are settlers, will make changes when they perceive the benefits of change outweigh the costs of the status quo.

According to Cardell, people who are trailblazers or pioneers or settlers, have different personalities; they approach life differently. They have different beliefs and values, different goals, different ways of authenticating their experiences. Similarly, teachers who are trailblazers or pioneers or settlers are likely to approach curricular reform and curricular evaluation differently.

The notion that teachers' attitudes toward change differed among teachers was echoed by Spector (1984). She wrote:

To the extent the teachers held the perspective that change was inherently good, they were willing to change to initiate the new curriculum. This perspective assumes that change is essential to achieve personal growth and is a means to express creativity. It implies that both growth and creativity bring a personal satisfaction in and of themselves, and that both are indicators of a successful teacher. Conversely, lack of change leads to boredom, a negative experience, and stagnation, indicators of an unsuccessful teacher (p. 566).

Spector wrote that attitudes toward change were shaped largely by a teacher's previous experiences with change. She found that in attitudes toward change, as in most areas of life, success breeds success. That fit with the findings of Guskey (1986) and
Fullan (1985), who wrote, "change in attitudes, beliefs, and understanding tend to follow rather than precede changes in behavior" (p. 393).

There have been attempts to connect a teacher's willingness or resistance to change with other personality traits, such as a teacher's sense of efficacy. These studies have led to ambiguous results. Guskey (1988) found that teachers who express a high level of efficacy appeared most receptive to the implementation of new instructional practices. Poole and Okeafor (1989) found that teacher efficacy had little effect on implementation. Welsh (1985) found that some teachers consider the adoption of an innovation as an attack on their craft pride with the inference that what they have done thus far has been inferior.

If teachers are viewed as being universally resistant to change, then curricular change, especially curricular change initiated by teachers, would be an impossibility, and the question of how teachers evaluate such a curriculum would be moot. If the extent to which teachers embrace or resist change is a determined by a fixed personality trait, then a simple personality questionnaire would suffice to evaluate the curriculum. If, however, there are conditions external to the teacher which facilitate the implementation of curricular change, then understanding those conditions would provide information as to the evaluative framework teachers hold.

The Practicality Ethic

McAninch (1993) found that teachers exhibited the same "clinical worldview" that Freidson (1970) described in a study of physicians. Freidson enumerated five elements which characterized clinicians' view of the world:

1. An orientation to action
2. A faith in the efficacy of one's own actions
3. A reliance on firsthand experience in decision-making
4. A crudely pragmatic approach to solving problems
5. A distrust for generalization (p. 169).

Numerous studies indicate that teachers view innovation from this same clinical perspective. For Richardson (1990), a teacher's decision to implement or not to implement an innovation was the result of a deliberate, cognitive, evaluative process to ascertain whether the change would “work” in their classrooms. Doyle and Ponder (1977) stated that when teachers talked about a new curriculum, the conversation revolved around whether the new curriculum was “practical”. The decision-making process was guided by what Doyle and Ponder called “the practicality ethic”.

It is important to note that even though the practicality ethic, as presented here, focused primarily on the relationship between the teacher and the innovation, Doyle and Ponder emphasized that a teacher's overall decision to adopt, adapt, or reject an innovation took place within, and considered, a much larger ecological domain. They identified three criteria by which teachers determined whether an innovation was practical: instrumentality, congruence, and cost.

Instrumentality was the degree to which the operational procedures were clearly elucidated. Doyle and Ponder (1977) found that when an innovation did not specify explicitly and with clarity how the teacher would use the curriculum in the classroom, it had a low degree of implementation.

Congruence referred to the fit between the operational procedures of the old and the new programs. Innovations which drastically differed from the established norms were less likely to be implemented than those which more closely resembled the norm.

Cuban (1988) made a distinction between two different kinds of change. “First-order change” was aimed at solving quality-control problems. It attempted to improve the efficiency or effectiveness of what was done. Cuban wrote, “Second order changes introduce new goals, structures, and roles that transform familiar ways of doing things into
new ways of solving persistent problems” (p. 342). The second-order changes were, by far, the most difficult to implement.

Cost referred to the comparison between the amount of investment required to implement the new program and the amount of return. Programs which required a large expenditure of teacher time or effort, as well as programs which extolled a heavy price in teacher anxiety, yet promise an uncertain benefit, were more likely to fail. Berlin and Jensen (1989) wrote, “Teachers change only if they are convinced that the new way is good for them—if it will lead to greater student learning, if students will learn more easily or enjoy learning more, or if the life of the teacher will somehow be better or easier” (p. 115).

The importance of the practicality ethic in understanding teachers’ appraisal of an innovation was confirmed in other studies (Fullan, 1982; Huberman & Miles, 1984; Vandeberghe, 1984). It again made clear that teachers did not evaluate the value of a curriculum in positivist terms; rather, its worth was determined according to the fit between the curriculum and the teacher. Cohen and Ball (1990b) wrote, “...instructional policies are filtered through teachers’ knowledge and beliefs about academic subjects and through their established practices” (p. 352). The three dimensions of the practicality ethic described some of the filters that teachers used to evaluate an innovation.

Negotiation: Learning versus Order

Doyle (1986b) identified the two major concerns of teachers as the concern for learning and the concern for order. Teachers have a huge emotional investment in student learning. Lortie (1975) found that the most satisfying aspect of teaching for a large majority of teachers was “the times I know I have ‘reached’ a student or group of students and they have learned” (p. 104).
Some researchers (Corbett, Firestone, & Rossman, 1987; Hunkins & Ornstein, 1989; McLaughlin, 1987; Thiessen, 1989) have attributed teacher opposition to innovation as a conscious effort by teachers to protect students from the effects of ill-planned change.

McLaughlin and Marsh (1979) wrote that, "A primary motivation for teachers to take on extra work and other personal costs of attempting change is the belief that they will become better teachers and their students will benefit" (p. 75).

But the concern for learning presents certain dilemmas which teachers must resolve (Lampert, 1985; McNeil, 1981; Romagnano, 1994). Teachers want each child to learn, but teachers are faced with the obligation to "cover the curriculum" (House, 1974). Occasionally these two goals are in conflict, and teachers are forced to decide what part of the curriculum must be abandoned, or how many students must be left behind to fend for themselves so that the rest of the class can complete the curriculum. Innovation which is seen to add on to an already overcrowded curriculum rather than replacing parts of the curriculum, or innovation which is not as time-effective as existing methods, are more likely to be resisted.

Teachers are faced with other learning-related dilemmas. Teachers would like students to learn in ways which require higher-order thinking skills. However, numerous researchers (Doyle, 1983, 1986a; Doyle & Carter, 1984; Romagnano, 1994; Tobin, 1987) observed the negotiation which took place between teachers and students by which students acted in ways to reduce the ambiguity and risk of academic tasks. An innovation which increases ambiguity and risk for students, no matter how educationally sound, requires teachers to expend greater effort and energy in order to get students to cooperate. An innovation which requires teachers to invest their "student cooperation capital" for uncertain gain is an investment many teachers may consider imprudent.
Although student learning is clearly the most important reward for teachers, maintaining order in the classroom is a basic necessity. Kainan (1994) found that issues regarding control were frequent topics of conversation among teachers in the staffroom. According to Duffy and Roehler (1986), "Organizational patterns and routines for getting through the day are, in effect, survival patterns. Innovations which disrupt these routines are resisted" (p. 57).

Certainly teachers prefer the presence of both learning and order, but in a less than ideal world, teachers sometimes overlook or justify certain types of behavior if they believe that the students are learning. Conversely, teachers might also use instructional practices which are less effective pedagogically so that order may be maintained. This is the dilemma faced by teachers who are asked to implement a curriculum which involves hands-on activities, cooperative learning, or some other radical change in the teacher-student roles. The homeostatic relationship between learning and order is maintained through negotiation. This negotiation has been studied extensively (Martin, 1976; Woods, 1978, 1980a, 1980b).

Summary

So far, the exploration of the components of the experiential dimension of teacher informal evaluation strategies has focused on the personality, values, and beliefs of the teacher toward innovation. In some ways they may not be generalizable to the present study. They reflect teacher attitudes toward reform which was developed outside the school setting, not reform which was generated by the teachers themselves. But understanding how teacher personality, values, and beliefs impact those situations may help to explain how a group of teachers choose to design a curriculum, as well as to understand how teachers who were less involved in the curriculum writing process are likely to react.
Richardson (1990) observed that if teachers were to adopt and implement an innovation, then they would have to believe that it would ‘work’. This meant that, “the activities did not violate the teacher’s beliefs about teaching and learning; they also engaged the students, permitted control over students felt necessary by the teacher, and helped teachers respond to system-level demands such as high test scores” (p. 14). These principles would seem to apply independent of the source of the innovation.

An Ecological View

Although early researchers focused on the psychological aspects of implementation, subsequent researchers (Corbett, Firestone, & Rossman, 1987; Cuban, 1990; Doyle and Ponder 1977; Fullan, 1982; McLaughlin, 1987; Middleton & Webb, 1994; Richardson, 1990; Waugh & Punch, 1987) have taken a more ecological view. They found that attributing the failure to implement an innovation solely on the classroom teacher was too simplistic. They found many forces at work in a teacher’s environment which directly or indirectly impacted the implementation of a curricular innovation. Fullan (1982) noted that change depends not only on the characteristics of the change and characteristics at the classroom level, but also characteristics at the school and school district levels, as well as factors external to the local system.

Historically, education has played a role in politics, and politics has been a part of the educational process. From time to time different political entities seem to set the educational agenda. In recent years, state departments of education have attempted to influence the direction of education through the textbook adoption process and high-stakes testing programs. Yet despite many attempts to reform education, classroom practice has remained relatively stable (Cuban, 1988, 1990).

Those at the top of the educational bureaucracy—governors, state legislators, and state superintendents of education—may have the legal authority to wield a lot of power,
but they seldom remain in those positions long enough to accomplish their goals. Teachers with tenure, on the other hand, may remain in the same position for 20, 30, or 40 years. Thus, teachers know that they can outlast the innovator and the innovation.

School administrators are often caught in the middle. Generally they have one- or two-year contracts, so, they do not have the option of riding out the innovation like teachers do. Thus, some administrators feel that they are forced to strike a bargain with teachers by which teachers give administrators the appearance of change, and, in return, administrators reduce the level of inspection and the consequences of non-compliance (Cuban, 1990) and provide for a modicum of rewards in an economy of scarcity (House, 1974). Several studies have found that the political path was the least effective means to producing authentic change (Corbett, Firestone, & Rossman, 1987; Corbett & Rossman, 1989; House, 1981).

In schools where the source of innovation is the teachers, the dynamics between the teachers and administrators may be reversed. The teachers would the ones who need the cooperation of the administrators. They may need administrator and school board approval to pilot the new course, they may need supplies and materials or other forms of logistical support, or they may need the administrator to provide support or cover from parents who do not understand or agree with the changes. In either scenario, change is more likely to occur when the teachers and the principal have a good working relationship (Smylie, 1992). Change is also more likely to occur when the nature of the relationship is cultural rather than political. That is, change is more likely to occur when the administrator and teachers share a common belief system and have common goals than when the relationship is defined by power politics. Lieberman and Miller (1984) recognized the importance of the interpersonal relationship among school personnel.
Culture has been defined in several ways. Corbett, Firestone, and Rossman (1987) distinguished between two types of culture: the profane and the sacred. The profane described the everyday patterns of behavior or "the way we do things around here". On the other hand, that which was considered to be sacred gave meaning to, and defined, professional identity and purpose. Changes at this level were rare. They took a long time, but were less vulnerable to subsequent change.

Fullan and Pomfret (1977) found that implementation was enhanced by what could be considered to be essentially culture-building activities. They wrote, "If there is one thing that stands out in our review, it is that effective implementation of social innovations requires time, personal interaction and contacts, inservice training, and other forms of people-based support" (p. 391).

McLaughlin found that successful implementation required some balance of pressure and support (Berman & McLaughlin, 1978; McLaughlin, 1987, 1990). "Pressure is required in most settings to focus attention on a reform objective; support is needed to enable implementation" (McLaughlin, 1987, p. 173). But it was the culture of the school which determined the shape that the pressure and support would take. If the culture of the school was described as a bureaucracy where power politics was the modus operandi, then one set of pressure and support procedures would be evident; if the culture of the school was described as a community with shared beliefs about the worth and dignity of every individual in the community, then a different set of pressure and support procedures would be evident.

Conclusion

In the first section of the review, I discussed five themes which served as a framework for understanding the theory dimension of a teacher's concept of evaluation: 1) the role of measurement and testing, 2) the importance of technical quality, 3) the role of
objectives, 4) politics, justice, and the role of stakeholders, and 5) the impact of constructivism.

In the last section, seven themes emerged which served as a framework for understanding the practical or experiential dimension of a teacher’s concept of evaluation: 1) the teacher’s predisposition toward change; 2) the fit between the teacher’s system of beliefs and practice and those implied by the innovation; 3) the clarity and explicitness of the procedures of the innovation; 4) the amount of work involved; 5) the teacher’s belief that learning is taking place; 6) the effect of the innovation on classroom management; and 7) the amount of pressure and support provided, especially during the early phases of implementation. It was out of this framework that I explored how teachers involved in creating their own curriculum evaluated it.
METHODOLOGY

Introduction

In this chapter I discuss the selection of the methodological framework which guided this study; then I present the guidelines which directed the data collection and analysis. This is followed by a brief description of the participants in the study (a more detailed description is presented in the next chapter), as well as an in-depth description of the setting in which the curriculum development and evaluative processes occurred.

Methodological Approach

In 1992, my colleagues and I, teachers in the mathematics department at Ocotillo High School, were given the opportunity to throw away the textbook and to re-create the Pre-algebra course from scratch. The teachers in the department did not hesitate to express their opinions concerning the new curriculum—some embraced it enthusiastically; others tried to avoid it for as long as possible, hoping that, like the reforms of the past, it would simply fade away. In the course of normal workroom conversation, I knew each teacher's opinion of the new course. I was curious, however, about how each one arrived at that position. I wanted to understand the underlying structures which led the teachers to different conclusions. And, to take it to a level of greater abstraction, I was interested in the process by which teachers evaluate any curricular innovation, not just this particular Pre-algebra curriculum. It was a study of teacher thinking.

Over the past two decades, a panoply of methods and techniques have been developed to explore teacher thinking and to investigate their value-systems or meaning-systems. Although many of these have been discussed in detail in recent handbooks on qualitative research (LeCompte, Millroy, & Preissle, 1992; Denzin & Lincoln, 1994), it has been participant observation and interviews which have served as the principal sources
of data in many of the studies of teacher thinking (Clandinin, 1986; Elbaz, 1983; Lampert, 1986).

The methodological approach taken in the present study was based on the "focused interview". Merton, Fiske, and Kendall (1990) described four criteria which distinguish the focused interview from other types of interviews. First, the respondents are selected because they all have been involved in a particular situation or shared some common experience. Second, the researcher provisionally analyzes the situation to determine hypothetically significant elements. Third, the researcher uses the preliminary situational analysis to develop an interview guide. Finally, the interview focuses on the subjective experiences of the respondents in order to ascertain the respondent's understanding of the situation. The responses serve to test the researcher's hypotheses, as well as to provide opportunities for unanticipated responses which, in turn, may lead to new hypotheses.

This methodological approach was an appropriate one for the present study. The teachers who were interviewed shared the experience of teaching the former curriculum, as well as the experience of creating and implementing the new curriculum. As one who was involved in the curriculum reform, I had developed some notions about the way teachers evaluate a curriculum of their own making. This was based, in part, upon my own evaluative structures, as well as my knowledge of the individual and collective concerns expressed by my colleagues. This previous exposure, and the information which came out of the review of the literature, provided the foundation for some provisional hypotheses which, in turn, led to the development of the interview guide. According to Merton, Fiske, and Kendall (1990), the participation of the interviewer facilitates detailed reporting in two ways:
1- Instead of having to make extensive explorations to identify relevant experiences, the interviewer can begin at once to explore the significant aspects of the particular experience.

2- Because the interviewer is familiar with the objective nature of the situation, he can provide cues which enable the interviewee to recall it more vividly (pp. 21-22).

Participants

The only criterion that was used in the selection of participants in this study was that they had taught at the school from the 1990-91 school year onwards. This was done so that the teachers would have taught both the old Pre-algebra curriculum out of the textbook, as well as the new curriculum during its first year of implementation. There were six teachers who met that criterion and agreed to participate in this study. Three of the teachers (pseudonyms Alan, Barbara, and Christine) were involved, formally or informally, in the early stages of creating the new curriculum, and were among the first to implement the new curriculum. The other three teachers (Don, Ed, and Fran) did not participate formally in the design of the new curriculum. Don waited until the third quarter of the year to implement the new curriculum, and Ed and Fran did not implement the new curriculum until the fourth quarter of the year, when there was no other option available. Each of the participants was an experienced teacher. Their teaching experience ranged from 7 to 20 years. More specific descriptions of the individual teachers serve as an introduction to the analysis of their interviews.

Interview Process

The interview process was completed in several phases. First, each of the teachers was interviewed for approximately one hour during the week of December 15, 1994. The interviews were audiotaped. Later the tapes were transcribed and subjected to preliminary analysis. The transcript of the interview was given back to the teacher so that he/she could elaborate or edit any of his/her responses.
Then, a follow-up interview was conducted approximately fourteen months after the initial interview (during the week of February 19, 1996). The purpose of conducting the second interview was three-fold. First, after preliminary analysis of the interviews, I felt that, as an interviewer, I did not effectively get the respondents to focus on the process of evaluating a curriculum in general. Instead, the discussion seemed to gravitate towards the specific merits or shortfalls of a particular curriculum, the new Pre-algebra course. Although this was informative, it made it difficult to generalize a teacher's apparent framework to a larger range of curricula.

It was serendipitous that a few months after the first interview, the district's central administration decided to pilot the Interactive Mathematics Program (IMP) in several classrooms in the year prior to the adoption of the mathematics curriculum. IMP is a commercially-published, activity-based Algebra curriculum. The district offered to purchase all of the curricular materials, including classroom sets of graphing calculators, and to pay the costs of the summer training program for any teacher (up to four teachers from each of the district's two high schools) willing to pilot the program. This meant that the mathematics teachers at Ocotillo High School were given the option of continuing to teach the present curriculum or to pilot a commercially-written program. I thought that in making that decision, the teachers would have an opportunity to reflect further on their evaluation strategies. Hence, through a follow-up interview, I could gain a better insight into their thinking. In addition, some of the teachers agreed to teach some multi-level classes, and so I thought that their experiences with that innovation might help those teachers focus on their evaluation strategies.

Finally, the follow-up interview gave me a chance to re-visit some of the original themes in order to determine their sensitivity to changes in the teachers' values over various stages in the life cycle of a new curriculum—from the initial awareness of
discontent with the old curriculum, through the development and implementation of the
new course, to discontent with the new curriculum.

**Framework for the Interview Protocol and Analysis**

The purpose of the interview guide was to set forth the major areas of inquiry. In
the first section of the review of literature, five themes were identified as being important
to the field of evaluation, and hence, were provisionally important to understanding the
way teachers evaluate a curriculum developed within the department. These were: 1) the
role of measurement and testing, 2) the importance of technical quality, 3) the role of
objectives, 4) politics, justice, and the role of stakeholders, and 5) the impact of
constructivism. In the second section of the review, evaluation was considered from the
perspective of the field of mathematics education, and, with the exception of the
application of constructivism to the evaluation of mathematics programs, many of the
same themes arose.

The third section of the review of literature revealed seven themes which research
has shown to be important to teachers involved in curricular reform, and hence were
 provisionally important to understanding how teachers actually evaluate a curriculum.
They were: 1) the teacher’s predisposition toward change; 2) the fit between the teacher’s
system of beliefs and practice and those implied by the innovation; 3) the clarity and
explicitness of the procedures of the innovation; 4) the amount of work involved; 5) the
teacher’s belief that learning is taking place; 6) the effect of the innovation on classroom
management; and 7) the amount of pressure and support provided, especially during the
early phases of implementation. This framework was not intended to be a set of
hypotheses to be tested; rather, it was to serve as a backdrop against which to compare
the views of the teachers.

**Interview Strategy and Protocol**
Alkin and Stecher (1981) described in considerable detail the methodological issues they encountered as they conducted their Decision Maker Study. Many of those issues were similar to those in the present study, and thus, a similar interview format was adopted for use in this study.

The purpose of this study was to understand the cognitive framework which teachers used to evaluate a curriculum developed in-house. In order to ascertain the teachers' evaluative structures, certain precautions had to be taken to minimize the contamination by other evaluative frameworks, especially those of the interviewer. First, because the structure of an interview (the questions which are asked and the order in which they are asked) inevitably mediates and shapes the responses (Clandinin & Connelly, 1994), the first portion of the interview was purposely vague and open-ended. The teachers were first asked to describe what it has been like for them to teach the new curriculum, and how they think that the new curriculum has impacted students. I purposely did not ask them to "evaluate" the new curriculum because I felt that this too would bring to mind some preconceived notion about what an evaluation should entail.

After the teacher responded to the initial question, follow-up questions aimed at clarifying the response, or probing for further meaning, were asked. It was only after the teachers had a chance to discuss their view of the new curriculum in categories of their own choosing that the next phase of the interview began.

In the second phase, I wanted the teachers to address some of the major themes which arose from the literature, while, at the same time, remaining committed to the idea of giving voice to the teachers. That is, my first priority was to listen to the teachers and try to understand their cognitive framework; and then, secondarily, to see how their ideas compared with those which come out of the literature.
In the second phase, a topic-centered interview format was chosen. Alkin and Stecher (1981) wrote:

Initially, we considered using a structured interview format with subject being allowed open-ended responses, but we rejected this choice as too rigid to capture the diverse range of stories we expected to hear from our respondents. In its place, we selected what we term a “topic-centered” interview format. Such a format places a modest amount of structure on the interviewer—by outlining in a “topic guide” the topics to be covered—but leaves specific questions and probes to the discretion of the interviewer. The respondent is almost unfettered, except as the interviewer may take steps to refocus the respondent’s remarks or move the discussion along to other topics (pp. 5-6).

If in the course of answering one question the teacher discussed another one of the themes as well, that topic was checked off the list. This was done for two reasons. First, it was important to keep the interview moving. I wanted to keep the interview under one hour in length so that the interviewees would not lose interest. Second, I did not want to seem to highlight or emphasize any particular theme or viewpoint thereby mediating their subsequent responses. Rather, I wanted the teachers to initiate the discussions to whatever extent possible. This also had the effect of “randomizing” the order in which the questions were asked. No two teachers were asked the questions in the same order, therefore, if the response to one question setup the response to the next one, the effect would be different for each teacher.

In the follow-up interview, the teachers (who were given a transcript of the first interview a week in advance) were asked whether they would change their responses in any way. Then I asked them in what ways their impression of the new curriculum was the same, and how it had changed. Finally, I asked them to discuss their decision to pilot, or not to pilot, the Interactive Mathematics Program (IMP) for the 1995-96 school year, and whether they were considering using IMP or the new curriculum in the 1996-97 school year. Again, I wanted the teachers to discuss their reasons for their decision.
Analysis of the Data

The interview data was analyzed at two different levels. Because the purpose of this study was to understand the teacher's evaluative framework, it is only fitting that the interview data be presented so that the voice of the teacher takes precedence over the hypothesized framework. Thus, the interview of each teacher is first presented in a case-study format, beginning with the teachers who implemented the new Pre-algebra course in the first quarter, followed by the teacher who taught it for the first time in the third quarter of the year, followed by the two teachers who waited until the fourth quarter of the year to implement it.

Each case begins with a description of the teacher's involvement in the curriculum-development process, a description of their typical instructional approach, and other information which may have impacted their evaluation of the new curriculum. In order to protect their identities, many of the interesting, but non-essential biographical information (such as age, marital status, ethnicity, number of years teaching, name of their pet) has not been included. The gender of the respondents has been preserved because the equity issue was of importance in this study. Because the school has a predominantly minority student population, the issue of fairness in regards to ethnicity was not a major factor, and thus the ethnicity of the teachers was not an important consideration. This information was gathered through workroom discussions, and informal visits to the classroom (delivering phone messages, borrowing supplies, covering classes when the teacher was absent, and so forth).

The opening remarks were analyzed in order to identify the values the teacher brings to bear in evaluating the new curriculum. Subsequent statements which either confirm or contradict those assertions were cited. The opening statements by each teacher have been presented in a virtually unedited form. This allows the reader to analyze the
teachers remarks for himself/herself, as well as to determine his/her own “intrarater reliability”.

Next, the teacher’s responses to the more specific questions in the second phase of the interview were analyzed and then presented thematically. This made it easier for the reader to compare the responses of the teachers on similar themes. The analysis of the data was not based solely on quotation analysis. As a participant observer, I was often aware of the story, and the life, behind the words. When it was possible, I shared that with the reader.

Finally, I concluded the analysis with a comparison among the teacher response to identify any differences between the teachers who chose to implement the new curriculum early, and those who chose to delay implementation.

**Setting**

The study was conducted in an urban high school (pseudonym Ocotillo High School), located in Arizona. Ocotillo High was one of two high schools in the Agave Unified School District. The school district encompassed a largely lower socio-economic section of the city—approximately 40% of the students received free or reduced-priced lunches. The school experienced many of the same difficulties as other schools located in lower socio-economic districts: high drop-out rates, low test scores, teen pregnancy, and the presence of gangs. Perhaps this explains why the district had been more open to educational innovation than many surrounding districts.

Ocotillo High experienced a steady growth in student population from about 1600 students in 1989, to 2100 students in 1996. The student population was approximately 80% Hispanic, 10% non-Hispanic Caucasian, 5% Black, and 5% Native American.

**Evolution of the Mathematics Program**
The present study of teachers' evaluative processes was conducted within an environment in which curricular change occurred constantly. In every year since 1989, the mathematics teachers at Ocotillo High School made significant curricular changes in the mathematics program. In order to put the teachers' comments about evaluation into perspective, I have provided an account of the events which led to the curricular reform.

1989: The Beginning of Outcomes-Based Education

At the end of the 1980's, the influence of the Back-to-Basics movement was pervasive. The Arizona Department of Education (1987) had recently published, Arizona Essential Skills for Mathematics. The Essential Skills Committee stated that its intent was to reflect the more forward-thinking recommendations of the NCTM (1980) and the Mathematics Framework for California Public Schools (California State Board of Education, 1985), and to de-emphasize the importance of standardized testing. However, it cited State Board Rule R-7-2-301.01 which stipulated that "each student shall 'demonstrate mastery as defined by the local governing board' of the Essential Skills" (p. i.). Thus, the skills listed in the document would come to serve as the checklist by which school districts were to demonstrate student mastery.

In 1988, the Agave Unified School District formed two committees, the Math Adoption Task Force and the Math Curriculum Guide Committee, to develop the district-wide mathematics curriculum and assessment program. From the work of these two committees, the two high schools adopted the Addison-Wesley textbook series. The district curriculum guides for Pre-algebra and Algebra were then written to match the table of contents of the textbooks and to articulate with the Arizona Essential Skills document. Each teacher was given a copy of the district K-12 mathematics curriculum guide. It measured three inches thick, and was placed in a three-ring binder. It became known as "The Blue Book".
The work of these two groups played a vital role in the district's plan to fully implement a mastery-learning program known as the Outcomes-Driven Development Model (ODDM). Although some details of the ODDM policy have been modified over the years, one thing which remained constant was that every teacher in the mathematics department administered the same exams, and those exams were the only criterion by which students could earn credit for the course. In 1989, the first set of quarter Criterion-Referenced Tests (CRTs) were developed. Once again, it was the skills listed in the *Arizona Essential Skills for Mathematics*, literally interpreted, which ultimately determined the content of the CRTs. Those CRTs primarily assessed computational skills using a multiple-choice, machine-graded format. An overall mastery level was set at 70%.

At the same time, other measures were adopted in an attempt to raise the mathematics standards for graduates of Ocotillo High. Approximately 70% of the incoming freshmen took Pre-algebra, 25% took Algebra, and no more than 5% of the freshmen had completed an Algebra course prior to entering the ninth grade. Students were required to earn two credits in mathematics in order to graduate. Previously, a student could meet the two-year requirement by taking some combination of General Math, Pre-algebra, or Consumer Math. Thus, it was possible for a student to graduate from high school without taking Algebra. There were several mathematics teachers in the district who, at the time, believed that many students (perhaps a majority of the students) were not capable of learning Algebra. However, part of the ODDM philosophy stated that "All students can learn". Eventually, the teachers agreed to adopt the goal for every graduate to successfully complete at least through Algebra. Consequently, beginning in 1989, the General Mathematics course was dropped and Pre-algebra became the entry-level course. In addition, admission to the Consumer Mathematics course became more restricted over the course of this study, and was dropped beginning in the 1995-1996
school year. In 1991, the admission requirements for the state's three universities were changed, increasing the mathematics requirement from two to three credits of mathematics through Algebra II.

According to the district's plan, the Outcomes-Driven Development Model was to have been phased in across all subject areas over several years, starting first with the mathematics department, and then extending to English, History, and Science. The mathematics teachers at Ocotillo High School were the only ones who adopted the plan enthusiastically. The mathematics teachers at the district's other high school, as well as the teachers in the other departments at both schools, resisted ODDM.

Many problems arose with ODDM during its first year of implementation. The school board and the central administration had perhaps unrealistically high expectations about the impact ODDM would have on lowering the failure rate and increasing standardized test scores. Certainly, the district had committed valuable resources—money, time, and effort—to the program. Professional reputations depended on its success. At the end of the first quarter grading period, only 40% of the students had passed the Pre-Algebra course, and the failure rate for Algebra was somewhat higher. At this point the administration was disappointed, but still supportive. They expected that the benefits of ODDM would soon be realized. In the second quarter the failure rate increased slightly, and by the third quarter, the failure rates rose even higher.

As the failure rates increased, numerous complaints reached from the site administrators to the central administrators, to the school board. Despite numerous attempts to explain to parents and students that performance on the quarter exam would be the only criterion upon which the grade would be based and credit earned, confusion and anger remained. Parents and students thought that points should be given for completing classwork and homework (even if the students did not understand it). With
the mastery level set at 70%, they also complained that they could no longer pass with a
"D".

Confusion also arose in regard to the way grades were reported. Because the
mastery level was set at 70%, and no "Ds" were given, the district adopted the use of a
grade of "CPP", Continuous Progress-Passing, for students who had not yet passed the
CRT, but were making satisfactory progress, and a grade of "CPF", Continuous Progress-
Failing, for students who were not completing the minimum number of assignments. The
reason for the use of this language was due, in part, to the fact that the state of Arizona
had a "No Pass-No Play" rule. Students could not participate in interscholastic events
unless they had a 2.0 grade-point average and were passing all of their classes. So for the
purposes of the eligibility the students who got a grade of CPP were not failing, but for
purposes of earning credit, they were not passing.

Then, in 1990, the state legislature changed the "No Pass-No Play" rule, and for a
short time, students who earned a CPP were declared ineligible for participation in
extracurricular activities. But the state rule included a provision by which students could
re-establish their eligibility. As a result, students who received a CPP were declared
ineligible to participate in extracurricular activities, but because those students were able
to re-establish their eligibility immediately, no student who completed his/her assignments
became ineligible. But the district's computer-generated reports on eligibility did not
distinguish between students who received a CPP or a CPF, nor did it distinguish between
students who were involved in extracurricular activities and those who did not. The
administration and the school board were of the impression that the mathematics
department was responsible for large numbers of students becoming ineligible. The reality
was the number of students declared ineligible was, in fact, very low.
Other difficulties with reporting grades arose because the computer software program the district used for grades was designed to work with semester credit. Students who had earned a credit for a quarter either the Pre-algebra or Algebra course which was out of sync with the calendar year had to be given a “CPP” even though they may have earned an “A”, “B”, or “C” for the course. Again, this had implications on eligibility which had to be ironed out. It also gave the impression to administrators and the school board, who chose only to look at the computer printout of grade distribution, that few students were earning credit. The teachers, who had access to different information, saw success where those removed saw failure. The district grade reports did not reflect the relatively large number of students who passed the exam in the week after the grades were reported. For instance, a student passed the second quarter of the curriculum in the third quarter of the year still received a CPP on the report card, and the school board and administrators, who only saw the computer printouts of the grade distribution, perceived the non-success rate to be much higher than it actually was. Although it has been seven years since ODDM was implemented, the same problems persist. There is still no system in place to adequately reflect the number of students earning credit, and those removed from the classroom continue to receive the same inaccurate set of data.

Moving students to different classes each quarter created scheduling difficulties which often impacted the guidance department, and inconvenienced the teachers in other departments as well. These problems put the mathematics teachers at Ocotillo in a rather unenviable position. Publicly, the central administration praised them and set them up as a model for the changes it wanted the teachers in other departments to follow, thereby setting them apart from their peers in other departments. Privately, the administration condemned their efforts and put pressure on them through the site administrators to decrease the failure rate. But, because the standards were absolute,
there were no quick fixes available. ODDM represented a radical departure from the community's understanding of school. Students, parents, even many administrators and school board members, had no experience with, nor an understanding of, the implications of a system which based grades upon a student's performance measured against absolute standards. Those outside the mathematics department accused the math teachers of, at best, not caring about the students, or worse, deliberately trying to hurt students. The math teachers were angered by such comments. They were angered even more when they heard from students that teachers in other departments would give extra credit for such things as students turning in word searches or not using the potty pass during the grading period. At the end of every grading period, the school board would complain about the failure rates to the central administrators, who would in turn complain to the principal, who would pass the concern down to the department chairperson. Thus, the teachers were often at loggerheads with the administration. The teachers, who had access to more reliable information, often had to defend the program against the uninformed opinion of the central administration. It was later rumored that one of the central administrators had diverted computers earmarked for the mathematics department at Ocotillo High School to another department. In this atmosphere, the teachers believed it to be true.

Eventually, several central administrators retired and the relationship between the teachers and the central administration improved. ODDM, although never officially abandoned, has never been implemented by any other department. But ODDM brought the teachers of the mathematics department closer together. Although some of the cooperation could be attributed to a shared siege mentality, the primary unifying factor was the agreement to give the same exams. This decision, in turn, facilitated the development and sharing of instructional activities, which eventually led to the development of a new curriculum.
1990-1992: Years of Experimentation

After NCTM (1989) published its *Curriculum and Evaluation Standards for School Mathematics*, several of the teachers at Ocotillo High School began to experiment with new instructional strategies. At that point the teachers were not questioning the legitimacy of the computational skills listed in the district curriculum guide; rather, they were convinced that students would be better able to perform those computations if they understood the underlying mathematical concepts.

During the summer of 1990, four of the teachers developed a set of instructional activities which could be used in conjunction with the district curriculum, without using the textbook. The lessons included outdoor activities, use of manipulatives, and an assortment of activities found in various publications of NCTM or other educational sources.

At the same time several other teachers became involved with a project to introduce computer technology and systems thinking to high school students. The two groups of teachers melded their ideas for curricular activities and developed a first quarter curriculum. They decided to set up an experimental study, with half of the teachers using the new curricular activities almost exclusively, and a control group using only the textbook.

For the most part, the teachers and students who used the new activities seemed to enjoy them and both teachers and students felt that the students were learning the material better. In fact, the students and teachers who were in the control group resented not being able to do the fun activities that teachers in the experimental group were doing. Because the experimental study itself was becoming such a divisive issue, the teachers decided to abandoned the study before the first quarter ended. They went back to the practice of freely exchanging their ideas.
At this point there were not enough activities developed to make up an entire curriculum for the second quarter. As a result, except for some continued experimentation on individual lessons, the textbook became the main instructional aid for the remainder of the year.

In the fall of 1991, one of the teachers suggested that the Pre-algebra students begin the year by investigating the number systems used by the ancient Babylonian and Mayan civilizations. Several teachers in the department started the year in this manner, but enthusiasm waned after a few weeks. At the time, several reasons were cited. First, the teachers did not have a vision of the goals of the reform. Often, they were given the next lesson in the series on the morning it was to be presented. The teachers would do the lesson in one day, only then to be told that it was intended to be a three-day activity. This went on for several weeks. To make matters worse, the skills which were being covered in the activities were not directly related to ones on the first quarter CRT. One by one the teachers began to abandon the new materials and either used the 1990 materials or used the book. Once again, the reform did not extend past the first quarter.

Despite the setbacks, experimentation continued. The teachers who were involved with the curriculum development efforts were convinced that the sequence of lessons in the textbook, and hence in the district curriculum, was an impediment to the construction of a curriculum which emphasized the development of a conceptual understanding of mathematics. For instance, all the lessons involving decimals were taught in the second quarter of the year, whereas the units on fractions and percents were treated as separate entities in the third quarter. The teachers, through the department chairperson, sought permission from the district’s central administration to revamp the Pre-algebra program.

1992-1993: First Year of Implementation
In March 1992, the mathematics department was given permission to re-write the Pre-algebra curriculum. Several factors came together to make this possible. First, there was the recurring problem of high failure rates, and the central administration was willing to try any new approach which would make this a non-issue with the school board and the parents.

Second, the center of political power over curricular decisions was shifting toward the state. The state superintendent of schools and the Arizona Department of Education started to exert significant pressure on local school districts. They required schools to administer its performance-based assessment in reading, writing, and mathematics, known as ASAP, in addition to the norm-referenced, standardized test, the Iowa Test of Basic Skills (ITBS). The state also discussed tying the allocation of certain federal funds contingent on a district's performance on the ASAP exams. In addition, the Arizona Department of Education recommended that:

Beginning with the ninth grade class of 1995, graduation from high school shall be based on successful demonstration of competencies as set forth by the State Board adopted essential skills for the core subject areas listed below. Students shall demonstrate competency by attaining a score representing a level of proficiency, determined by the State Board, on the ASAP Form A assessment, as measured by the ASAP generic rubric...

The new state assessment program also required the school districts to develop its own assessment plan. These changes in state policy provided the mathematics teachers at Ocotillo H. S. with the political leverage necessary to allow them to proceed with radically changing its own curriculum and making performance assessment as the basis for its quarter exams. From 1992 through 1994, the performance exams were still teacher-made and used department-wide to assess students, but beginning in the fourth quarter of the 1993-1994 school year, the state's performance exam (ASAP) became the sole assessment instrument and the mastery level changed from 70% to 75%.
Developing the new Pre-algebra curriculum. The department chairperson put together a "committee" of five teachers to work on the new curriculum. Two of the members had been some experience in developing curriculum frameworks into which instructional units and individual lessons would eventually be placed. The other three teachers had been involved with implementing some of the lessons in the previous years. There was no one on the committee who represented the more conservative view of curriculum.

The committee decided that three criteria should be used to guide the process of selecting topics to be included in the new curriculum. First, any skill which was listed in the Arizona State Essential Skills for Mathematics needed to be covered in either the Pre-algebra or Algebra curriculum. Second, those concepts or skills considered to be prerequisite for success in Algebra were included. Finally, skills, concepts, or applications which were considered to be useful for everyday life were also included.

The two members who felt comfortable developing the curriculum framework did so and presented it to the other committee members. No attempt was made to reduce the units into objectives and sub-objectives; rather, the topics were left as broad areas of focus. For instance, in the unit "What Part?", fractions, decimals, and percents are all introduced in the first few days of the unit and are then used interchangeably throughout the rest of the unit. De-compartmentalizing the curriculum to the greatest extent possible was viewed as a way to facilitate students' making connections among the topics. A description of the Pre-algebra curriculum as initially developed appears in the appendix. The curriculum has continued to evolve.

Copies of the framework were circulated among the teachers in the department. To say that it was imposed on the department would be too strong; but neither was there any group discussion of the vision and direction of the new curriculum in those early
stages. The mathematics teachers almost never meet formally in a department meeting, rather, discussion took place continually, before and after school, during lunch, and in the hallway during passing periods. Consensus was arrived at informally. This way of communicating seemed to work very well under normal circumstances, but it did not facilitate the development of a group vision of curriculum.

**Implementation strategy.** Changing the curriculum meant making radical changes in instructional practice, from what has been labeled traditional or frontal teaching to the use of what are now referred to as constructivist or interactive methodologies. The new curriculum called for greater use of activities and cooperative grouping; increased attention to processing and thinking rather than products and right answers; more written and oral communication of mathematics by students.

Because the degree, the speed, and the ease to which, teachers were willing and able to make the transition from traditional to constructivist teaching varied, the course was phased in one quarter at a time. Initially four teachers were needed to implement the curriculum in the first quarter of 1992-1993. With each passing quarter, the new approach was adopted and more teachers were brought into the process. This gave teachers who were less comfortable with change the opportunity see the new curriculum in action. By teaching classes which were repeating a given quarter, a greater amount of curricular material was available.

Because the new Pre-algebra curriculum was implemented one quarter at a time, during the first year a considerable amount of time at the beginning of each new quarter was taken up trying to bring students who had not yet participated in the new curriculum “up to speed” with those who had been in the program from the beginning of the year. In subsequent years the transition between quarters became more smooth.
The curricular materials were never packaged in a very transportable or user-friendly form. The "teacher's manual" consisted of the oral communication between teachers prior to doing the lesson. Each day teachers who were teaching the same quarter of the curriculum would get together informally in the workroom or in the hallway between classes to discuss what worked or what did not work. As the learned from their experiences in implementing the new course, changes were made, new activities were created, and new curricular materials were developed. Teachers and students alike eventually came to the realization that since the world in which we live is constantly changing, the process of curriculum development would likewise be a dynamic process. Change would be the only constant.

Culture of the mathematics department. When the teachers talked about themselves as a department and what made them different from other groups of teachers which they knew, several themes recurred. The teachers often used such phrases as, "We do whatever it takes", "We do what is in the best interest of the students", and "We do what is best for the department".

First, the teachers put in many hours beyond the contract time without monetary compensation. They were among the first to arrive at school in the morning and among the last to leave in the evening. They participated in colloquia at the university, attended and made presentations at various professional conferences, and served on numerous district and state-level committees. Second, there was a willingness to share lessons and resources. Teachers who had been given computers or classroom sets of calculators because of their participation in special summer inservice programs willingly shared those resources within the department. Third, there was genuine mutual respect. On issues such as the quarter exams and grading, the teachers reached consensus through negotiation, compromise, and accommodation, and abided by the same policies. On
instructional matters the teachers were free to use their professional judgment in selecting lessons and activities. There was a great deal of collaboration among teachers who were teaching the same quarter of the curriculum. Fourth, there was the absence of a hierarchy of teachers within the department. In other departments, teachers with the most seniority choose the best teaching assignments for themselves; they get the Advanced Placement courses or the upper classmen, while the new teacher gets the lower-track courses and the freshmen. In the mathematics department at Ocotillo High School, teaching assignments change each quarter and seniority did not play a role in the decision regarding who taught which course.

1993-1996: Reform Expands

Major curricular changes have occurred in each of the past three years. The curricular and instructional approach that was adopted in the Pre-algebra course was expanded the following year in the development of a new Algebra course. In the third year, the Algebra II course was developed and implemented using a similar philosophy.

In the 1994-1995 school year, several teachers modified the curriculum to allow for multi-level instruction. That is, the curriculum was aligned in such a way that Pre-Algebra, Algebra I, Algebra II, and Pre-Calculus students could work together on the same project but at different levels of mathematical complexity and sophistication. They referred to these multi-level classes as “stacked classes”.

With all of the changes, the teachers realized that even the new curriculum was not an end, but merely as one step to further curricular reform. One of the teachers in the department took part in a pilot interdisciplinary program. Two teachers opted to pilot the Interactive Mathematics Program, a commercially-produced, activity-based Algebra curriculum. Several teachers tried their hand at teaching some “stacked classes”. The Pre-Algebra curriculum has changed considerably since its first year of implementation.
But the direction of change has been toward a more progressive approach, not back to the use of a textbook.

Assumptions and Limitations

One of the assumptions of this study, as in any study involving interviews, was that the participants will respond truthfully and accurately. It was also assumed that, especially in the unstructured narrative portion of the interview, the teachers would talk about those things which had the greatest significance to them at that particular point in time.

Second, in most qualitative studies, researchers are outsiders who must gain entry into some other cultural setting. They are participant observers for only a relatively short time, and then they exit the cultural setting. In this study, not only does my entry into the department actually predate the study itself, but there was also no exit for me when the study was completed. This situation has both strengths and potential shortcomings. On the one hand, I am more intimately knowledgeable of the history and contextual factors which affect the teachers' responses. On the other hand, the reader may be concerned that I lack adequate distance to put the teachers' responses into proper perspective, or that I may be less candid and critical in analyzing and reporting the data because at the conclusion of the study the teachers would continue to be my co-workers. Certainly there were teachers whose views of teaching, curriculum, and evaluation were similar to my own, as well as teachers whose views were quite different. In order to lessen the effect of personal bias, I have provided lengthy citations of the teachers.
RESULTS

Introduction

This chapter is divided into several parts. In the first section, I present the interviews with the six teachers. There were two interviews with each teacher. The first one was conducted in December, 1994, and a short follow-up interview was conducted fourteen months later in February, 1996. Unless otherwise indicated, the direct quotations are from the December, 1994, interview. In the actual interview, the questions were not asked in any pre-ordinate manner. The goal was to make the interview as conversation-like as possible, and not to be an oral questionnaire. It was only at the end of the interview that specific questions aimed at covering the topics were asked.

In the interviews which follow, even though some of the direct quotations are rather lengthy, I edited them very little. I left much of the interview intact for several reasons. The first reason derived from the purpose of this study; namely, to give voice to the teachers in order to understand their evaluation frameworks. Some of the views expressed by the teachers were vastly different from mine and their backgrounds and experience were vastly different from mine. Thus, it is important for them to be able to make their own cases without interruption. Editing has the effect of changing the message from that of the speaker to that of the editor. Seeing the comments in virtually unedited form allows the teachers in the department to speak for themselves, and allows the reader to interpret the teachers' words, unmediated by the excessive editing by a third party.

I did, however, present a running commentary on the teachers' comments. The reason for doing so was to provide the reader with additional background and contextual material to allow the readers to better interpret the teachers' remarks for themselves. My comments are not intended to be a criticism of their views; rather, my comments reflect my own attempt to understand and make sense of the teachers' remarks as viewed from
my perspective and my worldview. Remarks which seem to be critical should not been seen as a criticism of the teacher, but perhaps as my inability to see the world from their perspective.

Presenting a running commentary has an additional advantage. As I drew comparisons between the teachers comments, and as I drew conclusions based upon what I perceived the teachers to be saying, the reader has some basis by which to judge whether my analysis was reasonable, or a fabrication out of isolated fragments.

During the interview, the teachers often discussed the same issue at various times during the course of the interview, and they did not always directly answer the question which was asked. At times, they answered a question which I had not yet asked. Therefore, in order to make this presentation more coherent, and in order to facilitate inter-teacher comparison of responses, parts of the interview have been moved from their original chronological position into one which is more thematic.

It is important for the reader to note that the order in which the interviews are presented is roughly the same as the order in which the teachers became involved in the curricular change and the implementation of the curriculum. That is, those teachers which implemented the curriculum in the first quarter (Alan, Barbara, and Christine) are presented first. The teachers who waited until the third and fourth quarters (Don, Ellen, and Frank) follow.

In the second part of this chapter, the teachers’ views were compared on the various themes which had been raised during the interview process. The purpose of comparing the teachers views was to assist in developing an understanding of the frameworks teachers used to evaluate curriculum.

Alan
Alan's room was usually the first one to which the principal would bring visitors. This was true even before the new curriculum was adopted. His class was entertaining and full of energy. Although the desks were arranged in rows, the students were encouraged to discuss the problems and work cooperatively.

He adapted the performance-type materials and lessons developed within the department, and used them almost exclusively. His modifications tended to add somewhat more structure to the activity or to the worksheet, as well as to provide additional opportunities for students to explain their work. He tried to strike a balance between providing the students with enough structure that they felt empowered, but not so much that it stifled their learning and creativity, or that it forced the student to see the mathematics the way that he did.

It seemed as if Alan was always a week or two behind the other teachers in the curriculum. He was sometimes "accused" of doing this deliberately so that the other teachers could work all the bugs out of the lessons before he got to it. But, in reality, Alan did not like to move on until he was reasonably certain that each student was ready. It has been said that most teachers teach to the 20th percentile, Alan taught to the first percentile. Although the rest of us would have faced a mutiny by the students in the upper quartile, the ones in Alan's class did not seem to mind. What certainly came across in everything Alan did, and what every student knew, was that Alan cared about each and every student in his class, and that he cared passionately about preparing students for whatever life held in store for them.

Alan had been involved in numerous programs for mathematics teachers sponsored by the university. He was enthusiastically committed to the goals of mathematics reform; and he defended those goals, and the way that the mathematics department was attempting
to achieve them, in a way which often disarmed its critics—students, parents, teachers, and administrators alike.

Alan piloted the new curriculum from the first quarter onwards. He was not a member of the committee that developed the new curriculum, however. In fact, he did not develop many of the original instructional activities and materials. Alan was not one to create lessons ex nihilo; his talents lie elsewhere. Alan was a bricoleur (Parker & McDaniel, 1992). He was very sensitive to the needs and concerns of the students; he quickly discerned when a lesson was not working, or potentially would not work for him, and he modified the lesson or developed a few supplemental lessons to address those needs.

Opening Remarks

I: What has it been like for you to go from teaching out of a book to teaching without one?

A: Before, with the book, what I perceive was happening was that I was doing a lot of entertaining to try to keep the kids focused on doing problems my way....But what are we doing now? The material itself is becoming much more the entertainment, not entertainment, the driving force, the motivation for doing it. The reason why I say that, is because I perceive that students are now empowered to understand. And when they look at something and it doesn’t make sense to them, they are more likely to question it, and question in a constructive manner. They are not questioning to figure out what is on the test, they are questioning to make understanding for themselves...

Even at the university, classically, you would have professors say, “You know what, I am going to put one of these three problems on the test.”

Now why did they say that? Because they were afraid. They thought that it was ridiculous to think that the students could possibly remember all nineteen that they had gone over because the students were trying to memorize. So that now the professors had to narrow the test, so that the students were not memorizing too much. It was a clear indication that it was a joke to begin with, because of the way that they did it. So they would say, “Okay, either I’m going to put the mixture problem on there or I’m going to put this on, or I’m going to put this rate times time problem on. Okay, so you’ll have to do be one of those three, so make sure you know them.” It was stupid.
Alan often returned to this theme of helping students to learn and to understand. But for Alan, it was not just a matter of helping students to learn so that they could pass an exam; Alan’s mission was to prepare students for life. This was one of the reasons why Alan considered it so hypocritical for a teacher to tell students that something was important for them to learn, and then to devalue it by telling them that they were not accountable for knowing it. His expectation in the scenario above would have been for the professor to teach for understanding, so that it would not matter which of the nineteen problems appeared on the test. To Alan, teaching for understanding was teaching for life; teaching for memorization was teaching only for the test.

He made a distinction between training students and educating students. He understood that the old curriculum had its foundation on the pedagogic model of training. And he sincerely believed that to pursue that pedagogic model in a rapidly-changing world, would ultimately harm the students.

A: It’s because you know that you are helping seedlings grow roots, as opposed to putting silk flowers out, which is what we did before. It couldn’t sustain for itself, it was a plastic world...

Criteria for a Successful Program

I: If you were to evaluate another program, or our program, what criteria would you use?

A: I would just want to go and listen to students and ask students questions. I would want to get a genuine feeling of what students knew, and particularly in an authentic kind of environment. In other words, I would ask them questions about, let’s say, a quadratic, and ask them...I would want to ask them something very open-ended so that they felt free to tell me as much as they knew. And if what they were showing me was just a collection of skills, particularly if they were discrete, and didn’t follow any particular order, then I would want to probe and ask them what those things meant to them. And if they lacked meaning, then I would suggest that the program is probably...certainly, not all that it could be.

I: What kind of information would you want?
A: I would like to have more feedback about students’ self-perception. Perception about how confident they are becoming. And I guess that it is an affective-domain question, to some degree, but also...It’s not only their attitude that “I like math”, or to a point that “I feel confident in math”, but that “I can be a problem solver of original-type problems, and do something with them”...That’s what I want students to do. I want them to sustain an effort and make connections with other things...even if they do not come up with a new view, then enrich the old view that they may have had.

Alan did not quote numbers, he did not mention that the standardized scores changed little since the new curriculum was implemented, nor that the success rates had increased significantly. He relied on anecdotal evidence and the impact on individual children to evaluate a new curriculum. He preferred to listen to students in order to get a sense of their understanding of mathematics. Alan believed that, as a teacher, he was in a better position to get the kind of information he wanted than an outside evaluator might be. He was not particularly interested in the students’ responses to questionnaire-type questions. He was interested in the students’ actual performance on day-to-day tasks. He valued persistence and perseverance.

**Standardized Tests**

I: What do you think has been the impact of the new curriculum on standardized test score?

A: I’d be curious to see if there has been an impact on standardized tests, but then why are we giving the standardized tests?...I don’t know if standardized tests test anything which we here call authentic learning....My niece who came into the room with a test-tube from my son’s new chemistry set at Christmas. Here she is a fifth grader and she asked her mother, “Mom, fill this test-tube one-third full of water.” And her mother says, “You know how to fill it, you know what one-third is.” And my niece’s response to her mother, and this is the absolute truth, was, “Don’t worry Mom, I can get it right on the test.” Meaning, she could get ‘box over six equals one over three’ right on the test, but she couldn’t fill the test-tube one-third full. That’s my opinion of standardized tests.
On numerous occasions, Alan remarked that the change from an emphasis on computational proficiency to the development of conceptual understanding, had given him the opportunity, for the first time, to discover for himself much of the mathematics he had been teaching for years. Although he had always scored well on standardized tests, he said that he has been reminded daily that his knowledge of mathematics was very superficial. Given this life-experience, it was not surprising that Alan was not impressed by the numbers—the standardized test scores or the success rates. He was not convinced that standardized test scores are a valid measure of the value of a mathematics curriculum. He thought that the kind of learning required to score well on the standardized tests was often in opposition to the goals of the new curriculum.

Success Rates

Alan also probed for the meaning of success rates. And once again, that meaning was tied to student understanding, not just the numbers on a computer printout.

I: What impact has the new curriculum had on success rates? Have you noticed that your students are more successful, less successful?

A: Success rates, I don't think initially changed, but they changed. In other words, the success rate before may have looked on paper to be very similar, but in actuality, one was measuring something which was plastic that really wasn't founded, that really was superficial; and now what one is measuring is something which is real....But the success is genuine, that's the thing. The real success is listening to that girl who came in and had a two on one of her questions about percent change. And all I did was ask her to assess what she had done so far with real data and then make a determination about whether it was right. And she assessed that it was not satisfactory and she spent fifteen minutes on it on her own and came up with an original formula which she created on her own based on her own knowledge that was like no other test that I have graded this quarter. She walked out as proud as a peacock because she had done that for herself. And she could only do that original thinking and product because she had self-confidence, or math confidence, if you want to call it that, and she had some math skills. And she had the ability to assess or check and verify for herself.
A point of explanation. When Alan talked about "that girl who came in and had a two on one of her question", what he meant was that there was one question from the quarter exam on which the girl had not yet demonstrated that she understood the concept. In the Outcomes-Based Model, she could not progress to the next quarter of the curriculum until she demonstrated that she understood that concept.

Alan seemed to instantiate Lortie's (1975) finding that one of the most motivating factors for a teacher was "the times I know I 'reached' a student or group of students and they learned" (p. 104).

Alan, again, showed that he was more interested in the long-range goals of empowering students for life than he was in merely getting them to pass a test or a quarter. Some things are more important than success rates. During the follow-up interview (2/96), Alan talked about assessments, but his comments could certainly be applied to his views on success rates. He gave the following analogy:

A: It's kind of like the soccer analogy. They asked me if I had a successful season, and I had a "losing" season by everyone else's standards. I said I wouldn't know for 24 years because I wanted to see how many kids are still playing soccer after 20 years. Then I would know if I had been successful. So I guess a lot of it has to do with how we measure success. (Int.: 2/96)

Alan may not know whether the new curriculum has truly been successful for another 20 years.

Equity

I asked Alan whether he noticed any groups of students which either benefited from, or were penalized by the new curriculum. Were there groups of winners or losers?

A: The group that typically I see that has the toughest time right now is the group who have been very successful in mindless training. In not trying to understand things, but actually has been very good at "Every Good Boy Does Fine" and memorization techniques like that get you the grade on the test. What is sad about that is that their success was based on their ability to memorize and the
teacher’s ability to present material. And the problem with that is that it reinforced them not taking on responsibility. If they weren’t successful it was easy to blame the one who was in charge. But no longer is that the case. Now, it becomes a collegial thing.

[Interruption]

Now, I think that it is becoming more and more clear to more and more students, greater numbers of students and percentages of students, that it is truly their responsibility to understand. I am here to help facilitate to the extent that I can. But we do them a disservice by ever giving them an answer, or even, to an extent, going overboard with the validation. There are students out there who are on the edge who need some sort of validation. But some really don’t want me to validate their work, but to validate it for themselves, and that is a huge step. If you go to any other school and see who is doing the validating of the student work. And if you don’t put an “A” on their paper or give them a pat on the back then why did we do it? Or check the answer in the back of the book. But they need some kind of external validation. It’s a huge step where the student validates what it is worth and whether it is worthwhile.

I thought perhaps that Alan did not understand the question, so I attempted to be a little more direct. I asked him, “Do you see any winners or losers? Do you see any differences between males and females?”

A: I don’t typically see any groups, in terms of guys/girls. I see it as a smorgasbord of people like if you go to a smorgasbord you could have rice pilaf here and you can have potatoes au gratin over here and they both are great and add something to the meal and so on.

I thought to myself, “Next time, do not interview Alan right before lunch.” I gave it one more shot. “So you didn’t notice any differences before and not now either?”

A: Not really. No, but again, that’s one of those things that I am blind to, I don’t really see those things very well. But I would suggest that I do see...well, okay, winners and losers. I don’t see losers, but let’s go on to the winner thing. I do see winners, and those are the kids that wouldn’t play the memorization, couldn’t play the memorization game, now feel included. Where they see their opinions are valued, it’s not only accepted, but is valued because of its uniqueness or as a new view of the problem.
Many teachers look out at a classroom of students and see nothing other than a class of students, with an emphasis on class. Alan looked out at the same classroom of students and saw 30 individual students. He truly measured success one student at a time.

**Amount of Work**

It seemed that every time I tried to move the discussion to how the curriculum impacted him, he moved the emphasis back to the impact of the curriculum on the students. I asked him to compare the amount of work involved with the new curriculum as opposed to teaching out of a book.

A: Workwise and things it is much more....I don't know. They are both tiring. But now its fulfilling and tiring as opposed to just tiring. I've always put in allot. But now I go home exhilarated knowing that a student has made knowledge for themselves, that they can actually do things without me, and start to see it around them. And it is not universal, it is not perfect yet. But we have a greater and greater percentage every quarter we go on....

Yeah. It is more upfront work. It is more, how do I want to say it, it is no longer a nine-to-five job. You can't punch a timeclock on this stuff because this stuff is always eating at you. You're always trying to make more knowledge for yourself, and then help students do the same with their circumstances. So consequently it is a 24-hour a day job rather than a 10-hour a day job.

Alan found that the new curriculum required more work. And yet he was exhilarated by it. He felt that he was learning in the process, perhaps more than the students. In trying to come up with new lessons, new scenarios, new applications, he had come to see mathematics all around him. He felt that he was discovering what had always been there. He wanted the students to experience the same thing, and he was exhilarated when they did.

**Classroom Management**
Alan had a wonderful rapport with the students which was derived from a real sense of mutual respect. Alan's students knew that he respected them as persons and their ideas; as a result, they returned that respect.

When he taught out of the book, Alan perceived that his job was to entertain the students in order to get them to do their work. He came to believe that that approach was no longer necessary because the work itself was entertaining. When I asked him what the impact of the new curriculum was on classroom management, he responded:

A: I never had any and I still don't, but my classes are nicer to me. Actually, classroom management is a finesse thing. You don't have the discipline problems that one might have because the kid is no longer entertained and refuses to do mundane stuff over and over....There isn't a classroom management problem when students see that there is a common goal in understanding and making knowledge, as opposed to,... Well, a lion tamer has to have a whip. Why? Because they are out there training things. A staff sergeant has to have authority on his side or the whole thing falls apart. But a cooperative group, working on a cure for cancer, has a discipline which comes from within, and drive, and they know this is a worthwhile thing, let's do it as well as we can.

In this passage, Alan described two typical views of classroom management. In the first, the teacher must resort to rather draconian measures in order to get the students to learn; in the second, the students work cooperatively toward a goal of making knowledge. Earlier, Alan referred to another practice teachers commonly use—entertainment. Alan felt that in the past he had to put on the clown suit in order to motivate the students. For Alan, one of the measures of the success of the program was the sense that he no longer had to be entertaining, the work itself did that. Of course, his classes were still entertaining, he just no longer felt that it was necessary.

Mutual Adaptation

In personal conversations, Alan had often talked about how "he can't go back". He had been changed in the process of creating and implementing the curriculum. He
could not go back to teaching out of a book. The sense that he too had been transformed seemed to resonate with McLaughlin’s notion of “mutual adaptation”. I put the question to Alan, “You have done a lot to change the curriculum, how has the curriculum changed you?”

A: The key here is the change. Change around here is the constant. We are changing all the time. And the problem with that, and it is really good and bad, is that we are trying to better the curriculum all the time. That is not to suggest that we don’t make mistakes, all the time, but that we try to learn from those mistakes. It is a 24-hour-a-day job. I actually dream the stuff. I rarely take a shower where I am not pondering something about what we are doing. That’s just a given....And whereas before, it was a 10-hour-a-day job, now it’s a 24-hour-a-day job. But it’s not a job. To call it a job means that it is discrete from the rest of your life. Just as we want students to harmonize mathematics with their life, I think as a math educator, we’re beginning to integrate math with our lives. And that’s not to say that it has not taken over our lives, although it’s beginning to, it means that we’re seeing..., we’ve increased our sensitivity to the mathematics around us and we are seizing more and more opportunities. So it is really a 24-hour a day job, but the rewards are much, much greater.

When Alan talked about the work involved in doing this curriculum, he called it a 24-hour a day job. He returned to that idea in response to this question as well. For Alan, it was as if he chose to create and implement a new curriculum; but, like grabbing hold of a live electric wire, he was no longer able to let go.

**Stakeholders**

I: What are your perceptions about what parents think and administrators think about what we are doing?

A: I think that the parents in this particular community are very trusting. They still at least say the words that education, that to get a good job, you still need a good education. And to some degree, they still believe it; and to some degree, they are just saying it because they heard it so much, they grew up with that idea. So I think that it is a trusting community, to some degree.

Administrators, I think...administrators are, everyone is trying to do good things, but I think that it is harder for administrators because they have to play school to such an extent. Nothing against the state and nothing against the federal
government, but the forms that have to be filled out are somewhat Mickey Mouse, I can only imagine what administrators have to fill out and what games they play to play school every day. With that kind of view, with those kinds of glasses on, I don't know if one could see clearly. I think that it makes it very, very difficult.

They have to go into a classroom and leave administrivia behind, and see with their own self-confidence, say what it is we want the kids to understand, and see if that is taking place. To be armed to really make assessments in the classroom about things. I think that they are the most difficult...I think that it is the most difficult for that group, the administrators, to really play at a significant level in this arena. I don't think that the parents would have as much difficulty because they don't bring as much baggage with them.

Other teachers may see parent apathy, Alan chose to see parents who were trusting of teachers and the system to do what is in the best interests of their children. Alan was also more sympathetic than most to the plight of administrators. He saw that the administrators were forced to work in a political arena which handicapped their ability to deal effectively with issues of curriculum. Alan was referring to the administrators' reliance on things such as standardized test scores and success rates, yet having no clue as to what the students really knew and understood.

Closing Remarks

At the end of the interview, I invited Alan to discuss anything that I had left out that he wanted to address.

A: Again, the bottom line is, before, whereas one felt a sense of satisfaction when students did well on a test, now we're not against them doing well on tests but we are celebrating everyday when students feel the joy of making knowledge for themselves. It's almost like a chick coming out of its shell, everyday they are pecking off a little more of that shell, starting to get that independence for themselves. Before it was our job to keep the egg warm, now we are cheering and celebrating as they break the egg open and start to make their life for themselves.

Decision about the IMP

During the follow-up interview (2/96), I asked each of the six teachers to explain their decision either to pilot the Interactive Mathematics Program during the 1995-96
school year, and then to discuss whether they would consider teaching IMP during the 1996-97 school year.

I: Last year you made a decision not to do the IMP, and you had reasons for that; and next year, if you have a choice to do it or not, what are some of the considerations...

A: Part of my reasoning last year, to not do it, was to let others do it. And I don't know if I knew that much about it. But having seen some of it this year, I got a chance to look at some of the packets, and I don't know if those packets are really representative of the whole program, but they seem very stifling. It may be a quantum leap from a textbook, but from my perspective of where we are, where we are trying to find out where every student is all the time, and allow them to make their own learning, the lock-step process for me just doesn't work anymore. Coming up with a scenario which allows people to wrestle with stuff at their own level, and what we do is run around and Militate that, or we actually facilitate students facilitating each others knowledge, that becomes the game. And it's a lot more effective and a lot more satisfying for the students, and it's much less judgmental.... (Int.: 2/96)

I: So, in that case, then...

A: No.

I: That made it easy.

A: I just can't see myself doing it. (Int.: 2/96)

Before I could even finish the sentence, Alan said that he would not consider doing the IMP next year. The Interactive Mathematics Program is arguably the most progressive, commercially-available, mathematics program available, but for Alan, doing the IMP would be a step backwards. He felt that it still did not facilitate the myriad ways students think, and that it was too much of a "lock-step process". And Alan 'cannot go back'.

Explicitness and clarity
Much of the new reform was done without the development of a detailed set of objectives. Every year new curricular changes continue to be made. I asked Alan how he dealt with the lack of explicitness and clarity.

A: It makes it good and bad. Because you can’t do anything wrong but it also allows for optimal...This is a Catch-22. When I take an exam, or someone wants me to express my thoughts, I don’t even want to have lines on the piece of paper, because I find that limiting. I now see that I have to write in somebody else’s way and convey my ideas. And I don’t want to do that. Maybe I want to draw a picture and I would find the lines too confining as far as my ideas flowing. (Int.: 2/96)

Alan often described himself as being random-abstract (or abstract-random, he could never remember which). In order to function, he claimed that his physical environment must have a high degree of order. On the other hand, in the cognitive domain, he felt confined by structure.

Objectives

Alan continued to discuss the question above, but he began to focus on the role of objectives for him.

A: So as far as trying to prescribe what is good for kids, or set up scenarios which are good for them to have, a reasonable destination—we are all going to go to New York this weekend—that’s great. But to say that we are all going to take I-20, or whatever it is, and we are going to stop every 30 minutes just in case someone has to go to the restroom, and so on. That would not be my idea of an effective trip for everybody. Everyone would have to make their own decisions about potty stops and food stops and how much you can do in a day, and so on. And allow their experience from one day to enrich their judgment on the next day. If you make all the judgments up front, then where is the learning? And that is kind of what we do with the educational process. We make all the little chapters, we make all the little segments of this, before we know what the kids are even capable of. (Int.: 2/96)

It was consistent with Alan’s philosophy to find ways to maximize the learning experience. The purpose of algorithmic thinking is, by its nature, to reduce the amount of
cognitive activity. The development of objectives is aimed, in part, at reducing the amount of reflection which teachers would otherwise have to perform, so that they can concentrate more on other aspects of teaching. Alan believed that there was a price to be paid for that. He went on to say:

A: We put a governor on every kid's learning. We got to find a way to get out of kids way. (Int.: 2/96)

Barbara

Barbara had a very laid-back, easy-going style. At times the desks in her room were pushed together into groups of four; other times the desks were in rows. She, too, used almost exclusively the performance-type curricular materials which had been generated by teachers in the department. Barbara worked extensively with Mathematics, Engineering, Science, Achievement (MESA) club which encourages students belonging to minority groups to consider careers in mathematics, science and engineering. She was also very involved in the 4-H program.

Barbara was a member of the committee that met several times after school and during the summer of 1992 to design the new curriculum. By her own admission, Barbara did not see herself as one who envisioned the broad curricular landscape, but she quickly comprehended the vision which others in the department held. During the interview, when I asked her whether she thought the program was heading in the right direction, she said:

B: I've been very pleased with the way that it has been developed. I think that I am always open to new direction. And at this point I don't know where else it could go. It's definitely on the right track. I think that I am one of those that kind of sees if someone points it out and says that we could do this. I would say, "Oh yeah". But I don't think of those automatically, as far as, this is what we need to do.

She saw her role in terms of creating new lessons, or modifying existing lessons to fit the new curriculum, rather than developing the larger framework. She readily created
and adapted lessons which aligned with the philosophy of the new curriculum. Her lessons often incorporated scenarios which came out of her experiences in home-building, music, and animal husbandry.

Barbara was a member of the committee which developed the new curriculum. Barbara served as a barometer by which those who were pushing for change could judge how far and how quickly to go. She was very sensitive to the needs of others, and she helped to bridge the gap between the more progressive and the more traditional teachers. Her feedback was greatly valued.

She was a risk-taker and she could tolerate a large degree of ambiguity. Even when the goals of yet another one of the department’s attempts at curricular reform had been poorly articulated, she would volunteer to pilot the new curriculum. She piloted the new Pre-algebra course from the first quarter onwards.

Opening Remarks

I: What has your experience teaching the new curriculum been like?

B: I think that it is great as a Pre-algebra program. I never understood what Pre-algebra was, except getting the students ready for Algebra. But it seems like it does a lot more than that now. ...I’ve been amazed at how kids get stuck on a problem that is operationally easy, but they don’t know what to do because there is just no understanding at all. And they have to understand this stuff in order to pass or to go on to the next quarter. All the emphasis has been changed; instead of just grinding out numbers to understanding and making sense of math. So I’ve enjoyed that. In seeing the kids feel good about themselves, that “Yes, I understand this”, that “This is easy”. That’s the number one comment after they finally learn something is, “Is that all there is to it? That’s easy.” So that has been real nice.

Barbara mentioned several themes in her opening remarks to which she would return throughout the interview. She described the traditional curriculum as “grinding out numbers”. Avoiding the tedious, boring curriculum of old was very important to Barbara.
Barbara often cited the differences between the mathematics she was teaching with the mathematics that her two teen-aged sons were learning in another high school.

B: I think about what my kids are doing. They’re both good in math, but they are not all that enthused. It is boring to them. And so I think that if they were challenged in a way that they could think and do things and not have to crank out 25 problems of this. Because they always say, “If I know how to do it after 5, why do I have to do more?” That’s what I get at home.

The second theme to which Barbara often referred was the focus of the new curriculum on promoting student understanding as opposed to proficiency at computational manipulation. As a consequence, Barbara noticed that students were able to solve multi-step problems which, formerly, they were unable to solve. This, in turn, empowered students mathematically and, as a result, now “the kids feel good about themselves”.

Criteria for a Successful Program

I: What criteria do you use when you say that one program is good, or that another is not so good?

B: Just how the students respond to it, is a lot. When they would pass a test in the old program, when we were using books and learning how to do these operations or algorithms, there wasn’t that ownership there. [The students would say], “Well, I passed the test, so what”, and go on to the next one. There wasn’t any type of a... what I would call a learning environment. It was more of just, you come in and do your thing and that’s it. But now the kids put a little more into it, have a little more ownership. I’ve seen kids who would not be interested in anything until you hit upon where you are pouring concrete, then they really light up, because that’s what they have experienced at home—their dad pours concrete, so they could do this. It would be neat to get more units to reach students who might not be interested in math, or [students who ask], “What do I need this for?”, and to get more specific areas or contexts to learn it in and then to be able to apply it. Because, it is always so much easier if you learn it in a context that you are familiar with, instead of just abstract. So I think that in that way it is the best criteria—how students respond.

But also myself, as far as what I feel, they are learning and they are better able to understand things and reason through things, and I feel better that they are
better prepared for life. At the beginning of the quarter they could not think through a four-step problem, but then at the end of the quarter they can; if they could do it in this context, then maybe would have a better chance of applying it to something else.

Barbara returned to the two themes she brought up in her opening remarks: student interest and student understanding. Like Adam, Barbara relied on the responses of her students. Barbara looked for affective indicators, like enjoyment and perseverance, as well as understanding. It was not standardized test scores or success rates or attitude surveys which formed the basis of her curricular evaluations. Seeing students “put a little more into it” or “have a little more ownership” or having a student “really light up” were the data she collected in order to determine whether the program was working.

She, too, expressed the view that the ultimate goal was that students are “better prepared for life”.

I: If the school were to hire a professional evaluator, what could he/she tell you?

B: I think that the program should be evaluated by what are the students getting out of it. What’s the outcome for the students? If you compare what they are getting now—reasoning and logic and higher-level thinking—compared to what they were getting before, then there is just no comparison.

Again, Barbara stated that the curriculum should be evaluated according to what the students are learning. To Barbara, the emphasis was on higher-order thinking skills.

**Standardized Tests**

I: How do you compare the standardized test scores now with those in the past?

B: Standardized test scores? [laughter] You had to ask. [laughter] Hopefully the ITBS will be changed and the criteria will be more like the ASAP. (Int.: 12/94)
During the first interview, I did not ask Barbara to explain her reaction to the question on the importance of standardized testing. So in the follow-up interview I revisited the question.

B: I was sharing with the students that doing well on the SATs or the Academic Decathlon will get them into college, but it sure won't get them through college. As far as importance, it has to be kept in perspective. It is something to put on a resume to say, "Yes, I scored this", but it is not going to get them through college or life. So its importance is a lot less. A lot of other people tend to put a lot of emphasis on it. But I have heard that their scores are going up. (Int.: 2/96)

Barbara put a priority on those things which have the most life-long effect. Although she acknowledged that SAT scores were a factor in admission to college, their effect stopped there. She believed that standardized tests needed to be kept in perspective.

Success Rates

I: How do you compare the present student success rate with that of the past?

B: I don't know. On the one hand, I remember having classes where I would have a lot of students pass and higher percentages than what I see right now. But I don't think that is necessarily true because, well, one thing I think is that the standards have been raised — so that affects it. And second, it's not as easy to cheat. There were a lot of students who were able to get answers or memorize this or that and cheat, or whatever the case may be, and get through some way. But now it is very difficult for them to cheat or to get through without actually knowing it and showing it. And I think that a lot of depends on what quarters you teach at what time. Lately I've been teaching mostly off quarters. And so I can not be worried about my numbers at that point. Because I remember a few years ago, I would have a class all year long because I would be able to start and keep on track, so I think that you are going to have different percentages there. So right now it is very difficult to say.

I am more pleased with what they are learning and once they pass I feel better about it. Instead of saying, "Well, I hope this kid doesn't suffer." When they pass this quarter I know that they earned it — hopefully it stays in long-term memory. They earned it at this point. I have to say that, and feel good about it.
Barbara could not cite the precise percent of students passing or failing a quarter. Yet she had a sense that she may have had a higher success rate in the past, but, unlike several administrators, she had a better sense of the lack of reliability and validity of those numbers. She was more keenly aware of the myriad contextual factors which affect success rates, and she considered those factors in her evaluative processes.

She was also more interested in what the students were learning than whether the students passed the course. She stated that in the past the students may have passed the quarter exam because they were able to memorize a few procedures for the short-term, but still did not understand the material. Consequently, in passing one quarter, the students were set up for failure in the subsequent quarter. She believed that the new curriculum and the new assessments were better able to determine whether the students had the prerequisite understandings for success in the quarter.

**Equity**

**I:** Do you see any groups of kids are winners or losers in what we are trying to do? Do you see any advantages or disadvantages for males or females?

**B:** That's interesting. I don't know. I haven't really studied this, or tried to do any kind of analysis of that. But when you said that, "male/female". I could see that in some quarters it could be more..., like third quarter Pre-algebra, that females, for one reason or another, might have more difficulty with it than males do. And I think a lot of it tends to do with stereotyping. That could be, but I don't really know, it seems that if you don't really like what you are doing, topic-wise, then they seem to have more trouble.

Barbara did not notice any systemic sources of inequity in the program. She did refer to a group of lessons in the third quarter curriculum which used a scenario of designing and building a house in order to learn area, surface area, volume, as well as to develop an understanding of the arithmetic operations and how to apply them. Students drew floor plans and calculated the costs of some of the materials. She thought that
perhaps the girls would not enjoy doing that as well as the boys might, although she said
that “she doesn’t really know” if that turned out to be the case. It should be noted that
earlier in the interview Barbara cited an activity in this same group of lessons (pouring
concrete) as an example of the kind of type of lesson which promoted student interest and
understanding, but she did not mention any gender differences in the enjoyment of the
problem.

I continued with this topic to see whether she perceived any gender bias in the
curriculum as a whole.

I: Do you think that the overall style of teaching in the program impacts one
particular group differently than it does another?

B: I think that the whole style benefits everyone. I think that the old one only
benefits those who can sit still and go through books and that sort of thing. I don’t
think that those “book people” are suffering or that it is more difficult for them.
We are definitely reaching students who do not like books. There are some who
do not like books, and when you try to give them some things to do out of it, they
won’t do it. They’d rather do something which is more creative. This is definitely
a more creative program and it allows for a lot more flexibility and variety, and so
it keeps a lot of kids interested for longer periods of time than the old book way
ever would have. As far as it hurting anyone, it doesn’t hurt them.

I think, if anything, the females might have a bit more trouble…I don’t
know, it’s stereotyping, but I hear a lot about it, that they have more trouble with
spatial-type things and so forth, and it could be the way that they are brought up
and they are not supposed to see these sorts of things and so forth, and whereas
we are getting more into the applied (math), and perhaps they might do better with
the books possibly.

Barbara saw the new curriculum as a benefit to everyone, especially those students
who could not sit still when using a textbook. She raised the issue that one group of
people, “the book people”, could have possibly experienced more difficulty with the new
curriculum, but she quickly dismissed the idea. Once again, Barbara’s working hypothesis
seemed to be that if the students liked the course, then they would work, and work for
longer periods of time. Enjoyment translated into perseverance.
Barbara was remotely aware of the gender literature which suggested that girls "have more trouble with spatial-type things", but she suggested that it may be due to "the way that they are brought up and they are not supposed to see these sorts of things". I believe that Barbara was saying that if the female students were being told by society or their culture that girls are not expected to be able to perform tasks which involve "spatial-type things", then they will be less likely to attempt them. It was unlikely that Barbara would think that females are biologically unable to perform such tasks, considering that she held a masters degree in industrial engineering.

Barbara did express some concern that perhaps the female students might possibly have some disadvantage as the focus of the curriculum shifted to applied mathematics, but again, she had not found any confirmation of that (formally or informally) in the numbers.

**Amount of Work**

I: Is this more work than teaching out of the book?

B: Yeah, it's more work, only because... It's as much work as you want to make it. In years past I couldn't think of anything, my creative juices weren't flowing, so I just took whatever. I'd keep trying more custom-made worksheets or activities or projects just to keep it varied — for the student's interest and my own, instead of doing the same things over....So I've made it be more work. But after a while though, it won't be as much. But once you get real comfortable with a quarter, with what is going on, it's easier to *ad lib*, it's easier to assess where the students are and get what they need. When you get to the end of a quarter which you never taught before, you say, "I didn't spend enough time on this", or "I should have done this", or "I should have approached it this way". So that's what makes more work is trying to improve on your own teaching.

For Barbara, the new curriculum was more work, but it had been work which allowed her "creative juices" to flow. The purpose of the work was to maintain interest and to improve teaching.
Barbara, like the other teachers in the department, created lessons, shared them with her colleagues, adapted the lessons of others, and modified her own lessons. In this way the work load was minimized.

Classroom Management

I: So, in terms of classroom management, is this easier or harder?

B: In terms of variety, you can see what works for the kids and what doesn’t. You can always keep one step ahead of them. So if they say that this is boring, or I want to do something different, you can do something which is radically different.

And a lot of times they will say things like, “This is fun” or “Is this math?” They don’t see where it fits in because they have been so conditioned.

And that there is such a variety there that it helps with classroom management. It is never the same thing day after day. And if things get bad, if this is not working, then what do we need to do about it? You kind of adapt....A lot of times class projects will work well. No one wants to do anything individually, but they like to work in groups really well. They’ll just get into several small groups or buddy up, I just have so much flexibility.

I: Do you find that easier?

B: It is much easier here when the students come up with things and the kids teach things, and someone says, “I know how to do this, and let me....” “Well, how about this example?” and they come up with their own. They kind of direct a lot of their own learning a lot more so than with the book.

Barbara was very flexible. She adapted the style of her lessons from individual work to cooperative group activities or projects according to the nature of the activity, the instructional needs of the class, the demeanor of the class, and so forth. Simply put, she varied the activity according to whether she perceived that it was working. One of the things that she found was that the new curriculum broke the students’ preconceived notions about mathematics. She also liked the way that students had begun to direct their own learning.

Dealing with Change
In the follow-up interview, I asked Barbara about how she dealt with the constant curricular changes.

B: Oh, I ad lib anyway. That's part of my personality, I like seeing change. I get bored easily. And that way it doesn't bother me. If I can see where it is going, or at least have some sort of direction, then the change is just another way to make it happen. (Int.: 2/96)

Barbara liked change; it kept her from getting bored. She did not need step-by-step instructions about what to do next; as long as she had a sense of where the program was going, she was comfortable with change. Her attitude towards change paralleled those expressed by Alan and his analogy of taking a trip to New York. Just let her know the destination and she would get there.

**Mutual Adaptation**

I: Do you find yourself being changed by the curriculum? Have you changed over the past couple years?

B: If anything I would say that it has changed me less than what the old curriculum would have. With my own personality and what I like to do and so forth, I fit better with the curriculum than with the book. I think that if we were doing a book curriculum, I would change more to fit the book-type operation. I like to ad lib, I like to be more personally involved with the students, I like to, not perform, but have more of a give-and-take type of classroom environment.

Barbara said that the new curriculum had not changed her all that much because it was more aligned with her basic philosophy about teaching and learning. For her, it was the textbook which forced her to change the most from her core beliefs.

I: Has your opinion of the course changed or has it remained the same throughout the process?

B: My opinion of the program is that, if anything, it has gotten stronger. Maybe I was a little hesitant. Not very much, but just a little bit because it was so new...and not knowing where it was going. But with familiarity, I feel better about it. I was always glad to see change. I like change anyway. I was glad to see it change and my comfort level has gotten better with it. I like it just as much.
I could see that, maybe getting down to specifics and things, that there are still things that we need to make sure that....Things are very general right now,... maybe objectives, or I think between Pre-algebra and Algebra there are things which have been so de-emphasized or not touched upon or some place we need to put it in because you see them in this quarter and they haven't had it and you assume that it was. We really have to make sure that the things that they need for this quarter, that they have had it some time or another, or otherwise you have to teach it. And I've run into that a lot of times. That's a little more with not being familiar with what they have had at each quarter. I think that that's my only....I'm not always sure. And there's always room for improvement. Things are good but they shouldn't stay exactly where they are at. I like a lot of things that we did when we had our own tests, I find that in some ways it was more stringent. And in some ways it wasn't. I think that we need a happy blend.

Barbara talked about a sense of fragmentation. With each teacher adapting the curriculum to fit his/her own style, with some teachers using a lot of activities and others none at all, Barbara was saying that at the beginning of each quarter, when she got a new group of students, she was not certain what experiences the students had or what the students knew. She was concerned that some of her students had done some of the activities and projects, but others had not. This made planning the activities for the quarter more difficult. She was suggesting that perhaps it was time to formally develop objectives, not so much for the purpose of day-to-day instruction, as much as it was to provide some uniformity to the students' educational experience. Laying out some sort of curricular framework would have been helpful to her.

I: Does it take you very long to form an opinion of the value of the course.

B: I like the change, and what we've done, again, it has been positive, my opinion about it....And things are not perfect, and they were not always before. I think that it's just a matter of,... my opinion, as far as whether I like the program really hasn't changed, but maybe I've been able to see room for improvement, to get it on firmer ground. That's what I mean with the changes. It's not like, "Oh no, I don't like what we are doing now and so..." It's all been positive. I'm just now trying to....I think as it is growing and changing we have to get a little more specific in some things and tie in continuity. It's been fragmented, to a point, I think that now it is to the point that it is developed, but now let's get that.
continuity further, between the other courses, to see the whole picture,...to get a balance between what is going on in greater detail.

Barbara expressed what several others in the department had expressed, that perhaps it was time to pull things together. Change is a process, and a journey. During a journey there are periods of time when all one does is travel. But there are also times when one needs to stop, to get one’s bearings, and to determine the best way to get there from here. It is a time to evaluate the past, in order to plan for the future. It is also important to take the time to repair the wagon wheels, pick up new supplies, and simply give the horses and the people a chance to refresh themselves for the next part of the journey.

For Barbara and others, there had been so many changes in the Pre-algebra, Algebra, Algebra II courses, along with the experimentation with multi-level classes and the pilot of the IMP, that she felt that the time had come to stop, look around, see where the department was and where it was going, and how it might set out.

Stakeholders

I: Do you think that administrators, parents, students, or other groups share similar views about this program?

B: They are behind us. A lot of people do not like change. They don’t see how having to make up schedules is a math-type problem. Or how logic or deductive reasoning and things like that could be math because it isn’t dealing with a bunch of numbers and doing operations on numbers. So even a lot of the topics which are covered in Pre-algebra and Algebra are not typical. For instance, statistics... you don’t get that until you are in college, they think. Or what do you need it for, or whatever. But it’s an important part of everyone’s’ life. So it’s just a lot of topics that have never been covered before that people assume that you don’t need, or that you can get it someplace else. But I think that it needs to be pointed out that we still do the operations math and so forth but let’s do it in a context where you can actually do some analysis.

When Barbara said, “They are behind us”, she did not mean that they were supportive. Rather, she was saying that they were not as far along in the reform. They
did not yet see what it was the mathematics department was trying to do. She did not
discuss on whom she thought the responsibility to communicate lies.

I: Does the opinion of the other groups affect your view?

B: When we were starting and it was so new, and there was a lot of
opposition to it, it definitely played because when I make my decision, I look at all
the sides of the argument. So I didn't form an opinion right away, saying yes or no
about it, without actually hearing all sides to it. It probably took me longer to
form my opinion, that I like this way rather than that way. I was listening to all
sides. It's a large group; they have to know something. And this is the way it has
always been for so long. Why hasn't it changed before? Why hasn't math changed
earlier? Why isn't there more going on? Especially when you are so far out in
front, you question it a little more if it is not in the mainstream.

Barbara liked to listen to all sides before she made a decision. She valued their
opinion, if for no other reason than there were a lot of people who held opposing views.
She did not seem to weigh their views as if they were stakeholders with a moral and
ethical right to influence the process. Rather, the voices of opposition seemed to serve as
data which she collected, but that data did not carry additional weight.

Decision about IMP

I asked Barbara about the reasons she chose not to pilot the IMP curriculum for
the 1995-96 school year. She said:

B: I think that a lot of it was that when you are given the program, you do
this. There wasn't any leeway or room for putting things in that you know that
works. That sort of thing. Very cut and dry. (Int.: 2/96)

Because it was an official pilot for the publisher of the IMP, there were certain
conditions placed on those who agreed to pilot it. One of the conditions was that the
teachers actually follow the curriculum as written. Barbara would have felt too restricted
doing the IMP under those conditions.

Because two teachers in the department did pilot it, I asked her whether she would
consider using it in the 1996-97 school year. She said:
B: Unless they say that we can use it and use what we want with it. So that it is not so cut and dry structure-wise. If it is up to us if we use it, and what we use, how much we use. Because I could see that a lot of it could be beneficial, being another resource. But if it was set up the same way, then no. (Int.: 2/96)

Having seen two teachers in the department teach the IMP, she saw some value in it, but she still did not want to teach it if that meant giving up her ability to respond to the needs of the class in ways that she deemed necessary.

Explicitness and clarity

In the follow-up interview, I asked Barbara how she dealt with the lack of formal, explicit objectives and the lack of clarity. She responded:

B: I learned a couple years ago, you have to ask. Because a lot of the information is not volunteered to you. And so if I ever have any questions about anything, I talk to everyone, and I ask....(Int.: 2/96)

Barbara was sensitive to the fact that those in the department who had most vigorously promoted mathematical reform had not always taken the initiative in assisting those who were less in favor of the reform to adapt to the changing reality. Barbara was a vital link between teachers who were more traditional and those teachers who were out on the edge creating new units, or experimenting with things like “stacked classes”. [A stacked class was a multi-level mathematics class containing students who were taking Pre-algebra, Algebra, Algebra II, and Pre-calculus, and having them work together on the same projects, but at different levels of complexity.] The teachers who were “out on the edge of space” were accused of leaving a “vapor trail” instead of a “paper trail”. That is, they created new lessons and activities but did not leave any written documentation about the lesson. Often the students were given a blank piece of paper or a sheet of graph paper with the instructions given orally, instead of on a worksheet. Barbara helped bridge that gap by making things more explicit and sharing that with the other teachers.
I asked Barbara, with all the curricular changes which were to occur the following year due to the state's development of new standards, what the department could do to better support the teachers in the department.

B: It seems like communication is always a problem. A lot of activities are planned and arranged by a lot of different teachers. And we have a problem trying to share those. But it takes so much more time. We develop them for ourselves, and it takes so much more time to try to share them and get them out. We need some sort of networking...to get the info out. That would make it easier to share about what is happening, about changes, or if I am having problems with this topic, then it would not take so much time. (Int.: 2/96)

Barbara suggested better communication, and finding better ways of sharing lessons and ideas.

Christine

The desks in Christine's classroom were always arranged in rows, but the students worked together on their lessons. Christine also used the performance-type curriculur materials generated by teachers in the department. Throughout the class period, she circulated among the students and answered their questions.

Christine had participated in several programs for mathematics teachers sponsored by the university. She was a member of the group of teachers which met several times during the summer vacation to put together the new curriculum. She was also one of the teachers who piloted the program from the first quarter onwards.

Opening Remarks

I: I'd like you to reflect on what your experience with the new curriculum has been like.

C: I think that they have been very positive. It seems as though the students are engaged a greater percentage of the time, and engaged in higher levels of thinking also more of the time than when we were using the books. Those are the big things.
In Christine's opening remarks the first thing that she mentioned was that the students were more actively engaged in learning, and they were engaged in higher levels of thinking.

Criteria for a Successful Program

I: What criteria do you bring to bear when you are evaluating a program?

C: First, if the program is geared toward long-term goals or short-term goals would be something... In that what is going to be beneficial for them when they leave here; the long-range goal as opposed to the short-range. You cannot prepare someone for the future if you aren't preparing them to be a problem-solver and independent thinker, a reasoner, an analyst. And all of those can go right across the board. You can be a problem solver, a systems thinker, and an analyst, and an independent thinker in science, in social studies, in English, in music....

Christine focused on “long-range goals”. She believed that the goals of the curriculum should be to prepare students for the future, and that meant producing students who are thinkers.

Standardized Tests

I: Do you notice any difference in standardized test scores?

C: I didn't know what they were before, and I don’t know what they are now. I don’t have the foggiest. (Int.: 12/94)

In the first interview, I did not have Christine elaborate on her comments about the standardized test scores. It seemed apparent that they were of little importance to her. She did not have a clue as to what the scores were, either before or after the new curriculum. But in the follow-up interview, I brought up the subject once again. She stated:

C: I think that it is going up. I don’t know by how much, but from talk within the department, I think that it is going up. (Int.: 2/96)

I: Is that important?
C: Yes and no. It's important more for outsiders than for us in the department—administration, building and central administration, community at-large it is important. For the students' future? I don't know if it makes that big a difference. (Int.: 2/96)

Christine again was ambivalent about standardized test scores. She recognized that they were important to others outside the department, but she herself thought that they were unimportant. Neither I, nor Christine, made a distinction between student performance on the Test of Academic Proficiency (TAP) test, which is the achievement test which the state has mandated to be administered, and the SAT exam which college-intending students take. Based upon other discussions I have had with Christine, she was referring to the TAP test.

Success Rates

I: Have you noticed any difference in their success rate?

C: It seems to be to me that we have more a situation of have and have nots than we did before. Before we had a lot of gray people. Did they know or do they really know? We still do have some gray people, but it is really being polarized. There are some who seem to be able to use the higher thinking skills and others who do not. I'm not really sure if our percentage rate is really higher on passing or not. I just know that the ones that are passing seem to..., compared to the ones that were passing before, seem to know a lot more, or greater depth, maybe I should say. (Int.: 12/94)

At the time of the first interview, Christine did not know of the impact of the program on the number of students passing or failing each quarter. She seemed to notice a difference between those who could use higher-level thinking and those who could not.

When Christine said that "it is really being polarized", it is unclear precisely what she meant. In common usage, the word "polarization" generally carries a negative connotation. But in assessment it is important to be able to know when students understand something, and when they do not. In this case, polarization may be
synonymous with being able to make critical distinctions between a student's knowing and not knowing—which would be beneficial. It is unclear whether the polarization to which Christine referred had been caused by the curriculum itself, or whether Christine had simply become more aware of the differences in what students know and understand mathematically.

In the follow-up interview, I asked her about the success rate and she stated:

C: Before I think I said that I couldn't tell quantitatively, but we've been doing this long enough that I know that at least my success rates are going up. And even the kids who are not going on to the next quarter, I think that they are coming out of with more. There are still those who take the course and get absolutely nothing out of it, and they repeat it. But I think that ones who are passing know more than before. (Int.: 2/96)

Conventional wisdom says that when standards are raised, fewer students will be able to attain those standards. Several teachers found that, contrary to conventional wisdom, raising the standards had resulted in an increase in the success rate. Christine believed that more of her students had passed and that they had learned more; even the ones that had not passed the quarter exam had learned more than in the past.

Equity

I: In these haves and have nots, do you notice groups of people who are winners and groups of people who are losers? Differences between males and females, or...

C: No. I see attendance is critical; and also an active participation. A passive participation for some people will be enough to get them through, but for most it will not. But if they just there and letting the situation come to them, they probably aren't going to succeed. But before, with the book, I do think that you could be more passive and you still would succeed. But now, you need to be an active learner and an active participant.

I: So do you see that as being affected by particular groups.
C: I haven't noticed it, but I haven't been looking either. Now I'm sure if you went and looked at all the numbers you might find a difference but just thinking about my classes, I don't....The big thing is the two that I have mentioned: attendance, and then once you are here, if you are active, then that makes the biggest difference.

Christine did not notice any differences based on gender or ethnicity. She thought that the differences in performance were due largely to attendance and participation.

Amount of Work

I: How has it been for you? Easier? Harder? Do you like it more or less?

C: Oh, I like it more. It is more difficult because you have to plan more. But in a way it has been easier because it has been interesting. I don't get bored. With the book, you get bored very easily. And even though it is easier to get ready for, it's boring. So it is more work, but it interesting work.

Christine balanced the additional work involved in creating a new curriculum against the decrease in boredom. She acknowledged that creating the new curriculum had been more work, but she also stated that the side effect of the additional work had been to make her job more interesting. Avoiding boredom was a theme to which she often returned.

Classroom Management

I: In terms of classroom management, is it easier or harder?

C: I think because they stay so long on task that it has been easier. I don't know if that is just because I'm more of an experienced teacher or because of the materials....I think that experience does help with classroom management. But I also think that because they are more engaged, they aren't going to be messing up.

I: Why do you think that they are more engaged?

C: I think because it is more hands-on and activity-type situations, and they can use cooperative learning and work towards a group solution, I think that they are more able to keep on task. Because if they are at a dead-end and not sure how to go on, like with bookwork, they are handicapped until you can get over and
help them. But with some of the projects we are working on, if they hit a dead-end there is someone in the group that they can ask.

The new curriculum facilitated cooperative learning in the activities. Many of the activities required the collection and analysis of data, which was most often completed in groups. Christine noticed that these types of activities kept the students more actively engaged for longer periods of time. Because the students were working together, there was less down-time waiting for a teacher to provide an explanation. This meant that they would not be “messing up”.

**Change**

Christine’s views on change could be discerned in her responses to two different sets of questions. In the first interview, I asked her about what her initial impressions of the new curriculum.

I: What were your first impressions of this program?

C: It was scary. It was very scary. We all grew up with doing page 5 then page 6 then page 7 and then that’s how we learned to teach, page 5 then page 6 then page 7, and I taught that way. But when it’s not that....It’s almost like the feeling that I’m sure some of the Russian people are having right now, all the decisions are not being made for you. You have this freedom to invent and to think, and it’s scary. After the initial little shock, then of course it is just great. Forget this lock step, goose-stepping into the book kind of stuff, but at first it was scary.

I: How long did it take you decide that it was worth doing?

C: Until you actually get in there and start doing, I don’t really think you can tell, thoroughly. I think you might have an idea that it might, but until you actually get in there... and I think that that is one problem with people who evaluate programs that aren’t teaching. I’ve never understood how a secondary administrator, a curriculum administrator, can evaluate something and say that this looks good, this doesn’t look good....I guess that I’m a let’s-try-it-and-see-if-you-like-it kind of person. I can’t see how you can say, “Yeah, this is what we should do” or “No, this has no merit”, if you haven’t tried it.
How long did it take? It was less than nine weeks. By the end of the first grading period, I felt that this was the way to go. But you know you still have all this baggage which you are trying to drag along, "Oh, I can't, how am I going to do all this." Well you still have all this baggage. Well, finally you get to the point where you say, "I don't need all this baggage anymore." Then you take this real step forward where you don't need that book anymore and you don't need the check-off lists of skills. And all of a sudden,...and I'm not sure when that really happened. And then you kind of start going. Then, by that time, you kind of know that it is really working. I guess you've kind of known all along that it is working, but you really have to keep holding on to that security blanket. Something that you know, or felt that it worked in the past. I don't know if you knew it worked in the past, but you felt that it worked in the past; so you are going to keep holding on to that. And then you have to tell yourself to let it go. (Int.: 12/94)

Christine had been part of the group that had put the curriculum together. But it was still a stretch for her to move from teaching a curriculum which was based on a textbook and used activities only occasionally, to one in which the textbook was discarded and activities were used much more frequently. She said that it was scary at first, but she soon found it liberating.

In the follow-up interview, I asked Christine about how she dealt with all of the changes which have transpired in the past few years. She stated that:

C: I personally kind of like change. That's why I didn't want to stay at the middle school level because for two years I did exactly the same thing, over and over. And when I taught at the elementary school, the same thing two years of it. I was getting bored. So in a way, change is difficult because there is much more preparation; you really have to hunt for activities; you're not really sure if this is the best way to go, but I kind of like it. (Int.: 2/96)

She stated that for her, change reduced boredom. Thus, in her personal economy, the anxiety and the additional work involved in change were outweighed by the excitement and challenge of change.

**Mutual Adaptation**

I: That leads into another question, sometimes we change the curriculum, and sometimes we are changed by it.
You did pick up on this, a little. You are trying to find projects, whereas before I never would have looked in the newspaper for things. Now you are looking for things as a teaching implement. I think that that makes you more aware.

One of the attitudes which the new curriculum tried to foster in the students was the idea that mathematics is not something which is confined to the classroom, but that it is something which is all around them. Christine learned that lesson as well.

Later in the interview she stated that:

Yeah. I think that because what we are doing is multi-level, it is challenging. I find it challenging to myself also. And that is what I enjoy. Before people would ask, “Are you going to keep teaching until you retire?” Before, I could not see myself as doing this for the next thirty years. I can see myself doing this, what we are doing now, for the next thirty years. Well, yes and no. Because this is evolving, I know that it will not be the same for the next thirty years, but it will be on the same path. I can see myself going down this road for the next thirty years, but I cannot see myself going down the other road for thirty years. It would have driven me insane.

Christine had been changed in the process of doing the new curriculum. She had developed a new understanding of teaching—from a view of teaching the same thing day in and day out, to a view of teaching in which the curriculum which is constantly changing, which would allow her to grow and not get bored for the next thirty years.

In the follow-up interview, I asked Christine a question about how the department could better support teachers in the curricular changes which would be taking place next year. In the course of her response, she recalled the following incident which described how doing the new curriculum had changed her perspective.

Just yesterday I was looking for an activity for my Algebra II class. And I wanted it to deal with geometric growth and decay and possibly have in it something with logarithms. So I started looking back at some of our old textbooks. At times I think that I’m not really very progressive. But when I look at those textbooks, and I just shudder, the logs are just so devoid of any real-world application, and they are strictly computation. I just had to shudder, I just couldn’t
believe it. I thought, I guess that I'm a little more progressive than I thought.
(Int.: 2/96)

Stakeholders

I: How do you think that parents and administrators view what we are doing?

C: I think that their level of understanding is better than it was, but that we still have a long way to go in that. There are still parents who are looking at the short-term—just get them through the class and I don't care about anything else—just get them through soccer season, just get them through whatever. And that might just be part and parcel with dealing with parents.

Administrators? I think that we have really come a long way with our administrators. What I should say is that we have come a long way with the administrators. We have come a long way together, the administrators and us. Looking back, I didn't see us as being able to do what we are doing now, five years ago. And it is not only administration, or parents, or students, it is even us. I think we have evolved in the past five years. We have these co-evolutionary cycles going on that intermingle with the students and parents and administrators.

We are evolving at different rates, but we are all evolving in the same direction.

How it is going to work out in five years? I have no more idea of what will be going on in five years than I did five years ago. I never would have thought that we would be doing what we are doing now. So what's going to happen in the future? Boy. Just looking at the last five years here. I have no idea. It's going to be exciting, but what is going to be? I don't know. It's going to be fun though.

Many teachers have an us-against-them attitude toward administrators. Christine had the most positive view of administrators. She had seen the changes that both teachers and administrators had made over the past few years. Christine was unique in her view that there are "co-evolutionary cycles going on that intermingle with the students, parents, and administrators".

Decision about IMP

I asked Christine about the reasons she chose not to pilot the IMP curriculum for the 1995-96 school year. She said:

C: Couple of things. I felt comfortable with the program we were doing. It wasn't perfect, but I could see that we were working toward the right end. But with IMP I didn't know enough about it to really want to switch. I knew that I
was going to have success, and I would be teaching in a way that I would be comfortable with, with the program we were doing. With IMP I didn't know enough about it to really want to jeopardize what I was doing. (Int.: 2/96)

Christine did not have enough information at the time to make an informed decision. She did not want to jeopardize the success she felt that she was having in order to do IMP. I asked Christine whether she would consider teaching the IMP curriculum for the 1996-97 school year. She said:

C: I think that I could do IMP. I don't know if I would want to do it the next ten years. But I wouldn't mind trying it. There are drawbacks with IMP. There are drawbacks with the program we are doing. And so I would give it a shot. (Int.: 2/96)

Christine liked what she had seen from the IMP and she would be willing to give it a try. She was not sure that she would want to do it for the next ten years, but that would be true of any program.

Explicitness and clarity

In the follow-up interview, I asked Christine how she dealt with the lack of formal, explicit objectives, and the lack of clarity. She responded:

C: I would like them clearer. I look at what the ASAP is testing, I look at the general objectives that it is testing, and I try to flesh out and see what the prerequisite skills might be and so that's more work. So it would be easier if it were all spelled out. But it is not the end of the world if it is not. I know some people in the department who would have a really difficult time with this, and I know that there are people who have no trouble with it, and I'm kind of in the middle. I think that if we really want people moving in the direction of the reform, I think we need a little bit more concrete objectives. No so much concrete, but explicit, I guess. (Int.: 2/96)

For Christine, having things spelled out a little more would have made things easier, but she got along alright by looking at the quarter exam and deciding from that what needed to be covered. She viewed herself as being between those who wanted a great deal of flexibility and those who wanted a great deal of structure.
I asked Christine, with all the curricular changes which were projected to occur during the coming year due to the state's development of new standards, what the department could do to better support the teachers in the department.

C: I think that one thing that we are working on right now is the curriculum guide at the district level. And that would be a big help. I'm marginally creative enough to come up with some activities. If I didn't have even that small ability to do that, I would find it extremely tough to teach right now. For people who are very creative, this is the best of all worlds, I would think. That would be the first thing, I think. Curriculum guide for us uncreative people.... (Int.: 2/96)

At the time of the interview, Christine was working on the district curriculum committee which was in the process of putting together a curriculum guide for teachers. It would contain activities and the objectives they address. She felt that the curriculum guide would help the teachers who were having the most difficulty with the new curriculum.

Don

Don had been out of town for most of the summer of 1992, and, therefore, he was not involved in developing the original materials. Don used some of the performance-type activities for his lessons, and he adapted them according to his personal teaching style. He also created many of his own lessons. These lessons were either performance-type activities which closely paralleled the quarter exam or they were lessons aimed at giving students additional practice on computational skills.

Don's teaching style was more traditional than that of Alan, Barbara, or Christine. Using an overhead projector, he demonstrated the procedure which students needed to follow in order to complete the assignment. He tended to answer the students' questions from the front of the room; he did not generally circulate around the room. He seemed to focus more on the development of procedural knowledge as opposed to conceptual understanding.
Opening Remarks

D: Working out of the book, the way that we did it before was, of course, a lot easier because everything was laid out for you. The new one is a lot harder because there is so much work involved in getting the curriculum and the lesson plans done. A little more fulfilling doing the second one, of course, this new way, because you have all the input into what you want to put into it. With the book it was just teach what was in the book. You really had no input, or very little input. I guess you could put more into it if you wanted to but, usually, not a whole lot. But with the new one you get a little bit of your own work into it. But it is a lot harder starting from scratch, having to make all the lessons.

Don expressed two themes in his opening remarks. The first had to do with the amount of work involved in writing one's own curriculum. As mentioned earlier, Don created many of his own lessons. He did so in order to match the lesson with his preferred style of teaching, as well as to match the lessons with the exam. Don admitted that, in the short run, it was easier to allow the textbook to determine the curriculum. But Don also pointed out that with the increased work came a sense of teacher empowerment because a teacher had more input into what was taught, and that produced a sense of satisfaction.

Criteria for a Successful Program

I: If you were to look at two different programs, what are the criteria you would use to judge whether which is better?

D: I guess that the first thing that you would look for is their test scores; maybe I'm conditioned to look at those. How they did on their SATs. Although I know you should include how much the students enjoy doing it. And then something...I'm not sure if you can do it or not, but look at them five or ten years down the line and see what their impressions of the math program was and how it helped them, or if it didn't help them. Just see what their thoughts would be about how math helped them in their search for a job after school. But that would be hard to do, though. It would be hard getting kids back together. But that probably is the most important thing we could do. And with our new program, I would imagine that it would be pretty important to see how we affect people five and ten years down the line.

With the book, mostly what you hear, from a lot of people, is that a lot of stuff is stuff that you will never use. The Algebra especially. A big percentage of
people are never going to use Algebra in their life after school. It may affect them in ways they don’t know. Maybe this new math will let them know how it is affecting them, even if they don’t know how to use it. But a lot of people say that with the Algebra, they just can’t see a reason for it.

Don’s view of curriculum evaluation seemed to be informed by some unidentified source of what one “ought to do”. Based on this source, he said that the criteria by which to evaluate a curriculum would include SAT scores and how well the students enjoyed the new curriculum. The criterion which he seemed to consider most important was the feedback from students five years after graduation.

I: Which way do you think is better for students, if you were to compare the old curriculum with the new one?

D: If I were to compare, and I’ve told other people this, I think that with the book and what we are doing now, somewhere in the middle. Where maybe we do include a little bit of book work, but we also include some hands-on activities for them to do. But with the book, whenever we came to the word problems, you always kind of skipped those because no one wanted to do them; those should have been included more. But more than just word problems, the students should have more hands-on experiences with their learning. So somewhere in-between. I think that you need a little bit of both.

I: So if you were to re-do your own course, how much would it look what we are doing now, and how much would it resemble the book.

D: I go back to what I said before, that it would include a little bit of the book. I am not sure what order you would do it. Maybe we would look at the formulas in the book and try to work on some problems and then do some hands-on. But it might be better to do it in the opposite order. Do some hands-on and learn some principles like they are doing with the solar cookers, just have them try to do it at the start and then when they start asking why did this happen then go back to the book and work it that way.

Don was willing to use both the new activities in conjunction with working out of the book. He did not define precisely what that meant, but presumably he was referring to working the computational problems. Don’s approach to teaching was to provide his
students a very structured procedure for solving a problem. Don, like many teachers, believed that students learn best when they are presented something in a very structured way, rather than by presenting multiple approaches which might confuse students.

**Standardized Tests**

I: You mentioned earlier about test scores. How important are test scores and success rates?

D: I don’t know how you would evaluate without test scores. I think that they would be pretty important. But what test would you use to evaluate them? That would be a tough one. That the SAT is the only answer? Possibly if they were going to college, that might be a help since they would have to pass an entrance exam, that would be a help.

Now, students who aren’t going to college, there’s got to be some kind of evaluation. The way that we are doing our curriculum now, it is harder to evaluate it. I would imagine that we would have to get to the point probably where people do not grade their own test. From grading, you always try to help your students maybe a little bit, but it might be better or more accurate if people would grade other teacher’s tests. But it is real hard to get a good evaluation of this program. I don’t know if that is a disadvantage or an advantage, but we can do a lot of things with it. But its hard for other people to test it, to see if we are doing what we say. I don’t think that there is a really good test to test what we have been doing.

Don stressed evaluation based upon testing. He examined several candidates: SATs for students who are going to college, some other test for students who are not. He concluded by stating that there was not a good test to evaluate the new curriculum.

**Success Rates**

I: From your interaction with students, how well they are learning?

D: If you are going to ask do I see a big difference? The learning level? Not really. Well, maybe that is not true. I remember when we first gave the first ASAP test to seniors three years ago and half of them wanted to walk out, because they thought that it was really dumb. Where now I can give these-type test to the P1s and P2s, well the P2s especially because that is what I taught last, and they will write three or four pages answering the question whereas that would never have happened before. So yeah, I definitely see where this could be better, where
they finally have to start thinking. With the book there really wasn’t any thinking, just trying to remember a formula and do problems, but this one you got to really think.

The biggest advantage is right now that they have to think and write which is something a lot of them will have to do on jobs when they get out of school, when they get out and make decisions on their own. It teaches them that a lot better than the book did. So there is definitely an advantage for the writing part and thinking over the book. (Int.: 12/94)

Initially, Don did not think that there was much difference between what the students were learning in the old and the new curricula, but on further reflection, Don thought of some differences in student learning since he started teaching the new curriculum. He talked about how students, when explaining their answers on a test, had begun to write more. Don had found that the new curriculum encouraged students to think more than when they worked out of a book; and that these were the skills which they would need in the future.

In the follow-up interview, I asked Don if he noticed any differences in the success rate with the old curriculum and the success rate with the new curriculum.

D: No, about the same. In the Pre-algebra it’s probably not as good. In the Algebra it seems somewhat better. I’m not sure of the reason, maybe the students have to get used to the system. By the time they get to Algebra, they know a little bit more. (Int.: 2/96)

Don perceived that the success rate in Pre-algebra might be down, while the success rate in Algebra might be up. He attributed this to the fact that it took the incoming freshmen longer to adapt to the system.

Equity

I: Do you think that there have been groups of students who have been more successful or less successful?

D: From my experiences with this quarter it is hard to say, because I have real good success in the second quarter of ASAP but I think that the course was easy. I don’t think that the objectives were hard to teach and there wasn’t a lot of
material on this. So, of course I have had greater success, but it would be hard to
tell, it would depend on the material you were trying to teach.

I: Have you found any differences between the success of males and females?

D: I've never seen any examples of that. I keep hearing about how all the
females and women have disadvantages in math, but I've never seen that. I'm not
sure where that applies, but I haven't seen it at this school at all.

I: Then you haven't seen any differences in the success of boys or girls
between the old program and new program?

D: No, I've never seen that. Well, you have to be careful about that because
since we write our own lessons, you have to include girls in some of those
problems and not always the boys. That's about the only time I really think about
it is when I write my own lessons. But I really haven't seen any differences in
sexes or minorities or ethnic groups.

Again, Don had a vague awareness of the literature concerning mathematics
education and gender equity. Don had not noticed any differences between the
performance of males and females in either the new or the old program. He tried to be
conscious of the way that he wrote his own lessons so as not to include scenarios which
would be of interest to only the boys or only the girls.

Amount of Work

In his opening remarks, Don stated that teaching out of a book was easier, but that
in preparing his own lessons, he was able to customize the lessons. For Don that process
seemed to be rewarding. At the end of the first interview, I asked Don whether he had
anything to add that I had not covered in the interview. He said:

D: Well the main thing with this one is that all the concepts are great, you
can't argue with them. But the hard part of it is implementing it. The writing up
the lesson plans, drawing up the curriculum, is the biggest drawback. It just takes
up so much time and you are not given any time to do that. That's the biggest
disadvantage to this program. Days when I can come in (like sometimes I come in
on the weekend because no one else is around) to get some work done. Or even
just working on the weekend at home, you can get a lot done. But, you just don't
have time at school to do any of this, which is a big disadvantage. There's so
much to do. That’s the hardest part, just trying to get the work done to implement your ideas. If you had the time, I could see where we could do even a better job.

Don put a lot of time into preparing his lessons. He carefully prepared the worksheets, as well as the overhead transparencies he used to teach the lesson. I started to ask him, “If the program was laid out a little more and you didn’t have to do so much inventing…”

D: You know, now you bring up something, it’s laid out for the ASAP and it really wasn’t originally meant to be done this way. And so in one way we created a problem for ourselves because we’re trying to mold it into something it wasn’t meant to be. The advantage to that is if the teachers who are working on the state committees [which are rewriting the essential skills and the ASAP tests] get the new objectives and they are done in a better order, then we are going to have a better idea of how to do them. What we have to do for lessons. So we are learning stuff from this, it is a lot harder to do than the new curriculum should be. So that may help.

When the new curriculum was first implemented, the quarter exams were also written to match the curriculum. Later, the state mandated that the state-wide performance (ASAP) exams be given, and the mathematics department made the decision to use the ASAPs as the quarter exams. The curriculum and the ASAPs were not a perfect match, and over time the curriculum began to shift in the direction of the ASAP. Many of the activities were retained, but those activities which did not align with the ASAP were replaced with new activities which did match. Don, like several other teachers, designed lessons which closely paralleled the test, but not necessarily the philosophy of the original curriculum.

The state was scheduled to issues the new standards for mathematics sometime in 1996. The new standards should align closely with current practice, and thus, ultimately require less work than other schools will need to do in order to comply.

Dealing with Change
In the follow-up interview, I asked Don about how he dealt with the constant curricular changes.

D: How do we deal? Good question. We just do it. We're really not given, I'm not anyway, I don't know if anybody else is, much say in what is going to happen. We are told what is going to happen. We're given classes to teach, and so I prepare as well as I can for the classes when I'm assigned one. Trying to decide what the objectives are, what I have to get done. And just work at it and do it. And so as far as dealing with it, I just have to do it because of necessity, you have to teach the students what they are going to need to know. (Int.; 2/96)

When Don said that he does not feel that he has much of a say about, or control over, what was going to happen, he may have been referring to the new set of mathematics objectives which the state was about to issue. It may have also been that Don perceived that he did not have much say in what happened in the department. While it was true that the objectives and the quarter exams had been determined by the state, Don had considerable freedom to get there in any way he saw fit. From a curricular standpoint, he could have chosen to use a book or the activities developed within the department, or the activities which he created.

In terms of the scheduling of classes, this was done within the department. The master schedule was made, based upon the number of students at each level, and each teacher made his/her preferences known. Then the classes were assigned in an attempt to satisfy each teacher's request. There were no special privileges based upon years of service. There were times when it is not possible to grant every request a teacher made, but this seemed to affect all teachers equitably.

Don's feeling that he did not have much control over what happened may have had its roots in the way that business was conducted in the department. The department had few formal meetings at which issues were discussed and debated. Instead, issues were debated informally at lunch or after school, or the department chairperson would poll
individuals separately. When decisions were made which run counter to a teacher's wishes, then that teacher may have felt that his/her voice was not heard or validated. Don seldom made his requests known; neither was he one to publicly complain about things. He may have felt that he did not have much control over things.

Perhaps one reason that curriculum reform had occurred was because those who favored reform were the more vocal members of the department. And in their attempts to argue the merits of mathematical reform, the reformers may have inadvertently driven underground the dissent, anger, and frustration of the less vocal members of the department. The system can be unkind to those who did not keep themselves informed, as well as unkind to those who did not make their opinions known.

Mutual Adaptation

I: Has your opinion of the program changed, or how has it changed, since the first time you saw it being done or the first time you started doing it yourself.

D: The first time that I was exposed to this was when I heard someone on the radio saying that there were books written saying that maybe Algebra wasn't even necessary for a lot of high school students. And being a high school math teacher, I wondered how can that be. And then when this program came in, I could start to see what they were talking about. That you could teach the math concepts and a lot of math-related items without really getting into Algebra by doing hands-on. At first I really doubted that we could do it. I definitely favor it more than when we first started it. But again, like I said before, I'm not sure. The book is at one level, where you're working all book; and we're doing now almost all hands-on, develop your own, not using the book at all. And I get the feeling that somewhere in the middle is the answer. Where it would be maybe a little bit of, I don't know if it would be book, but some rules that they could use to start with and then see how they apply and then use some hands-on activities. So I still haven't gone completely the way our program is, where it is going to be completely away from the books, I still somewhere in the middle, but it's still a pretty good move from where I started. I used to think that books could be the only way, but now I see how we could do it without the books, but still kind of leaning towards using books a little bit.
Don’s understanding of Algebra, as well as that of the person on the radio, had been shaped by the content of traditional Algebra textbooks. And in that sense, there certainly had been little necessity for most people to do the kinds of algebraic manipulation prescribed in most Algebra textbooks. Today, technology has made those traditional skills obsolete even to those who formerly may have needed them. But a much broader view of Algebra would recognize that algebraic thinking is ubiquitous in daily life.

By using more hands-on activities, Don had made a “pretty good move” from where he started. Change is a process (Fullan, 1982), and Don had changed. In the follow-up interview, Don said that he would like to start out every lesson with an experiment which demonstrated the objective, and how he would like to use the graphing calculators more in class. Those were big steps.

**Stakeholders**

I: What do you think is the opinion of parent, administrators, and others who are affected by this program?

D: I would think that the parents in this district don’t know what is going on. They are not very involved. And so they don’t really know what is going on. They probably don’t know that what we are doing is different from what we used to do with the book.

Administrators, I think, also don’t really know what is going on. Whether that is good or bad, I am not sure, but I don’t really think that administrators have a math background so they don’t know. They get it from the state level that we are supposed to take the ASAP-type test, and it looks good on their record if they push it, but I don’t think that they really know the effect, whether it is doing good or bad. I don’t think they know that much about the program.

Don believed that most of the stakeholder groups were unaware of the changes had been made, and why they were made. He did not suggest that the department should have done anything to change that. He was not certain “whether it is good or bad” that the administrators did not know what was going on. There were advantages to keeping a low profile.
Decision about IMP

I asked Don about the reasons he chose not to pilot the IMP curriculum for the 1995-96 school year. He said:

D: Last year I really didn’t have that choice; you had to go to the summer training program and I couldn’t go, so I wasn’t even given the opportunity. I was thinking strongly about it last year, but I couldn’t do it because I couldn’t do the training.

I: Would you have done the IMP if you had been able to go to the summer training?

D: I would have done it, I wanted to see what the program was like.

I: Were there some advantages that you saw with the IMP?

D: The advantage was the calculators, the TI-82s. Yeah, I wanted to be able to use those. And also having the written curriculum already done for you. I thought that it would be an advantage.

For Don, one of the advantages of piloting the IMP was that the teachers were given a classroom set of TI-82 graphing calculators. And Don would have liked to use those in his class. The other advantage he saw in the IMP was that the curriculum was already all laid out.

I asked Don if he had considered teaching the IMP curriculum for the 1996-97 school year. He said:

D: I think that since then I’ve changed. Seeing what has happened at our school with IMP. It doesn’t seem to be as successful….So now I kind of doubt if I really want to do it. If I get the choice, I wouldn’t want to do it, from what has happened this year. (Int.: 2/96)

Don had talked to the teachers who piloted the IMP curriculum this year, and from those discussions he believed that IMP had not been very successful. As a result, he decided to continue to teach the curriculum developed at Ocotillo High School.

Explicitness and Clarity
In the follow-up interview, I asked Don how he dealt with the lack of formal, explicit objectives and the lack of clarity. He responded:

D: I don’t agree with that. I think that the objectives are written down for each test. They give you the objectives that they want you to teach, or are supposed to be taught in that quarter. The first thing that I do when I teach the quarter, at least with the ASAP, because they are written down, is to check the objectives. Then I usually check the test also to see how they are applied in the final exam, and I go from there to make my lessons. So, I have no problem with the objectives. They are all written out in the ASAP, which objectives are going covered each quarter. (Int.: 2/96)

Don did not agree that there was a lack of explicitness or clarity in the curriculum. He looked at the materials provided with the ASAP exams and found the objectives which were covered, and then checked the test to see how they were applied. This seemed to provide him with all the structure that he needed.

I asked Don, with all the curricular changes which were to occur in the following year due to the state’s development of new standards, what the department could do to better support the teachers in the department.

D: Of course we are going to have to have the objectives written for each quarter. We’re going to need three or four tests for each quarter, at least, minimum, so that we can get away from teaching to the test. And we’re going to need to keep the curriculum intact for four or five years so that we have a chance to develop some lessons. The way that it is now, you develop a lesson, the ones I’m doing right now for the ASAP, and I know that they are, in a way, it is kind of a waste of time because next year they will all be changed. I’d like to see us stay with something for 4 or 5 years, even though we may make some minor changes as we see fit. So that I could see if I could develop some things and use it for 4 or 5 years and keep improving. (Int.: 2/96)

Don thought that the key would be to get the objectives and exams set for each quarter, and then keep the curriculum the same for four or five years. Making radical curricular changes all the time made it difficult for him. He preferred to get it set and then fine-tune it over time.
Classroom Management

In the follow-up interview, I asked Don about how the new curriculum had affected his classroom management. He responded:

D: The big change, of course, is in doing experiments (like the water draining out of the bottles). And I would really like to get to the point where you would start every class like that to demonstrate the objective, and then go from there, and see what objective could apply to that experiment. For me, I need to keep the curriculum the same for 3 or 4 years so that I could develop some of those. (Int.: 2/96)

Don said that he was doing more experiments or demonstrations to help illustrate an objective or concept. The demonstration method helped students see the concept, but allowed the teacher greater control of the situation, both in terms of what the students are to learn, as well as to the students' behavior. Don seemed to like this approach, and wanted to develop some more in the future, but again, he would like to see the curriculum remain the same for a few years so that he could fine-tune them.

Ellen

Whenever I walked into Ellen's classroom, I was struck by a sense of orderliness. Students were always quiet and well-behaved, and busily working on their assignments. Ellen would circulate around the classroom answering the students' questions. On the board were worked examples of problems, and the approach was typically one which focused on the computational procedure rather than on the conceptual understanding.

Ellen did not participate in the original planning of the new curriculum. Family obligations and time constraints contributed in part. Ellen had been successful with her students teaching from a textbook and using a more traditional, frontal teaching approach. On several occasions Ellen admitted that the thought of changing to a radically new way of teaching was intimidating. Ellen did not begin to implement the new curriculum until
the fourth quarter of the year. By that time, many of the activities had been modified to facilitate a more conservative approach.

**Opening Remarks**

E: OK. One of the things that I see in the class is that I see that the kids enjoy it more. There's a lot more hands-on experience, a lot more things they feel more comfortable doing, rather than just taking a book and turning to page 200 and doing 50 problems. And I see it as a benefit for the kids. The curriculum, I have no problem with. I do have a problem right now with the ASAPs. I'm not pleased with some of the ASAPs. I don't see it always as testing what I really want to test. I mean, I would like to see the test changed a little bit.

I: What would that include, what kinds of changes?

E: I think it would be a little more ... there are things in the curriculum that we do that are not being tested. There are some things that I work with them and they really get comfortable doing...like we did measuring angles and circles and radius and diameter and the only thing on the test is just replicating a picture and I don't know. I don't think that most of them would use a protractor to do it anyway. Most of them who are artists would just do it without even having to use a ruler or protractor or anything, they could do it without that. So I don't know, that's just an example from the first quarter that I just taught. So, I just see that we could probably write a better test— ASAP type, but a different test.

What else? I enjoy teaching it more. I enjoy it. I think that we could work a little bit more together as a department developing some more curriculum. Sometimes when I teach a quarter that I haven't taught before, I'm sort of, "What do we have?" I'm like, I haven't done this before so I need a little bit more direction. But overall I see it as a real benefit. I think we just need to work on some things together.

I: How do you define that benefit? Benefit how?

E: Basically, the only benefit, I'm not talking about to us as teachers, I'm talking about benefits to the students, is I find that they enjoy it more and they are learning more than if I'm doing just 50 problems of multiplication. I see that they are getting more of a benefit out of it as related to real-life experiences and things that relate to them and their lives and their families.
I: How do you see it in terms of its impact on you? You mentioned that it is difficult the first time because the materials not there. In general, though, how has it been for you?

E: For me? In general I would say pretty good. Even if sometimes I have to plan that morning what I am going to be doing that day. You know I get here and sort of panic, "What am I doing today", and, "I don't know what I am doing". But once I do it once, then usually I feel comfortable with it and so...I've enjoyed it, I actually do enjoy it.

In Ellen's opening remarks and in the clarifying questions, she emphasized three points. The first was that students enjoyed the new curriculum more, and that she enjoyed it more. Second, the ASAPs did not align with the instructional activities as well as she would have liked. The ASAPs were the performance-type tests which the state had mandated be given to students, and on which the students had to demonstrate mastery. Because the mathematics department followed an outcomes-based philosophy, the teachers were faced with a dilemma. They could administer the ASAPs in addition to the quarter exams which they had created, or they could administer only the ASAP and use it for the quarter exam. Giving both tests would take away from instructional time and increase the amount of time teachers would be grading exams. Giving only the ASAP meant that the curriculum would have to be modified somewhat in order to accommodate the objectives inherent in the test. The teachers opted for using only the ASAP.

The third point Ellen made was the need to work together as a department to develop more activities. Most of the discussion took place informally, at lunch or after school. Ellen ate lunch with her friends in other departments. After school she either attended meetings related to her work with the Agave Teachers Association, or she remained in her room working on lessons or tutoring students. As a result, she tended to miss out on the discussions among the teachers on issues of mathematics and mathematics education. But it was out of those informal discussions where teachers' viewpoints were expressed, and where the direction of the department was negotiated. The teachers
pushing for change got a sense of how far, and how fast, the department as a whole would be willing and able to move.

Criteria for a Successful Program

I: If you were to compare our program with another program, what would you look at? What criteria would you bring to bear?

E: I think mostly, how much the kids are getting out of it. I don't know, I think that it's something you cannot test. You know, how much are the students getting out of it? Are they enjoying it? Are they learning things? You know, the two go hand-in-hand. And I don't think that it is something that we can necessarily test, or determine off hand.

I: If you could create a curriculum of your own, what would it look like? Would it look like this?, would it look more traditional?

E: Actually the truth is it would be a blend of the two. I'm real happy with the Pre-algebra curriculum. I have some reservations about the Algebra and Algebra II, only because it has not changed at the college level and they still have to take SATs and ACTs and they have to take those types of tests and I'm afraid that we are disadvantaging them doing basically ASAP-type activities. So, I am a little fearful about that. So I would like to see a combination of the two, especially in the upper levels of Algebra and Algebra II and Geometry.

Ellen stated that there were two criteria by which to judge a curriculum: enjoyment and learning. She saw these two criteria as being connected.

The second issue which Ellen raised concerned the dilemma faced by many teachers who had become involved in mathematical reform. It was certainly an issue raised by several teachers in the department. Should the curriculum teach those things which will help the college-bound student do well on the college entrance exams, or should the curriculum cover those things which have a greater application? Most teachers agreed that it was virtually impossible to do an adequate job at both.

Standardized Tests
I: What do you think about its impact on standardized test scores? Do you think that there is a difference?

E: Standardized tests, well it depends on what kind of standardized test. I think that if we are talking about the state-mandated ASAPs then our students will be more prepared for those. But if you are talking about the multiple choice type of tests, then I think that our students will be more impaired. They won’t be used to those types of tests and they be used to rote type of activities which those tests usually test and I don’t think that our students will do as well. So it depends which type of test they are being given.

I wanted to pursue Ellen’s view of the testing dilemma a bit further. I asked her, “Do you think that the traditional stuff should be done because it is on the test and because it would help them on the test, or because you think that it is important in general?”

E: I don’t think that it is important in general, but because of society and the way that things are right now, and that even though things are changing, it hasn’t changed yet. They still have to fit into the system, and they still have to get into the best college that they can and all that kind of stuff. I want to help them do that; I don’t want to disadvantage them. For Pre-algebra I’m very happy with that, but in the upper levels I would like to see a combination of the two programs.

College admission and scholarships were often tied to a student’s performance on these tests. Whichever way teachers chose to go on this issue, it required a lot of soul-searching.

Success Rates

I: What impact do you think that it has had on success rate? Have you noticed that your students are more successful, less successful?

E: I don’t know. I don’t think that we can actually measure that. The tests are completely different. Our grading is completely different, we used to do 60% was passing and we have a completely different grading system. So, I can’t actually compare the two. I don’t see that there is any way to do that.

Ellen saw that differences between the old grading system and the new grading system made any comparison of the two programs based upon the success rates invalid.
Equity

I: Do you think that there are any groups of winners or losers? Sometimes they talk about differences between males and females in math, in differential effects. Do you think that this program has helped or hindered any particular group? Any differences between males and females, between the old program and this program?

E: Actually no, I don’t see any. I think that it was in the third quarter when I was doing construction-type activities, the girls seemed to enjoy it as much as the boys. At first I thought “Oh no, the girls are going to hate this, you know, and not want to do this, but actually I didn’t notice any difference and actually the girls received it as well as the boys. And they were going, “Are we going to have to figure out how many bricks? and ...”. No, they weren’t like that. So my initial thoughts about it were completely different than what actually happened.

Interestingly, when teachers mentioned potential sources of gender inequity in the program, they cited the example of the building project. It seemed that avoiding a unit on building out of fear that the girls would not be interested in it or would not do as well with it, would validate the claim, and perpetuate the practice that the building trades are a males-only domain. By teaching it to everybody, the message became that these occupations are for everybody. It was a promising sign to see that the girls participated in these lessons as actively as the boys.

Mutual Adaptation

I: Sometimes we go about changing curriculum and sometimes after doing the curriculum we are, in turn, changed by the curriculum, by what we are doing. Do you notice any differences in the way that you look at curriculum, or look at the way that you are teaching, or anything else?

E: Yeah, I’m more aware of things that I do that promote more thinking activities. And I’m more aware of the more rote activities, especially with the Algebra and Algebra II. So in actually implementing the Pre-algebra curriculum, I’m more aware of what I am doing in the upper levels, in trying to get more thinking skills in those areas also.
I: What were your first impressions of the program, before you started teaching this, but you saw others getting started, what were your initial impressions of the Pre-algebra program, and then at what point, if it did change, at what point did it start changing?

E: The only thing I saw... I was a little fearful at first, only because I wasn’t familiar with it. I was used to...I know what first semester is; I taught it before; it’s what I am used to doing; I know that assignment 12 is on page such and such. So I was a little bit fearful. But I didn’t have other impressions about it, other than I wasn’t comfortable with it at first because I didn’t know what it was.

Ellen’s comments were reminiscent of the Stages of Concern model (Hall & Loucks, 1978; Hall & Hord, 1987) which described how teachers involved in implementing a new curriculum go through several stages of concern. Ellen began by not knowing much about the new curriculum. She was uncertain about how to teach it because she was unfamiliar with it. But eventually she began to focus on the impact the curriculum has on the students.

Stakeholders

I: How do you think that parents and administrators and others who are interested (or may not be interested) but are certainly affected by what is going on, directly or indirectly, how do you think they perceive what is going on?

E: I think that most of the parents don’t really know what is going on. Honestly, I do think that most parents are not involved in their children’s education. So I would say that most parents don’t know. And that the ones that do, most of them receive it pretty well. When you explain it to them, they’re pretty happy with it. Sometimes it comes in the form of their student did not pass and so now they want to know what is going on. But once you explain it to them, what is going on, what the program is like, they are usually pretty receptive. So parents take it pretty well.

Administrators? I don’t have the vaguest... I have no idea what goes on in their minds. I don’t know.

I: Have you noticed any changes in your perception of what the administration wants?

E: Actually, no, no. I don’t pay too much attention to them anyway so I don’t know.
Ellen echoed the sentiment of others, that parents were generally not involved in their children's education. Ellen also described the us-them division between teachers and administrators. There was no indication that she had any particular administrator in mind; it seemed to be about administrators *qua* administrators. This view might also be related to her work with the Agave Education Association.

**Decision about IMP**

When I asked Ellen about her decision not to become involved with the IMP program, she told me that she did want to do the IMP program for the 1995-96 school year but that she was unable to rearrange vacation plans in order to participate in the summer training program. She said that she wanted to do the IMP for two reasons. The first was that the program was "all laid out for you". Having the program packets available would have suited her style better than trying to look for around for materials.

The second reason Ellen gave for wanting to do the IMP was the classroom set of graphing calculators which are a part of the program. Ellen said that if she were to be given the opportunity to teach the IMP in the 1996-97 school year, she would do it.

**Explicitness and Clarity**

Ellen said that the most important thing that the mathematics department could do would be to keep all of the materials centrally located, and to have some way of networking with each other so that everyone knew what everyone else was doing. Her greatest concern was the lack of clarity and explicitness in the program.

**Frank**

Frank took a more *laissez-faire* approach to teaching than most teachers had. He presented the lesson in the first ten minutes or so of class. After that, he made the assignment. Students who chose to work on the assignment, did so; those who chose to seek the teacher's help, did so; those who chose to do nothing, did so. Frank valued self-
motivation and perseverance; he wanted students to develop a strong work ethic. Frank had pulled himself up by his own bootstraps. In addition to teaching, he worked a second, part-time job.

Frank did not participate in the planning of the original curricular activities, and he used them infrequently. Instead, he typically took a very traditional approach, concentrating on computational skills. He waited until the fourth quarter to implement the new curriculum.

Opening Remarks

F: I guess the first experience that you have is frustration. There's no question about it. Frustration as far as what the expectations are. And even within expectations, what you classify as success and non-success. I think that once you've established that, at least, then your next headache or obstacle is actually getting your curriculum ready for success. When you use a textbook, or when you use a curriculum with a list of objectives, it doesn't even have to be a book, then you've already identified what the goals are, and thereby you prepare for success toward those goals.

When you have something which is no longer controlled, as far as mathematics, now you're talking about an English barrier, or I should say a language barrier, and comprehension of the individual, as far as the world around him because you are trying to apply things which are around the student's everyday life. Well, they're not all the same. Some kids have never picked up a screwdriver, or don't tell them what a hammer is because he doesn't know what a hammer is. That's one of the faults with it that I've always known. Because if you say that you're trying to make it relevant to a student, well a student's world, is... Well, it's the individual's..., it's every single kid walking in here. Relevant, relevant..., if you were to talk about..., if you were to go to the extreme of drugs, there are some who have never worked with drugs, so they wouldn't know what you are talking about. You could be talking about money and some kids have never handled money. Mom buys me whatever I want, whatever I want Dad gives me; okay, so there isn't any particular field that you could say that this is relevant to kids. No, you're not. That's what books did anyway. They tried to get you word problems that are relevant... So you can try, and you can try to inject that with your enthusiasm but there are still going to be people that say, "I don't know what you are talking about. And it doesn't mean anything to me."

And so, as far as the curriculum, like I said, success and the preparing for success, the relevant is always important and always good, but you are not going
to find things that everyone is excited about. Even with some project which is very fascinating, and most kids would agree, but you are going to get a certain percentage that don’t agree. They know that are never going to build a hot-dog cooker so they are not excited about that.

In his opening remarks, Frank made two points. First, he described how the new curriculum was frustrating to him. He believed that the goals should first be established, and then a detailed set of formal, pre-specified objectives. Second, he expressed the view that no matter how the new curriculum attempted to be relevant to the lives of the students, no curriculum would be relate to every student.

On the surface, Frank’s criticism of the new curriculum might appear to be somewhat disingenuous. By the time the fourth quarter of the school year had come around, the course had already been taught three times. There were three-ring binders available which contained the original activities, along with modifications made by the teachers who had taught the course. And, in fact, there was actually a set of objectives, written *post hoc*, to go along with each lesson in the first quarter of the curriculum. Finally, the quarter exams were also available to him prior to the first time he taught the course. Later, when the ASAPs began to be used as the exit exams, the objectives which were to be tested were listed on the first page of the teacher’s guide; and he could see from the questions what needed to be taught, as other teachers had done.

On the other hand, it would be unfair to expect that the teachers who did not participate in the curriculum development and did not struggle with the curricular issues to have the same level of understanding as those who did. The teachers who participated in the curriculum development were in a better position to create a curriculum which matched their philosophy of mathematics education and their preferred style of teaching. Those who were not involved in the process were, in effect, forced to make greater adjustments.
Finally, the techniques needed to teach for understanding and conceptual knowledge were not the same as those required to teach the procedural knowledge associated with teaching from a mathematics textbook. Lessons based upon a textbook tend to be reductionist, as each lesson focuses on a single objective. On the other hand, the emphasis of the new curriculum was more holistic; a single lesson attempted to make connections among multiple objectives. Thus, the objectives in a lesson may not be transparent to all teachers. Seen from this perspective, Frank's criticism was not unreasonable.

Criteria for a Successful Program

I: What are your criteria for what is a successful program?

F: I think that a student should learn to be resourceful and adjust to all environments. It is not a matter of whether it is relevant or not. It's this is the objective given to you. Whether it is this teacher or that teacher, this employer or that employer, this supervisor that supervisor, you have to adjust to your environment. I don't like accepting that this teacher is more exciting than you are, or this project is... I don't care. If this is your obstacle, than this is what it is.

Whether you continue higher education makes no difference. If you continue your higher education, the one thing that you have to learn is to be persistent. It's got nothing to do with education. You may have a terrible background, if you are persistent, then you will be successful. In business, you can talk to anyone that has made it the long way, to a million bucks. He may not have made it the first time; he may have made a million bucks and lost it, and the second time around he says it's easier. I believe it, but it's the hard knocks, being persistent. It's got nothing to do with the curriculum or the teacher, it's getting our people used to, hey... You come in, you have to communicate what is expected within that structure, but they have to comply.

Frank seemed to be saying that the curriculum was of minimal importance; that what was most important were the life skills of being persistent, doing your job, being on time, and so forth. It was unclear to me why, under those circumstances, a teacher would need objectives. One could argue that those life skills could be taught just as easily by
having students dig a ditch, as by sitting in a classroom learning mathematics. So I asked him, “Would you say, then, that the curriculum doesn’t matter?”

F: The curriculum doesn’t matter when you are hopefully looking at something which is long-term, like they follow through, and build like building blocks. A student must understand, and hopefully appreciate that someone’s already taken care of that part. He doesn’t have to worry about that part. But a student does have to understand that whatever he is given, he must do the best he can with that. It doesn’t matter whether it is Teacher A or Teacher B, or if Teacher A is much more colorful than Teacher B. Hey you got to learn that material, and what I am hoping, is that regardless of what the material is, that it is a building process. That’s when you run into trouble with new curriculum. You got Teacher D not going along with the programs that A, B, and C are doing. It doesn’t work, you’re building... The student gets B, A, and C, and then gets D and it is totally different. It can be presented differently, but as long as the objectives are building on previous objectives.

Now, how you present it is up to you; that is the freedom of being a teacher. You can’t have a principal that is going to say that you are going to do it this way, or a department head, or anyone. You have to have that freedom because if you get excited about the way you are doing it, then you will do a better job; there’s no question about it. It doesn’t mean that you are going to have better success with students, because students receive you in different forms anyway. We know already from studies that if you are more attractive, the kids will respond to you more...than if you are less attractive. But that has nothing to do with curriculum. We do want to build it where it is along a certain line, asking minimal objectives that keep building.

Frank’s comments to students preferring Teacher A or Teacher B might refer to the fact that students often talked openly about preferring one teacher to another; or how one teacher was more interesting or “colorful” than another. Frank believed that later in life, people have to be productive regardless of who their boss is. He expected students to accept the responsibility for doing their work. On other occasions Frank said that in life, it was ‘no work, no pay’; in school it is ‘no work, no pass’.

It appeared that Frank’s metaphor of education was ‘education as an assembly line’. To Frank, the purpose of the objectives was to design the factory so that the raw materials could be assembled in the correct order. It was the teacher’s job to make certain
that each raw material was available according to the design, and then, in his *laissez-faire* approach, it was the student’s responsibility to take those raw materials and assemble them. Objectives were important to Frank because they informed him about what raw materials the student already might have already assembled so that he could have the next ones available.

Frank’s concern was the concern that other teachers have aired, and that was that they were not certain what knowledge the students who were coming to them possessed. This was very clear from his closing remarks to the first interview:

I: Was there a question I should have asked, but didn’t, that you would like to address?

F: No, not really. My biggest concern, getting back to the basic, is that as fearful as we are in listing objectives, we have to have objectives. And it has to cross-reference. It has to cross-reference for ASAP, it has to cross-reference for us as a department, and you could put the state essential skills. It’s real easy to say that the ASAP list the essential skills, they are not clear. They are not clear to what extent, at all. We need to sit down and realize that..., we have a necessity to understand volume, why? Well, because in two quarters later they are going to use volume. Well a real good example would be the Pre-algebra where they are talking about finding area. And it’s essential that they understand area because area is going to be involved in finding volume in third quarter. And third quarter they are going to have to have an understanding what area is, to change it to a volume to change it to a liquid volume. But if they don’t understand area, then now we’re talking about just going through a process without knowing what is going on. Now if you’ve got that, then you can actually have a teacher work on area and have enrichment skills where they put not where they have to learn it, but if they catch it then fine. It’s great enrichment. But at least when they are drawing on that it “Yeah I remember that.”

According to Frank, the purpose of the curriculum was to make certain that the students got things in the right order. This was especially true for teachers who held to the traditional view of mathematics education. For instance, using Frank’s example, the traditional view would be to teach area prior to teaching volume so that students would be able to manipulate the formula:
Volume = Area of the base X Height

But from a constructivist approach, the progression from area to volume is not necessary. Students could just as easily view volume as a process of counting unit cubes. One simply counts the number of cubes in the bottom layer, and then uses that information, along with the number of layers the object contains, to find the total number of cubes in object. In this case knowledge of area is not prerequisite to learning about volume.

Standardized Tests

I: Do you see any difference in standardized test scores and is it a priority?

F: For me, they are not priorities. That’s one of the things that coming from this school system and this community that the most important thing (other than a student being able to adjust to his environment, given whatever the environment is) is that he be given quality education. If you are given quality education, which you haven’t been given, then you are going to have failure, a large failure percentage. That’s fine, that’s part of change. So I’ve never worried about that.

If you are talking about standardized testing, I think that the (student) population we have now are not concerned about those results. So that testing will not mean anything, so you’re not going to get a true result. It’s just not important. So any of that testing that you do, you are not going to get true results, because the student that is giving you that result doesn’t care. So success in failure rate, as far as the district is concerned, that’s foolish too. Because now you are complying with parents’ demands and administration’s demands, and you are not giving a true grade. In other words, I’ve always maintained that it is the silliest thing to go around with a bumper sticker which says that my student was a success at elementary school when they are two years behind in education. So why is it wonderful that they are getting straight A’s in fourth grade doing second grade work. That has no value. The most important thing is the standards be there. Now if we do not have a superior rating, that’s fine, we know that what is being put in front of them is quality. They are not receiving that high, high standard, but whatever they are getting is quality.

There were several points which Frank made which should be examined. He said that the students did not value standardized test scores, and as a result, they chose not to take them seriously. Thus, the test scores could not produce a valid picture of the students’ educational opportunities.
He explained that, in trying to establish a quality education, he expected to have a high failure rate, and that was acceptable to him. In fact, Frank’s failure rate was often the highest in the department. It was not uncommon for his failure rate to run 80%, 90%, or at times 100% of the students in a class.

Frank argued that failure rates were also an invalid indicator of the quality of the curriculum, if high grades are given out simply to comply with “parents’ demands and administration’s demands”. To Frank, high grades do not necessarily indicate a quality education. I pursued this notion of a quality education with him.

I: How would you define that quality? If you have two different curricula, how do you say that this one has quality, and this one does not? For instance, if we are interested in quality in the Pre-algebra program, what would that look like?

F: I think that setting that standard is not something which can be done immediately. I think if you were to ask a teacher, he would be foolish not to take time researching it and setting up and establishing these are the minimum standards we want; this is going to lead into our Algebra and this will lead beyond, whether it’s Geometry, Calculus, or college. And with the understanding that this is the minimal standard to be functional mathematically in society. Not that you have to go to college, but that you are functional. Whether you become a carpenter or mechanic, whether you become a bookkeeper, this is the minimal math which is required for your daily life. Checkbook, or buying some tiles at home, painting a room, all these should be minimals. All these should be met in Pre-algebra. That, to me, would be a quality Pre-algebra. Because Pre-algebra, from what I would interpret it is a repetition of the math they learn through the eighth grade. So all the basic skills that you learn in K through 8, and you do have a repetition.

I: Do you think that what we are doing now is leading to that quality, or do we need to make changes?

F: Yeah, I think as far as the Pre-algebra, I think so. The more applied is more towards the understanding, which is crucial. I agree with the notion that you have to have hands-on to understand; not that every kid will understand or not every kid will appreciate what is coming across. But I also know that we can’t leave some of the basic drill skills because you have some students who are still learning to master the testing by drilling—realizing that to find out the number of BTUs you need to heat up the water in the swimming pool, all you have to do is
multiply everything. They have no idea that you change a length, to an area, to a volume, into a volume in gallons, to BTUs needed for the gallons by the temperature by which it is to be raised. All they know is to multiply everything and that is your answer.

So the idea is good, and it is being applied, but the kids are also getting it by doing it the way they did when they were doing back to the basics. And there is nothing wrong with it only, the key is for them to understand every step along the way....

Frank said that the hands-on activities were necessary, but that basic skills were also important. His reference to the "swimming pool" problem came from a question on one of the ASAP tests in which some students had learned from their classmates that all they had to do to get the right answer was to "multiply all the numbers together". Most teachers in the department later required the students to provide a full explanation as to what they were finding every step of the way, or they would not get credit for the problem.

Before leaving this issue, I asked Frank:

I: If the district were to bring in an outside evaluator, do you think that they could tell you something about the program that you did not already know, what might that be?

F: Well, if we had someone come in from the outside and try to improve on the direction of what we are doing, again, not the styles. You leave that styling to each individual.

I don't need a book, but I do need objectives. Very clear precise objectives. Now, how I present it should be totally open to the individual. I would like to be able to read the objectives and understand the objectives—that this objective is going to help me see that I am going to need it for this coming section of these mathematical skills, and the following one, and that it's going to depend on the two previous ones to add on. And it not as simple as a one-line objective....

In laying out the curriculum you have to get together and have at least an agreement that this is probably the best, or this is the way the majority of students see it. I think that if I am going to say that I am successful, it's not for my colorful way or the way I dress, or anything.... it's that kids learn from me because in my presentation, not the activity, not the exercise, it's the presentation was relevant to their previous experience. Now their previous experience may not be hands-on, it
may be of what they've learned. But when we change this curriculum, now I really
don't have anything to draw on. I'm not sure...

One of the things I always feel proud of is when a student leaves my class
in the old curriculum, under the old objectives, I knew that I had covered them.
There may not be an “A” in there because there wasn’t anyone who knew all the
objectives that I wanted and I presented them all. So when another teacher gets
them, they know we covered them. You can build on, they know we covered that
plus more. Where we break down is when we have those links which are not very
strong or completely closed then the chain breaks. There has to be a complete
ring, a complete link.

My emphasis has always been that if a child could get an “A” in my
Algebra course, there’s no question he could go to any other high school in the
area, and he will get his “A”, there is no question about that. If a student gets a
“B” in my class, he will get a “B” or better in any school he picks here in the city
as long as it is labeled the same.

That’s always been my emphasis because that is a proof of quality—that
you put out something that may not rank as the best but is quality. I mean there is
no question about it, it is a well-made item. And that is more important than
passing. There’s no question about it. That you have done your part in getting
them to that level, or whatever the student selects as being his level, that the
curriculum was there and you did that layer of foundation that should be solid if
that’s the markings that you give. If you are saying that he is a “B”-type
foundation, he’s a “B”-type quality that is necessary to be successful versus if you
give him an “A” but the quality is not there. Well that’s fine and dandy. It keeps
administrators happy, it keeps parents happy, but it does nothing for the individual.
And it does nothing, nothing, for the quality of education. On the contrary, it
reinforces the labeling that education is very poor. And that was the big argument,
going back to our faculty, that I recall, that we are giving too many inflated grades.
The way that I see it, we have high Fs and low Fs and high Fs are As. Now wait a
minute, a high F is an F. I don’t care if it happens to be eighty percent of your
population, then so be it. If we all do it, if education does it across the board, then
we start to realize that there is a problem, when certain departments have quality
standards and others don’t, then whoever is not having success, then it is their
problem.

It is important to put Frank’s remarks in perspective. Frank graduated from
Ocotillo High School. The school was located in a lower socio-economic neighborhood
and the students’ performance on the standardized tests had always been among the
lowest in the city. As a result, he felt that when he was at the university, he was not given
the respect that he deserved. He believed that he had earned his grades, but that grade
inflation had robbed them of their value. Ultimately, grade inflation hurts those who work the hardest for them.

**Equity**

I: Do you see groups of kids that are more successful with the new program, and the flip side of that, kids who are less successful?

F: I think that it is always going to be a flip of the coin. You will always have some kids who are going to be more successful and some who are less successful.

I: Are there any groups of students, and categories of students that you think that we might not be reaching? For instance, do you notice differences between males and females?

F: Not from my method of teaching. I can think of a different type of teacher who would have a less successful group. If a teacher was the type of teacher who was very structured, and had notes and had steps, and they were to go to something like this which is hands-on, it would be very hard. If a student was the type of studious student who always needed notes and preparation and studied from his notes and built on that, it would be very hard, because this is shooting off the hip, building on previous experience, and each individual student is different. We're not talking about mathematical experiences, we're talking about worldly experiences.

For me, I've always shot off the hip, and I've always tried to maintain something which came natural, rather than trying to have a lot of notes. That doesn't change anything. The thing that is frustrating is that curriculum is identifying this is what I want to get. What steps do I take to develop that? That doesn't come that natural. Especially when you do the hands-on. The hands-on is supposed to give the relevant. I'm convinced that there is a large chunk of kids that it is not relevant, then you need to get something which is maybe a bridge in between that, to bring them up to that. So the kid that was structured toward success in the old system is going to have trouble changing over. After a while he will get used to it.

But the biggest question is (I'm looking big picture here, not big picture as long-term as an adult, but big picture as toward college) that the colleges and universities have not changed. We keep saying that there are some that are changing and we are forerunners; that's fine. Now we have to believe in that. Just like we have to believe that society is changing. Fine, we know that it is changing. But is it changing the way that we think it is? Well, there's only theories. There's definitely changes, but whether it is long-term? I don't know. I
do know that it is in process, and that makes it very hard for this hands-on stuff because it is not very practical for most universities and their entrance exams, for the tests they use as entrance exams. Not practical at all, and they are not being prepared for it.

Frank did not think that the curriculum produced differentiated effects due to gender. Frank was concerned, however, about the student who was used to learning mathematics in a structured environment, who must now try to learn mathematics differently. He was also concerned that the students who were going to college would be at a disadvantage because the colleges and universities had not yet changed their entrance and placement exams.

**Amount of Work**

**I:** Is it more work?

**F:** It’s no question that it is more work. Anytime that you change the curriculum it is going to be more work. It’s not a question of good or bad. You said, “Is there going to be more work?” Change is always more work. I don’t care what you are teaching, what subject you’re teaching, if you are going to make a change then it is going to be more work.

Frank was not specific about how the new program had been more work for him. Certainly he had to make some adjustments in his teaching, but to my knowledge, he had not created any new lessons to share with the other teachers.

**Classroom Management**

**I:** Do you notice differences in classroom management?

**F:** Classroom management for me hasn’t changed any. I can add a bonus to it. The nice thing is you can always give a word problem. I still use the text and draw from it once in a while. I’ll ask for a particular problem out of the book and there’s no argument, they’ll do it without even thinking about it, whereas before you didn’t win, there was not even an attempt. If you are structuring towards that and they know that they are going have to go through it and to be responsible for it. So, it that case it made it easier. But day in and day out? No. I don’t notice any change.
Frank had not made many changes in the way that he conducted class. He did some of the activities from time-to-time, but he would occasionally do activities even before the department adopted the new curriculum. He did say that the students were willing to do word problems from the book, whereas, in the past, they would not attempt them.

**Mutual Adaptation**

I: Sometimes we change curriculum and sometimes we are changed in the process, we adapt. Has this changed you?

F: Not me in as far as teaching styles, no. I've always maintained that you can only keep the attention span of students for a short period of time. So as far as presentation, or whatever we are doing, its always been the same, it is minimal. I have them learn from their own experiences, whether it was from a book or hands-on, it's their experience. It's not what you tell them to experience, it's what they experience. So that hasn't changed any. It's changed where I've had to do a lot more work to see where I can see a project which is relevant to what is going to be asked and identifying possible problems in a language, or how something is presented....

Frank explained that the new curriculum had not had any effect on him. He had not changed to accommodate the new curriculum. Before the new curriculum was written, Frank would occasionally do some project or activity, but he would generally have students do the traditional computational problems. Even though the students were taking a different assessment, he continued to teach the material in essentially the same way.

I: Do you think that you would be just as comfortable doing the traditional stuff as doing the new curriculum. Do you have a preference?

F: I don't have a preference, but there is no question that I would be more comfortable in the old form only because I was there longer, and I got past those barriers of frustration. I knew exactly what my objectives were and how to prepare for them. The new curriculum, it takes time, but if there is going to be a
question about harder or easier, I would have to get to a point where I am really seeing that the curriculum does develop one step at a time. As far as how it’s done, doesn’t make any difference. Whether it is projects or not projects, getting out there and doing hands-on, that’s fine. It is only relevant to certain individuals, but it will never apply every single kid.

Frank said that given a choice, he would teach the old curriculum rather than the new curriculum, citing many of the reasons he had already discussed.

**Stakeholders**

I: How do you think that administrators and parents view what we are doing?

F: I think that we have a blessing there. First of all, if you are talking about in this school, and in this environment, you have a community which is pretty much dormant, as far as its involvement in school. You can do almost anything that you want, within reason. It can be good or bad and there won’t be any resistance. There’s no special interest groups, there’s no alumni, there’s really nothing there. There are individuals which can be a headache, but they are minimal because they are usually, as individuals, looking for themselves, not the curriculum. If they are going to be critical, they will be critical about anything they can find, but they are not critical toward the education. We don’t have that problem.

The second blessing we have is with everything changing towards that, or perceived as changing towards that. The administration is more than willing, is my perception, are willing to go along with anything that is going to help towards that change. It may not be popular, but you would have to be a fool not to realize that if there is going to be change, you have to have people who are willing to change it. You may realize down the road that, oops, we overdid it. No, that’s not quite the right turn, but there’s a change coming and you have to have a change in curriculum for that change.

You’re always going to have dislike from any teacher that is changing from what they are used to; it’s going to be uncomfortable. One of the things you have to do is expect from them what you expect from the student to adjust to the environment you are given.

Frank said that the community was ‘dormant’, and Frank considered that non-involvement a blessing, because a teacher, or a department, could do almost anything without interference. He viewed the administration as being willing to support change. But he also viewed their support as being politically motivated; that it is a politically popular thing to be for change, without knowing the details of the change.
Decision about IMP

I asked Frank about the reasons he chose to pilot the IMP curriculum for the 1995-96 school year. He said:

F: Just, for me personally, I have to have more to draw on. I'm not sure that I have the depth, compared to some people in the department, mathematically. What I want to be able to offer is more examples. What you guys are doing, with modeling things, is better. I've always believed that. But the modeling has to be sometimes simple enough that our kids can understand it. We start to use models that sound great, and for us they are a real challenge. But for the kids, it is so far out. The modeling that we try to do with the kids for the A2 [Algebra I-Quarter 2] and the formulas, you try to come up with a business of their own. The imagination for them is blank. How can you begin to develop formulas if they can not even picture what it takes to run it. With the IMP what I was hoping for was another battery of information and examples. Not that that is the answer, but what I found out is that they have some really neat models....The jury is still out as far as, are they are they are retaining it, are they really learning it, if it is really long term. Is it, are they going to remember the stories and come back and remember the mathematics. (Int. 2/96)

Frank did not think that his background in mathematics allowed him to be as familiar with aspects of applied mathematics or mathematical modeling to the same extent as other teachers in the department. He felt that the IMP curriculum was more accessible to the students than the one developed by some of the teachers at Ocotillo High. But the IMP curriculum had what Frank considered to be “some really neat models”.

In the second semester of 1996, the number of classes doing the IMP pilot was reduced, and Frank chose to let the other teacher continue to teach the bulk of those classes. He only requested that he be able to keep one section of the IMP so that he could try out all of the units. I asked Frank if he planned to teach the IMP curriculum for the 1996-97 school year. He said:

F: Yeah, I'm a team player, I'll go either way. I wanted to keep my hands in it, I said that I wanted just one class. I'd just like to continue to go with it, it doesn't have to be all classes. I want to see where it is going. (Int. 2/96)
Frank was indeed a team player in that he took whatever classes the department needed him to take so that other teachers might be able to get their preferences.

**Dealing with Change**

I: How have you dealt with all of the changes?

F: I think that it is very hard. On a personal observation, with all the changes, and I’m not the type of person that was structured to the book even when we had a book. It makes it hard to go back to previous assignments, make-up things....So the changes don’t really bother me....

With IMP you were supposed to get an extra planning period, and it was necessary because of all the writing they ask, and the amount of reading. They have their book, but it doesn’t have answers. It is open-ended. But when you get kids answering things, now you are looking for their creativity and understanding. And if you listen to them, it can add to your own creativity. But I haven’t had that time. So that’s a shortcoming, if you are just shooting of the hip, real quick like, you don’t really get the depth that I would like them to learn, to see them apply. (Int. 2/96)

Frank brought up a point which the other teachers had also brought up in conversation, but did not mention in the interviews; and that was that with the new curriculum, it was very difficult for students to make up assignments after they had been absent. But apart from that, Frank said that the changes “don’t really bother me”.

In the follow-up interview, I asked Frank to suggest some things that should be done to support the teachers if the curriculum changes again with the introduction of the new essential skills from the state.

F: Not only listing the objectives, specific examples of objectives and then open-ended examples of using those objectives. Even the objectives now as they are listed... You have to have a feeling that I am doing the same thing as everyone else. As a teacher, you’ve always been given that freedom....(but allow some flexibility) to set framework. There has to be a list of minimal objectives so that you can get your time-frame. (Int. 2/96)
Frank again repeated his concern that any new curriculum specify the objectives which are to be taught, but leave the selection of the specific instructional activities to the teacher.

Comparison of Responses by Topic

In the first section of this chapter, each of the teachers expressed his/her views on a number of similar topics. But at that time I made very few comparisons. I wanted the teachers to be able to voice their own opinions, and I also wanted the reader to make his/her own comparisons. Now it is my turn. The purpose of this section of the chapter is to compare the views of the teachers in order to understand the evaluative frameworks which the teachers used to evaluate a curriculum developed within their own department. On some issues the views expressed by the teachers shared much in common; on other issues, their opinions spanned a broad spectrum. In this section of the chapter, the views of the teachers were stated more succinctly. The reader is encouraged to refer to the preceding section of this chapter in order to place the teachers’ comments and views in context.

Opening Remarks

The first question was intended to give teachers an opportunity to talk about their experience with the new curriculum. The question was purposely vague and unstructured so that the teachers would feel free to talk about those things which they considered most important without the imposition of the interviewer’s framework. It was apparent that they, in fact, did so. Each teacher discussed themes to which they would later return.

As one compares the teachers’ opening remarks, there were notable differences between the views of the three teachers (Alan, Barbara, and Christine) who had taught the new curriculum from the beginning, and those teachers (Don, Ellen, and Frank) who delayed until the third or fourth quarter.
What was particularly interesting about their opening remarks was that when the teachers were asked about their experience with the new curriculum, the first thing that Alan, Barbara, and Christine related was the impact of the curriculum on student learning and understanding, and student empowerment. On the other hand, Don and Frank first talked about the impact of the program on them as teachers. Don referred to the amount of work, and Frank expressed his feeling of frustration in teaching a curriculum with no apparent goals or objectives. Ellen talked about a variety of issues, including the effects of the new curriculum on the students, as well as its impact on her. She mentioned that the new curriculum was more enjoyable to the students; although one could not tell whether this was important to her because it would result in greater student learning, or a friendlier classroom environment.

These differences in the opening remarks of the teachers would not be nearly so significant, if it were not for the fact that the teachers often returned to these same themes. It was not surprising that Alan, Barbara, and Christine would hold a more positive view of the curriculum than did Don, Ellen, and Frank. After all, from the beginning, they had participated in the development of the course to a larger extent than have Don, Ellen, and Frank.

Criteria for a Successful Program

I had asked the teachers to talk about the criteria they would use to judge a curriculum. The teachers indicated a wide range of criteria, and again there seemed to be differences in emphases between the teachers who implemented the curriculum from the beginning and those who waited.

Alan and Barbara both focused on affective indicators, like enjoyment and perseverance, as well as understanding. Barbara, like Adam, relied on talking to individual students to determine what they know. Christine focused on “long-range goals”. She
believed that the goals of the curriculum should be to prepare students for the future. And this meant helping each student become “a problem-solver and independent thinker, a reasoner, an analyst”. It was unclear how she would determine whether these goals had been met.

Don thought that the evaluation of a curriculum should include SAT scores for college-intending students, and possibly some other test for the other students. He also mentioned that another criterion might be how well the students enjoy the new curriculum. But Don was also interested in long-term goals. The criterion he considered most important was the feedback from students five years after graduation. He wanted to find out what the former students thought about how well the program had prepared them for their future jobs. Ellen stated that there were two criteria by which to judge a curriculum: enjoyment and learning. She saw these two criteria as being connected. Ellen raised a second issue. She was concerned that the curriculum ought to help prepare students to score well on the college entrance exams. Frank said that “a student should learn to be resourceful and adjust to all environments”. He emphasized the development of life skills or job skills, such as being persistent, doing your job, punctuality, and so forth. His criteria for a successful program did not mention anything which had to do with learning or understanding.

Again, the focus of the group of teachers who developed and implemented the curriculum from the beginning differed from the focus of those who were more reluctant to implement the new curriculum. The first group seemed to emphasize criteria which focused on cognitive development, especially as it related to students developing meaning and understanding, and being able to apply that knowledge in different settings. Even when they discussed persistence and perseverance, they talked about it in terms of mathematical power, in which students were willing to work through periods of
unknowing until they arrived at solutions to problems which to them were reasonable.

The purpose of persistence and perseverance was to foster further cognitive development.

At the other end of the continuum was Frank. Frank cited only behavioral criteria of a successful program; he did not mention any cognitive criteria. Frank’s view of persistence and perseverance was devoid of any special mathematical significance; it was a life-skill. Don and Ellen probably lie somewhere in-between. They mentioned student learning, SAT scores, and student enjoyment. Both Don and Ellen talked about student learning without placing as heavy of an emphasis on developing higher-order thinking as did Alan, Barbara, and Christine.

**Standardized Tests**

When I originally asked the teachers about their views on standardized test scores, I unfortunately did not differentiate between the students scores on the Test of Academic Proficiency (TAP), the battery of achievement tests that the state has mandated be given by the schools, and the Scholastic Aptitude Test (SAT), the college entrance exam. As a result, it may be more difficult for the reader to distinguish the one to which the teacher was referring.

In general, however, the teachers downplayed the importance of the TAP. Alan’s story about his niece’s inability to fill a test-tube one-third full highlighted the point. In informal conversation the teachers acknowledged that, because the test results were printed in the newspaper, they impacted the community at-large, which, in turn, had repercussions for the administrators, which were ultimately supposed to filter down to the teachers. But except for some public expressions of disappointment by the school administrators at faculty meetings, little was done to raise the scores.

There were several reasons why the teachers did not value the results. Frank claimed that the students did not value standardized test scores, and as a result, may have
chosen not to take them seriously. Thus, the test scores would not produce a valid picture of the students' educational opportunities. But the primary reason why teachers downplayed the results of the TAP test, and one of the few issues on which the teachers were in total agreement, was that the skills which were tested on the TAP did not even remotely match what the teachers thought the students should be learning, or the mathematics department should be teaching.

When it came to the SAT, however, the teachers, as a group, faced a dilemma. On the one hand, several of the teachers did not believe that the SATs assessed anything which they considered to be of real, life-long importance to the students. On the other hand, all of the teachers felt an obligation to the students to help prepare them to do well on those tests. College-admission and scholarship decisions have been tied to a student's score on those tests.

Alan recognized this reality and, from time to time, would put SAT-type problems on the board for bellwork. Barbara acknowledged that SAT scores were a factor in admission to college, but they would not help them get through college. She believed that they needed to be kept in perspective. Ellen taught lessons which have a more traditional content, especially at the Algebra and Algebra II level. In every case, the teachers allocated time away from the curriculum in order to serve the students' needs regarding the SAT.

**Success Rates**

When I asked the teachers about the impact of the new program on success rates, I found that success rates were not a very important criteria to any of the teachers. This was interesting when one considers how success rates (or failure rates) had been, from time-to-time, a lightning rod for criticism by the school board, central and school administrators, parents, coaches, and students.
The teachers, for a variety of reasons, felt that they could not use success rates as a valid measure of comparison. Alan could not compare a success rate which was measuring "something plastic...and superficial" to "something which is real". Barbara found it difficult to detect a difference because her comparison groups were not similar. She too found that differences in the quality of what the students were learning made comparisons impossible. Christine also noticed that the students who passed seemed "to know a lot more, or greater depth". And Ellen pointed out that when the department was using the book, students were passing the course by getting a 60% on the old quarter exams. With the adoption of the new curriculum students took new assessments so there was no way to compare. Frank's views about the importance of the success rate as a criteria for assessing the worth of a curriculum had some striking parallels to views which Alan held. Neither teacher thought that the success rate is meaningful independent of the quality of education which it purports to measure.

One of the shared beliefs which evolved in the department in recent years was that learning is more important than passing. The teachers found that there were times in the past that their efforts to get students to pass an exam meant that the students passed the test without fully understanding the material. This set the students up for failure in subsequent quarters. As a result, success rates were no longer equated with student learning.

**Equity**

Concern for equity, for the most part, was not a pressing issue, for either the male or female teachers. None of the teachers raised the issue before the question was asked, nor did they return to it after they answered it. None of the teachers mentioned noticing any differences between the performance of male and female students in either the new program or the old program.
Barbara and Ellen both referred to a group of lessons in the third quarter of the Pre-algebra program that could possibly be “more difficult” for the girls, or that the girls “are going to hate this”, but in neither instance did that turn out to the case.

Don said that he tried to be conscious of the way that he wrote his own lessons. Teachers seemed to monitor the issue of equity as they monitored most phenomena—informally and tacitly. The teachers did not formally investigate whether there was a significant difference in the success rates based on gender, or a difference in the composition of the upper-level classes based on gender, or manifestations of systemic or cultural inequity.

Alan, Barbara, Christine, and Frank identified other groups of students who might be at a disadvantage with the new curriculum. Christine found that the differences in performance were now due largely to attendance and participation. Alan identified “the student who has been successful at mindless training”, Barbara raised questions about the “book people”, and Frank identified the “studious type of student” as types of students who were more likely to have difficulty with the new curriculum. But again, no one had taken any formal steps to determine whether this was the case.

Objectives

The teachers expressed several different views with respect to objectives. Alan and Barbara, and to a lesser extent Christine, generally expressed the idea that if they just knew the overall goal or had a horizon line at which to aim, then they could get there from here. Don, Ellen, and especially Frank wanted a more detailed set of objectives, or a road map, to follow. All of the teachers were of the opinion that with so many changes in the mathematics curriculum, from Pre-algebra through Pre-calculus, which have occurred over the past few years, it was time, at the very least, to come to some consensus about a framework of what was supposed to be taught in each quarter of the mathematics program.
Work

Every teacher mentioned the fact that teaching the new curriculum involved additional work, but Alan, Barbara, and Christine found that the benefits outweighed the costs. Alan found the results of the work he put in exhilarating because he knew that his students were making knowledge for themselves, and that he too was making knowledge for himself. For Barbara, the new curriculum was more work, but it had been work which allowed her “creative juices” to flow; the work was a means by which to maintain interest and to improve teaching. Christine balanced the additional work involved in creating a new curriculum against the decrease in boredom.

Don found that it was “a little more fulfilling” because he got to put into the curriculum what he wanted. Ellen had always planned her lessons thoroughly; now she found herself having to hunt around for all the materials, and that was not time well spent. Frank said, “if you are going to make a change then it is going to be more work”; he was less clear about any benefits.

From these comments, it appeared that the teacher’s responses again, fell along a continuum based upon the time each implemented the curriculum for the first time. Although all of the teachers found that the new curriculum involved more work, the teachers who had been most involved in the process found that the work had paid off with a large dividend or benefit; those at the other end just found more work with little benefit.

Classroom Management

Many of the teachers found that classroom management with the new curriculum had actually gotten easier than with the old curriculum. Alan found that with the new approach he no longer had to entertain the students in order to get them to do the work. He believed that now the work itself was entertaining. Barbara found that with the new curriculum she could see what worked; there was a lot of variety, so the kids did not get
bored; students liked to work in groups; and the students directed more of their own learning. Christine noticed that the activities kept the students more actively engaged for longer periods of time. Because the students were working together, there was less down-time waiting for a teacher to provide an explanation.

Don had made some changes, even in the time between the first interview and the follow-up interview. He had come to enjoy doing demonstrations, but he was still in control of the learning. Ellen made less sweeping changes than Alan, Barbara, and Christine. Frank said that the new curriculum had made little impact on the way he taught, with the exception that when the students did word problems out of the textbook, they were more likely to do them.

When compared to the time the teachers were teaching out of a textbook, Alan, Barbara, and Christine had made larger changes in the way that they conduct their classes, than had Don, Ellen, and Frank. Alan, Barbara, and Christine each did the activities and used cooperative learning techniques to a larger extent than did the others. And they saw benefits in doing so, such as more students becoming more self-directed in their learning.

Change

The teachers had different dispositions toward change. Alan recognized that "change is the only constant". He was not fatalistic about that; he embraced change. Barbara and Christine both liked change; it kept them from getting bored, although Christine admitted that it was a little scary at first.

Don had a fatalistic attitude toward change. "I just do it because of necessity". He did not think that he had much control over it. Ellen, like Christine, said that she became more comfortable with change after she experienced it. Frank said that "changes don't really bother me". He said that his experience as a substitute teacher for four years made him flexible; but he also said that he has not made any changes.
Mutual Adaptation

In personal conversations, Alan often talked about how “he can't go back”. He had been changed in the process of creating and implementing the curriculum. He could not go back to teaching out of a book. Barbara said that teaching the new curriculum aligned more with her teaching philosophy than teaching out of the book had. Christine perceived that she had made come a long way since she decided to jump right in there and try it. She was now much more aware of the mathematics in the world all around her.

At the time of the first interview, Don said that he had made a “pretty good move” from where he started. He used to think that the only way to teach was to use a book; he had since come to see that one could teach without the books. In the follow-up interview, Don said that he would like to start out every lesson with an experiment which demonstrated the objective and how he would like to use the graphing calculators more in class. These were big steps. Ellen commented that she had become more aware of promoting thinking activities, especially in the Algebra and Algebra II classes, where, at the time of the first interview, she was still using the book to a great extent. She decided to use the IMP curriculum in the future. Frank said that he had made no changes in his teaching style. He was one of two teachers to pilot the IMP.

At the time of the first interview, there was a difference between those who implemented the curriculum from the first quarter and those who waited until the third or fourth quarter. At the time of the first interview, the first group made major changes in their practice in order to implement the new curriculum; in doing so they were themselves changed in the process. The latter group put more of their effort into adapting the curriculum in order to match their previous way of teaching. Thus, they were not initially changed by the curriculum. This may explain some of the differences between the amount of benefit each group has indicated they have derived from the new curriculum. By the
time of the follow-up interview, Don, Ellen, and Frank had become much more comfortable doing the new curriculum, and they were considering teaching the most progressive of the commercially-available mathematics programs. At times we change the curriculum, and at times the curriculum changes us.

Stakeholders

Most of the teachers said that the parents were not aware of the curricular changes which the mathematics department had made. Alan attributed that to the fact that the parents valued education and that they trusted the teachers to do the right thing. Christine believed that many parents were more interested in their children getting through, or keeping their eligibility to play sports than in whether their students actually learned anything. Frank considered the lack of involvement as a blessing, because it allowed the teachers to “do almost anything you want, within reason”.

When it came to administrators, the teachers did not look to them for curricular leadership. Many teachers had an us-against-them attitude toward administrators. Christine had the most positive view of administrators. She saw the changes that both teachers and administrators had made over the past few years. Christine was unique in her view that there are “co-evolutionary cycles going on that intermingle with the students, parents, and administrators”. Alan was sympathetic to their plight. He believed that they were bound up by the politics of their job, and that this affected how they evaluate curricular reform.

Don expressed the view that most of the stakeholder groups were unaware of what changes were being made, and why they were being made. He did not suggest that the department do anything to change that. There were advantages to keeping a low profile. Ellen also described the us-them division between teachers and administrators. There was no indication that she had any particular administrator in mind; it seemed to be about
administrators qua administrators. Frank noted that the administrators have been supportive of change in general.

None of the teachers thought that parents or administrators were in a position to evaluate the curriculum. The teachers thought that the parents were not very involved, and that the administrators lacked the expertise, especially in the field of mathematics, to make effective decisions.

Decision about IMP

Both Alan and Barbara decided not to do the IMP. Alan felt that the packets were stifling; Barbara said that she decided not to pilot IMP because there was not any leeway or room for teachers putting things in that work. Christine chose not to do IMP the first time around because she did know enough about it. She said, "I knew that I was going to have success, and I would be teaching in a way that I would be comfortable with, with the program we were doing; with IMP I didn't know enough about it to really want to jeopardize what I was doing." However, she said that she would be willing to give it a shot next year.

Don was seriously considering doing the IMP but could not attend the training. For him the perks were the classroom set of calculators, the TI-82s. "Yeah, I wanted to be able to use those. And also having the written curriculum already done for you. I thought that it would be an advantage." But Don would choose not to do IMP next year. Ellen also wanted to do the IMP, but she too was unable to attend the summer training program. She cited both the structure of the program, with its formally organized curriculum, as well as the use of the graphing calculators as the primary motivations. Ellen would opt for the IMP program next year if given the opportunity. Frank chose to do the IMP because he felt that his mathematical background was not as strong, especially in regards to mathematical applications, as others in the department who had degrees in
science or engineering. He wanted to do the IMP because the mathematical models were easier for him and the students to understand. He said that he would like to do IMP again, but he was willing to do whatever it took.

Explicitness and Clarity

Alan argued that explicitness and clarity were, by their nature, limiting, and hence, something which he eschewed. Barbara took the initiative and asked when she has questions. Christine would like the mathematics program made more explicit, but generally found the objectives from the exit exam. This was the same procedure which Don used. For Ellen and Frank, the lack of explicitness and clarity had been a constant source of frustration.

With the exception of Alan, all of the teachers would like the program to be made more explicit. With Barbara and Christine, a brief overview was enough. Don, Ellen and Frank would like the program goals and objectives specified in greater detail and to have the instructional activities more accessible.

A Model of a Teacher Evaluative Framework

In the next chapter, I discuss the findings of the study in greater detail and relate those findings to the literature. But before I do that, I present my impressions of the teacher interviews in a more general way, and propose a model for the framework the teachers in the study used to evaluate the curriculum developed in-house. I would like to preface these remarks with a caveat. I acknowledge that there are numerous factors which make any discussion of a model extremely tentative. These include the limited number of teachers in the study; the beliefs, abilities, and personalities of the teachers themselves; the nature of the curricular change; the department's use of common exit exams; the culture of change within the department, the school, and the district; and so
forth. The presence or absence of some of these factors affect the generalizability of the model at other locations.

The purpose of the study was to gain a better understanding of the process by which teachers evaluate a curriculum. Twelve themes from the evaluation literature and the change literature emerged to function as criteria for a tentative model of the teachers' evaluation framework, as illustrated in Figure 1.

Figure 1. Model 1 - Teacher Evaluative Framework

The preliminary model began with the assumption that the teachers would hold essentially the same views on the twelve criteria, and that their collective opinion of the importance of the twelve assessment criteria on their evaluation of the curriculum would
range from positive to indifferent to negative. The model also showed that the teacher framework lies in a time-context dimension. It has been mentioned in the Introduction and the Review of the Literature how contextual factors impact the teacher’s assessment of the program, but it was also evident from the study that time was an important factor. The teachers’ assessment of the curriculum at the time of the second interview was not the same as it was at the time of the first interview. The teachers had become more familiar with the new style of teaching and this had the effect of softening some of the criticism expressed during the first round of interviews. This dimension of the framework indicates that the teachers’ views are dynamic, and that a teacher’s evaluation of a curriculum is only a reflection of the teacher’s views at that particular point in time.

Analysis of the interviews with the teachers showed that the first model is inadequate. The study indicated that the teachers’ views were mediated by their degree of participation in the development and implementation of the new curriculum. That is, teachers who contributed most to the development of the new curriculum and who implemented it from the first quarter viewed the curriculum differently than the teachers who participated less in the development and waited until the third or fourth quarter to implement it. The model of the teachers’ framework in Figure 2 adds the third dimension, the degree of participation.

Teacher participation. As a variable, teacher participation is difficult to define with precision. In this study, those who helped plan the new curriculum and implemented it from the first quarter onwards could be considered to have participated to a greater extent than those who did not. But merely getting teachers involved early on in the development
of a new curriculum would not necessarily produce similar results. The teachers in the study who did participate early did so for several reasons. They had tried out some of the lessons and activities before formally incorporating them into an entire curriculum and they had experienced some success with them. They were teachers whose personalities seemed to seek change and, in fact, could not tolerate an environment which was static. They did not need or want a great deal of structure before becoming involved in something radically new. They only wanted a sense of the direction the curriculum was to go and then the opportunity to engage their creativity in developing and shaping the new curriculum. It appears that a montage of characteristics come together to determine a teachers' willingness to participate, and these characteristics ultimately impact how teachers evaluate a curriculum which was developed in-house.
A - the role of testing and measurement
B - the role of technical quality
C - the role of objectives
D - the role of politics, justice, and stakeholders
E - the role of constructivism
F - the predisposition of the teachers toward change
G - the fit of the new curriculum with the teachers system of beliefs about education and teaching
H - the clarity and explicitness of the curricular innovation
I - the amount of work and the work-benefit ratio
J - the belief that learning is taking place
K - the effect on classroom management
L - the amount of pressure and support provided

Figure 2. Model 2 - Teacher Evaluative Framework

Although the model in Figure 2 is an improvement over the model in Figure 1, the study indicated that the teachers’ views of these twelve themes were more highly nuanced than originally anticipated. The teachers’ views of the importance of measurement and testing were conditioned by the type of standardized test; they indicated that the importance of objectives was limited to instruction and did not have a particularly strong evaluative function. Thus the model in Figure 3 is a better representation.
A- the role of testing and measurement
   A1- achievement tests
   A2- SATs
B- the role of technical quality
C- the role of objectives
   C1- for evaluation
   C2- for instruction
D- the role of politics, justice, and stakeholders
E- the role of constructivism
F- the predisposition of the teachers toward change
G- the fit of the new curriculum with the teachers system of beliefs about education and teaching
   G1- change beliefs to fit curriculum
   G2- change curriculum to fit beliefs
H- the clarity and explicitness of the curricular innovation
I- the amount of work and the work-benefit ratio
J- the belief that learning is taking place
   J1- life skills
   J2- basic mathematics skills
   J3- higher-order thinking
K- the effect on classroom management
L- the amount of pressure and support provided

Figure 3. Model 3 - Teacher Evaluative Framework
DISCUSSION

Introduction

In trying to understand the framework which teachers use to evaluate a curriculum created in-house, I suggested that the framework may have a theoretical component, that is, an element which tells a teacher that there is a way in which a curriculum "ought" to be evaluated. I hypothesized that, if it exists, it would have its roots in the evaluation literature. I suggested five concerns of the evaluation field which deserve consideration as candidates for inclusion as elements of the theoretical dimension: (1) the role of testing and measurement; (2) the role of technical quality; (3) the role of objectives; (4) the role of politics, justice, and stakeholders; and (5) the role of constructivism.

I suggested that the framework may have an experiential component as well. That is, the framework may contain elements which emanate from the experience of being a teacher. I hypothesized that, if it exists, it would have characteristics similar to those found in several literatures about teachers and curriculum: the teacher change literature, the curriculum change and curriculum implementation literature, and so forth. I enumerated seven characteristics which those literatures suggest which deserve consideration as candidates for inclusion as elements of the experiential dimension: (1) the predisposition of the teachers toward change; (2) the fit of the new curriculum with the teachers system of beliefs about education and teaching; (3) the clarity and explicitness of the curricular innovation; (4) the amount of work and the work-benefit ratio involved in implementing and maintaining the new curriculum; (5) the belief that learning is taking place; (6) the effect on classroom management; and (7) the amount of pressure and support provided in order to implement and maintain the new curriculum.
In this chapter, I return to the interviews with the teachers to see the extent to which the elements of the hypothesized framework were present in the teachers’ responses in the interview.

**Findings**

The study found a large number of effects were mediated by a set of undifferentiated factors related to a teacher’s involvement in the planning and development of the new curriculum, to a teacher’s willingness to teach the new curriculum in the early phases of implementation, or to a host of other factors. These are referred to as ‘the degree of participation’. The study found the following:

1) measurement and testing played only a minor role in the teachers’ assessment of the new curriculum, but the role was mediated by two factors: (a) the evaluation instrument chosen, and (b) the degree of participation;

2) technical quality did not play a large part in their personal evaluative frameworks, although the teachers demonstrated an awareness of factors which affect technical quality;

3) objectives were not important to teachers for evaluative purposes, and their importance for instructional purposes was mediated by the degree of participation;

4) politics, justice, and stakeholders seemed to play little to no role in the teachers evaluative framework;

5) constructivism played an implicit, tacit role in the teachers’ evaluation framework;

6) the teacher’s predisposition to change played a role in a teacher’s evaluative framework, and it was strongly mediated by the degree of participation;
7) the fit of the new curriculum with the teachers system of beliefs about education and teaching affected the teacher's evaluative framework, and it was mediated by the degree of participation;

8) the clarity and explicitness of the curricular innovation had a great impact on the teacher's evaluative framework, and it was mediated by the degree of participation;

9) the amount of work was not as important a consideration as the work-benefit ratio involved in implementing and maintaining the new curriculum in the teacher's evaluative framework, and it was mediated by the degree of participation;

10) the belief that learning is taking place played a role in the teacher's evaluative framework, and it was mediated by the degree of participation;

11) the role of classroom management in the teacher's evaluative framework is unresolved; and

12) the amount of pressure and support provided in order to implement and maintain the new curriculum played a role in the teacher's evaluative framework, and it was mediated by the degree of participation.

Topics from the Evaluation Literature

Role of Measurement and Testing

The study found that measurement and testing played a minor role in the teachers' assessment of the new curriculum, but that the role was mediated by two factors: (1) the evaluation instrument chosen, and (2) the degree of participation in the development and the implementation of the new curriculum.

Formal evaluation of mathematics programs often include standardized test scores as one of the criteria by which to evaluate a curriculum (Cobb, et al., 1991; Mills, Ablard,
& Gustin, 1994; University of Chicago School Mathematics Project, 1995). Yet all of the
teachers in the study downplayed the importance of standardized achievement test scores,
although the reasons they gave differed according to their degree of participation in the
curriculum reform. Those teachers who were most involved in the reform stated that the
primary reason they did not value achievement test scores was that the achievement tests
did not assess the kind of mathematical knowledge and understanding that they value for
the students to possess. Those teachers who did not implement the curriculum until third
or fourth quarter were less likely to question the types of mathematical knowledge being
assessed. One of those teachers, for instance, did not value the achievement tests because
he believed that the students do not take them seriously, so that the results would not be
valid.

When it came to the Scholastic Aptitude Test (SAT) scores, however, the teachers
faced a dilemma about what material should or should not be covered in the curriculum.
Again, the teachers did not think that the SATs assessed the mathematical knowledge that
they valued any better than the achievement tests did. The difference was that, unlike the
achievement tests, the students' scores on the SATs have real consequences—affecting
college admission, mathematics placement, and scholarships. None of the teachers wanted
to disadvantage the students in their attempts to score well on the SATs. Those teachers
who were really committed to the goals of the curriculum reform felt the moral dilemma of
whether to choose a short-term good at the expense of a long-term good; as Barbara put
it, a good score on the SATs “will get them into college, but it sure won’t get them
through college”. Several teachers developed some teaching strategies to help diffuse the
problem, but most agreed that they could not serve two masters.

Don’s comment about not knowing of any other way of assessing a curriculum
other than by testing showed some vestiges of formal training in education. But when it
came down to making a decision on whether or not to pilot the Interactive Mathematics Program, not one teacher, including Don, cited test scores as a factor in their decision.

**Quest for Technical Quality**

This study found that technical quality did not play a large part in their personal evaluative frameworks, although the teachers demonstrated an awareness of factors which affect technical quality.

The National Council of Teachers of Mathematics (1989, 1995) has emphasized the importance of acquiring valid and reliable information for curriculum and program evaluation. The mathematics teachers in this study seemed to have an informal sense of the threats to validity. This was most evident when the teachers discussed the role of success rates. Alan could not compare a success rate which was measuring “something plastic...and superficial” to “something which is real” (instrumentation). Barbara found it difficult to detect a difference because she formerly taught classes which were “on track” but more recently had taught classes of students who were “repeaters” (nonequivalence). Christine noticed that the students who passed seemed “to know a lot more, or greater depth” (instrumentation). And Ellen pointed out that when the department was using the book, students were passing the course by getting a 60% on the old quarter exams (instrumentation).

But even though the teachers were informally aware of issues related to technical quality, there was no evidence that technical quality played a large part in their personal evaluative frameworks. When the teachers were deciding whether to implement Interactive Mathematics Program (IMP), not one of them asked for a technical report on the impact of IMP on the students. Those who did express initial interest in teaching IMP were given the opportunity to visit another school where IMP was being piloted. Seeing
the curriculum in action and talking to other teachers seemed to play a major role in their decision.

Role of Objectives

There were two findings of the study in regard to objectives. First, objectives were not important to teachers for evaluative purposes; second, their importance for instructional purposes was mediated by the degree of participation.

When the teachers in the study attended their pre-service teacher training, the Tyler Rationale, and writing behavioral objectives formed an important part of their training. Several years ago the Agave School District was pushing the Essential Elements of Instruction, and the teachers were exposed, in one form or another, to its emphasis on objectives. For evaluators, objectives formed the foundation on which assessments could be built.

In the present study, the teachers did not seem to be interested in objectives for evaluative purposes. By that I mean that the teachers did not make a formal, pre-ordinate list of objectives which they wanted the curriculum to accomplish, and then use that list of objectives as a checklist for a curriculum evaluation. The teachers may each have had his/her own informal checklist, or perhaps the assessments, which had already been established, served as a proxy for a more formal list.

The study also found that those teachers who delayed implementation of the curriculum valued objectives more highly, and wanted them in greater detail, than those who implemented the curriculum in the first quarter. But even those teachers who wanted some form of objectives, the purpose was for planning instruction, not as an aid to evaluating the curriculum.

Politics, Justice, and Stakeholders
The study found that politics, justice, and stakeholders played little to no role in the teachers evaluative framework. Since the mid-1970s, the field of evaluation has been discussing how evaluation is enmeshed in politics (House, 1972; Weiss, 1975). But in the present study, most of the teachers did not mention to any great extent, the impact that others had on their decisions. Only Barbara mentioned that the views of others had some impact on her initial assessment.

The department chairperson ran interference between the teachers and the administration so that the teachers would not have to deal with those political realities. He also dealt with parents when the concern was about departmental policy. The chairperson recalled a conversation he had with the principal about whether the principal had heard any complaints from parents about the new program. The principal was purported to have replied, "I have had enough calls to know that something new is going on, but not enough to be concerned."

As one reads the excerpts from the interviews in which the teachers talk about the administrators qua administrators, it is easy to get the impression that teachers, by and large, do not respect the decisions that administrators make on issues related to instruction, curriculum, or evaluation. The sentiment ran from pity and sympathy to contempt. But the teachers did seem to be aware that administrators must make decisions in a political arena whereas they, perhaps because of tenure, were free to make educational decisions in an atmosphere relatively free of political pressure.

The teachers in the study did not seem to be as aware of issues related to equity and justice as the evaluation and the mathematics education literature might suggest they ought. There was some consideration given to these issues in planning lessons, but the teachers did not evaluate in any systematic way whether there was any systemic injustice. It may be that teachers approached this issue as they do many other aspects of teaching, at
a very informal, tacit level of evaluation. That is, to a statistician, something is significant when \( p = 0.05 \); to a teacher something is significant when it makes them ‘stand up and take notice’. I suppose in terms of the equity issue, there has been nothing to make the teachers ‘stand up and take notice’.

The teachers in the study were rather unaffected by the views of the parents and administrators, but very attune to the views of the students. In the evaluation literature, the reason for seeking stakeholder input was partly political (evaluation utilization) and partly justice. The teacher’s apparent lack of desire for stakeholder input may be due, in large part, to the fact that the teachers were politically insulated and did not have to, nor want to, open the process to negotiation with stakeholder groups. As Frank said, “…you have a community which is pretty much dormant…. You can do almost anything that you want, within reason.”

The teachers in this study were concerned with how the students reacted to the curriculum, but they did not formally measure student enjoyment using a questionnaire. That method would have been too time-consuming, and its results would still only be validated by classroom experience.

**Impact of Constructivism**

This study found that constructivism played an implicit, tacit role in the teachers’ evaluation framework. In formal constructivist evaluation, such as Guba and Lincoln’s (1989) fourth generation evaluation, the evaluator attempts to negotiate a consensus among the stakeholders and to resolve any issues or concerns held by any of the stakeholder groups. In practice there was only informal negotiation within the department. The teachers who wanted curricular change got a sense of how far and how fast they could move ahead and still move together as a department. The teachers in the department who had developed and implemented the mathematics curriculum had
generally made an attempt to reduce the concerns of those who had been less inclined to change; but with all of the changes which occurred every year, that was not always done satisfactorily. As a result, there was a general feeling among those who have been less enthusiastic about change that their concerns had not been met. Although the process involved negotiation, it could not be described as a hermeneutic circle, nor did it involve all the stakeholders.

Topics from the Curricular Change Literature

Predisposition of the Teachers Toward Change

The study found that the teacher's predisposition to change played a role in the teacher's evaluative framework, and it was strongly mediated by the degree of participation. Typologies are developed in order to simply, and help make sense out of large sets of data. Over the years several typologies of teachers' predispositions toward change have been put forward to help make sense of the complexity of teacher reactions to the implementation of curricular innovation. Sieber (1972) described three types of teachers: the rational type, the co-operator type, and the powerless type. Doyle and Ponder (1977) described the rational adopter, the stone-age obstructionist, and the pragmatic skeptic. Cardell (1994) described the trailblazer, the pioneer, and the settler.

I will resist the temptation to put the teachers of this study into any one of these boxes, or to place them into ones of my own. But clearly the teachers in this study had different assessments of the curriculum, and clearly, in reading the accounts of their interviews, the teachers who spoke most highly of the new curriculum were the teachers who participated most in the development of the new curriculum and implemented it from the first quarter (Alan, Barbara, and Christine). Each of the teachers recognized that for the foreseeable future, change is going to occur in the mathematics curriculum. The state was expected to change its "Essential Skills" and adopt new "Essential Standards".
People experience change differently. Their experiences of change lie along a vast continuum of possible experiences of change. There are those who see change as a challenge to be met, or as something to be avoided. There are some who stand up to change, and those who bend with it, and those who are overwhelmed by it. There are some people, like Alan, who embrace change, who would not, and probably could not do something the same way twice, even if they wanted to. There are those, like Barbara and Christine, who enjoy change because it keeps them from getting bored. Don, Ellen, and Frank were less willing to make the change to the department-made curriculum, but each one was willing to pilot the IMP this year. And if circumstances had been different, then perhaps all three of these teachers would have made a change that Alan, Barbara, and Christine would not have. The issue is not simply one of a predisposition to change, but also a consideration of a change from what to what.

**Fit with System of Beliefs**

This study found several interesting differences between the framework teachers used to decide whether to implement a new curriculum, and the one that they used to evaluate one. The curricular change literature suggested that teachers were more likely to implement a curricular innovation if it fits with the teacher's practice and beliefs about education and learning (Cohen & Ball, 1990b; Doyle & Ponder, 1977; Richardson, 1990). McLaughlin (1976, 1980, 1990) found that programs which were flexible enough to allow for 'mutual adaptation' were also the most likely programs to be implemented. One might hypothesize from these statements that teachers who did not have to change much themselves, or teachers who could adapt the program to match their normal way of doing things would be the most content. This study found that this was not the case.

All of the teachers began the process by teaching out of the book. Some did it more flamboyantly than others, but all were teaching in much the same way. The new
curriculum called for all the teachers to make major changes in their *modus operandi*. But what the current study found was that the teachers who made the most radical changes in the way they teach mathematics also assessed the curriculum most favorably. On the other hand, those teachers who changed the curriculum most to fit their pre-existing styles assessed the curriculum less favorably. That is to say, those teachers whose belief systems changed in order to align with the philosophy of the curriculum, assessed the new curriculum more highly than did those teachers who modified the curriculum to fit their practice. In a sense, the ones who experienced a change in belief system, adopted a "convert mentality", with all of the zeal of a reformed smoker.

This brings to mind Fullan's (1985) comment that change of behavior often precedes changes in beliefs. The teachers who changed their teaching style the most, had the greatest change in beliefs, and then had the most positive assessment of the new curriculum; those who changed their teaching style the least, had a smaller change in their beliefs, and then had a less positive assessment of the new curriculum. It should be added that since the time the first interviews were conducted, there has been some indication that the teachers who a year ago were less enthusiastic about the new curriculum, have been becoming increasingly more positive about incorporating more demonstrations, mathematical models, and graphing calculators into their instruction. So time may also a mediating factor in the teachers' evaluation framework.

Clarity and Explicitness

The study found that clarity and explicitness (or the lack thereof) was a factor in a teacher's evaluative framework, but it was mediated by the teacher's participation. For the teachers who assessed the curriculum more highly, explicitness and clarity was less of an issue. Again, there seemed to be a difference between what the curricular change literature might predict and the results of this study. The curricular change literature
indicated that a curricular innovation in which the goals and objectives were not clearly stated, and the procedures were not explicit, would have a low degree of implementation (Doyle & Ponder, 1977). In this study, it certainly was true that those teachers who endorsed the new curriculum less enthusiastically often cited as the primary reason the lack of clarity and explicitness. This also was the group of teachers who did not participate to a large extent in the development of the course and who waited until the third or fourth quarter to implement the new curriculum. For teachers who were involved in the curriculum development process, the lack of clarity and explicitness did not seem to affect their assessment to the same degree. For them, a lack of clarity and explicitness meant greater flexibility, as well as greater opportunity to meet the varied needs of the students. It may be argued that by their involvement in the development process, these teachers had gained a greater clearer vision of the expectations of the course than those teachers who did not participate in the development process.

Amount of Work and the Work-Benefit Ratio

The study found that the amount of work and the work-benefit ratio involved in implementing and maintaining the new curriculum played a role in the teacher’s evaluative framework, and it was mediated by the degree of participation. According to the curriculum change literature (Berlin & Jensen, 1989; Doyle & Ponder, 1977), any innovation which required a large expenditure of teacher effort or resources with an uncertain return would, under most circumstances, not be implemented.

All of the teachers reported that implementing the new curriculum was more work than when all a mathematics teacher did was to teach “page 5 then page 6 then page 7”. But the amount of work itself was not as much of a factor in the teachers’ evaluative frameworks as was their perception of the work-benefit ratio. The teachers who assessed the program more favorably were quick to note that even though the curriculum resulted
in more work, they found that the work itself was more rewarding. They were not talking about the consequences of the work; these teachers were talking about the work itself. Alan found it 'exhilarating'; Barbara said that it got her 'creative juices to flow'; Christine said that it reduced boredom, and Don said that it "was a little more fulfilling". The teachers who viewed the new curriculum less favorably noted that change always produces more work. They did not note any particular benefits which they derived from doing the additional work. This finding is similar to that predicted by the literature.

**Belief that Learning Is Taking Place**

The study found that the belief that learning is taking place played a role in the teacher's evaluative framework, and it was mediated by the degree of participation. Learning was an important consideration to all of the teachers. Alan, Barbara, and Christine each stressed that the quality of what the students were learning was much higher in the new program. Each one talked about how students were involved in higher levels of thinking than before. On the other hand, Don, Ellen, and Frank were more likely to be concerned that the students were missing out on those skills emphasized in more traditional approaches, and the kind which is still required on standardized tests and in some college programs.

This study confirmed the view that teachers value student learning and will evaluate a curriculum based upon their perceptions about student learning. In this study the teachers who viewed the curriculum most favorably cited as a reason that students were using higher order thinking; those teachers who viewed the curriculum less favorably expressed concerns about the traditional mathematics skills that the students were not learning.

**Effect on Classroom Management**
The study left unresolved the role that classroom management issues played in the teacher's evaluative framework. The curriculum change literature suggested that a curriculum which disrupted the normal organizational pattern would be resisted (Duffy & Roehler, 1986). Yet this was not the case. Several teachers made radical changes in their classroom management. In fact, those teachers who changed the most, had a higher regard for the curriculum than did those who adapted the curriculum to lessen its impact on their pre-existing style. But all of the teachers seemed to enjoy doing some of the activities, and no teacher mentioned any negative classroom management issues associated with the new curriculum.

**Amount of Pressure and Support**

The study found that the amount of pressure and support provided in order to implement and maintain the new curriculum played a role in the teacher's evaluative framework, and it was mediated by the degree of participation. McLaughlin (1987, 1990) found that successful programs were those which required some balance of pressure and support. In the present study, the teachers who viewed the new curriculum less favorably cited the lack of support (as well as the lack of objectives) as the primary reason for their dissatisfaction. The teachers who viewed the curriculum more favorably were in less need of support because they had been more involved in its development. These same teachers were relatively unaffected by the pressure of teaching to the performance-based test.

**A Closer Look at the Teachers' Evaluative Framework**

The teachers in the study each viewed the curriculum differently, and many of these differences fell along a continuum based upon a number of factors related to the teacher's degree of participation in the new curriculum. Those who participated in the development of the new curriculum and implemented it from the first quarter had a much different view of the curriculum on a wide range of issues than those who participated
less. I got the impression from the interviews with the teachers that there was a parallel between the teachers' evaluation of the curriculum reform and the structure of scientific revolution which Thomas Kuhn (1970) described.

Prior to 1989, all of the teachers taught in essentially the same way. They followed the scope-and-sequence of the textbook; they emphasized the learning of computational skills and procedural knowledge. This was "normal teaching" at the time. The teachers believed that if the skills were broken down into objectives and sub-objectives, and if they were presented the material in an orderly fashion, then, given enough practice, the students should be to pass the exams and progress through the mathematics program. This was the rationale behind the district's adoption of an outcomes-based philosophy.

Over the next several years, two shortcomings of that system became evident to some of the teachers. First, the students often exhibited a "learn it and forget it" approach to the skills. The students would memorize the procedures long enough to pass the exam, but then would soon forget them. The teachers were frustrated that they had to re-teach things to students in Algebra I and Algebra II which they thought that the students had learned earlier. This was most apparent to the teachers when they got the same students at the next level which they themselves had taught previously. The second shortcoming was that students could not apply the mathematics to problem situations. For some of the teachers, these shortcomings led to what Kuhn (1970) refers to as a "crisis".

In 1989, the National Council of Teachers of Mathematics published the Standards, which argued for a different vision or paradigm of teaching mathematics. The new paradigm emphasized students learning mathematics conceptually. Some of the teachers argued that a revolution was needed. They began to develop lessons which would help students understand the concepts behind the algorithms. This evolved into the
development of the new Pre-algebra curriculum, and then, eventually, it expanded to encompass the entire mathematics program.

It seemed clear from the interviews that the teachers who were most involved in the development of the new curriculum were working from a different paradigm of mathematics education than those who were less involved. As a result, the evaluative framework by which those teachers assessed the new curriculum was also different. Kuhn (1970) stated that each group would evaluate a paradigm according to its own criteria.

When paradigms enter, as they must, into a debate about paradigm choice, their role is necessarily circular. Each group uses its own paradigm to argue in that paradigm's defense (p. 94).

It was evident that each group evaluated the curriculum according to criteria rooted in its own paradigm when the discussion turned to the role of objectives. One criticism of the new curriculum cited by the teachers who were less involved in the development of the curriculum was the lack of an explicit and detailed set of objectives; the teachers who were most involved in the development of the new curriculum, which focuses on developing conceptual understanding, defended the curriculum by pointing to the student's ability to employ higher-order thinking.

Kuhn found that the transition from normal science to the eventual adoption of the scientific revolution by the scientific community takes time. "The transfer of allegiance from paradigm to paradigm is a conversion experience which cannot be forced" (p. 151).

Time seemed to be a factor in the teachers' evaluative framework. The teachers who, in the first interview, wanted a curriculum which was a mixture of the new and the old, were moving more in the direction of the new curriculum a year later.

The purpose of a model is to help understand some complex phenomena by finding commonalities and differences. Building models inevitably results in the loss of the richness of the many individual teachers' voices. The model presented in Figure 3 reflects
an attempt to understand how teachers evaluate a curriculum created in-house. There
certainly were many differences based upon the teacher’s participation in the process. But
given all the differences among the teachers, one finding was absolutely clear—teachers
evaluate curriculum based upon their experience as teachers. Professional evaluators may
base their evaluation models on their expertise in psychometrics, sociology, or
anthropology; but teachers base their evaluative framework on their expertise of teaching
in the classroom.

The change literature proved to be a more valid predictor of the teachers
evaluative frameworks than did the evaluation literature. But several findings of this study
ran counter to what the change literature might have been expected. Teachers did not
mind a less orderly classroom environment; many teachers did not want the curriculum to
be explicit; teachers who adapted the curriculum to fit their belief systems did not value
the curriculum more highly. Some of these differences may be a consequence of the
adoption of constructivist methodologies, or because the curriculum was developed in-
house.

Implications for Further Research

The present study is meant to be an exploration into the evaluative framework
teachers used to evaluate a curriculum of their own making. It has opened several areas
which call for subsequent research. First, it was difficult to identify a single independent
variable, or causal agent to which to ascribe the differences of viewpoint between those
who had the highest degree of participation in the designing and implementing the new
curriculum. Were the differences due to personality differences?, to differences based on
educational philosophy?, or to decisions based on departmental politics? Are there unseen
contextual factors which could yet explain the differences in how the teacher? How valid
is the evaluation framework beyond the particular context?
With only six teachers participating in the study, the results are hardly generalizable, and need further study. A large number of serendipitous events coalesced to allow the program to evolve as it did. Under a different set of circumstances, would a similar curriculum have evolved? And how valid is the evaluation framework beyond the particular curriculum?

These, and many more questions are in need of answers. It would also be valuable for future quantitative studies to further refine the evaluation model.

Conclusion

In the introduction to the dissertation, I discussed how curriculum development, and hence curriculum evaluation, may soon undergo a radical transformation. And in this new state of affairs, the teacher will begin to assume more of the role of curriculum developer.

In the past few years, graphing calculators have entered the classroom and, in an instant, many of the skills which were traditionally taught in the high school, and even the college mathematics course, were made obsolete. In only a few more years, every classroom will be equipped with a computer with access to “the Web”. Teachers will be able to share their favorite lessons by placing them on their home page, and they will gain access to other teachers’ lessons in the same way. In this environment, curriculum development and evaluation will enter a new phase, one in which teachers will assume a larger role. As this happens, there may be a shift in the criteria which is used to develop and evaluate the curriculum away from standardized test scores and toward student demonstration of understanding.

I would like to conclude with a quote from Stake (1985):

We did not come to be great admirers of American teachers, or their capacity for self-correction, but as with Churchill’s view of democracy, it beats the alternatives.
We came to see that the important knowledge for correction on classroom practice is experiential knowledge (p. 244).
APPENDIX A

A Description of the 1992-1993 Pre-Algebra Curriculum

Quarter One

Perhaps the most important goal of the first quarter curriculum is to change the way the students think about mathematics and mathematics education, to change the way many approach and learn new material, and to get them to think and communicate mathematically.

In the first half of Quarter One the focus was on counting and measuring. Students found the length of their stride and used it to determine the distance between two objects. Each student made a table comparing the number of steps to the distance traveled, and graphed the information.

Students found the area of various objects by counting the number of unit squares which would be required to cover the surface. The students made scale drawings of the classroom, student parking lot, or tennis courts by counting the number of squares on a grid.

In some classes, students were involved in a project to plan a concert to be held at school.

In the second half of the Quarter One, the students studied fractions. The lessons on fractions drew heavily from the findings of the Rational Number Project. Fraction concepts were introduced using both discrete and continuous models, as well as with the number line. Because many of today's calculators reduce fractions to lowest terms and perform the calculations with fraction as well as decimals, these particular skills have been de-emphasized.

Early in the unit the relationships among fractions, decimals, and percents are investigated. In one group of lessons, students were given a piece of adding machine tape
which measured one meter in length. Students found the location of all thirds, fourths, fifths, sixths, eighths, ninths, tenths, twelfths, fifteenths, sixteenths, and twentieths by a guess and check procedure. Students could then see that equivalent fractions were those which measured the same length. The next day a meter stick was placed on top of the paper strip and the decimal equivalents of fractions were found. In another class, students used sectors of circles to identify equivalent fractions.

Quarter Two

During the first half of Quarter Two, the fraction concept was developed further. The fraction 5/8 was translated as “five out of every eight equal pieces”. No standard computational algorithms were introduced for converting fractions to percents, for instance. Instead, if a student wanted to convert a fraction such as 5/8 to a percent, the student would take a piece of graph paper, enclose a 100-square grid, and shade five out of every group of eight squares. The student then had to determine what to do with the remainder. Using a computer activity created by one of our teachers, the students were able to visualize percents.

At the same time the students were working on various aspects of the fraction concept, they were also conducting a survey of a question of their own choosing. This lead to some interesting discussions about reliability, validity, and ethics. The survey provided the students with an opportunity to apply the fraction concepts to analyze their data. In order to make the circle graphs, students used a 360-square grid to determine the number of degrees needed to represent each response.

A similar approach was taken during the exploration of signed numbers. No formal algorithms were given. Instead, the addition and subtraction of signed numbers (and the relationship between addition and subtraction of signed numbers) was investigated using a number of different models (piles & holes, cards, and numberline).
Students also “solved equations” informally by determining the missing number, with or without the aid of a calculator or number line.

Quarter Three

Many students have difficulty in determining whether a situation requires multiplication or division. The third quarter begins with several lessons in which the meanings of multiplication and division are explored. The students then begin a project in which they are required to purchase shares of stock from two different companies and to chart their progress for a six-week period. This activity reinforces many of the concepts introduced in the previous quarter, as well as encompassing many concepts new to the third quarter.

For approximately two weeks, students do a unit on graphing in the rectangular coordinate system and then doing transformations. The purpose of doing this particular unit was: 1) to reinforce the students understanding of the relationship between addition and subtraction; 2) to counter the common misconception that in multiplication the answer always gets bigger and that in division the answer always gets smaller; 3) to show the effect of multiplication or division by a negative number; and 4) to get additional practice in plotting points.

For the remainder of the quarter, students explored rates. They found their walking speed, the speed of windup toys, and the speed of sound. Data was collected from all of these activities, analyzed using the three measures of central tendency, and graphed.

In another lesson, the students determined the unit price of various grocery items.

Quarter Four

In the first part of the quarter, the students are introduced to ratio and proportion. In the first few lessons, the students “tasted” different ratios in order to determine the ratio
of water to powdered orange drink mix which produced the flavor they preferred. For these students, equivalent ratios not only meant that the cross products were equal, but it also meant that equivalent ratios were the ones which tasted the same.

In the next few lessons, each student was given a small bag of M&Ms from which they were to predict the contents of a two-pound bag. Data was collected from approximately 120 students. The data was fed into the computer and the frequency graphs were drawn. This provided an excellent opportunity to discuss the mean, median, and mode and which may be the most appropriate one to use in order to make a prediction about the contents of the large bag. This time when students determined percents or made circle graphs, they used proportions.

The students used proportions to find the height of a light post using shadows, and the number of fish (Pepperidge Farm Cheddar Cheese Cracker Fish) in a lake (a paper bag) by releasing tagged fish (Pepperidge Farm Pretzel Fish) and taking samples. This activity again included sampling, data analysis, use of proportions, and finding percent error.

The final unit of the Pre-algebra course was on systems thinking. The students started by using the computer game “Sim City”. On alternating days the students would either work on their own city or develop strategies to address particular problems (such as traffic, pollution, crime, or unemployment) on cities which were created to exhibit these particular problems. Then for two days the students used “Stella” to model the effects of drinking alcohol.
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