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ABSTRACT

Improving the teaching and learning of mathematics, science, and computer usage has been the focus of both education scholars and government policymakers over the last decade. The state of Florida responded by developing a statewide plan to coordinate reform efforts published as "A Comprehensive Plan: Improving Mathematics, Science, and Computer Education in Florida (Comprehensive Plan)." This paper summarizes the effort to evaluate the implementation of the Comprehensive Plan and findings resulting from the evaluation. Initial sections describe the reform movement, reform efforts in California, and the development of the Comprehensive Plan. Subsequent sections describe the evaluation design, implementation efforts of the Comprehensive Plan, observations regarding the influence a state policy has on local curriculum reform efforts, implications for various groups participating in the implementation of the policy, and specific findings and recommendations of the evaluation. A total of 44 findings were reported according to their contribution to attaining the eight goals of the Comprehensive Plan. The goals were: (1) to strengthen the K-12 curricula with an emphasis on student learning that prepares them to succeed in a technologically oriented society; (2) to make mathematics, science, and computer education more exciting by providing incentives to restructure schools and school systems; (3) to increase the use of instructional technology; (4) to increase the number of qualified teachers in these fields; (5) to increase opportunities for minority, female, at-risk, disabled, and gifted students to pursue programs and careers in mathematics, science, and computer fields; (6) to make measurable improvements by 1999; (7) to re-examine and adjust the statewide testing program to support the goals of the Comprehensive Plan; and (8) to expand the productive collaboration of educators with parents, community resources, business, and industry. A list of 12 recommendations resulting from the study is provided. (Contains 20 references.) (MDH)

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An Evaluation of the Implementation of Florida's Comprehensive Plan to Improve Mathematics, Science and Computer Education

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Improving the teaching and learning of mathematics, science, and computer usage has gained considerable interest by both educational scholars and policymakers over the last decade. In reaction to national and local concerns in these subject areas, the Florida Deparment of Education charged a group of Florida educators and business liaisons to develop a comprehensive plan to improve mathematics, science, and computer education that would lead Florida into the twenty-first century. This study was designed to analyze the implementation of a mathematics, science, and computer education policy in Florida and to determine to what extent state policies can impact student learning at the local level.

Background

As a way to frame the evolution of the Florida plan, one must understand the context in which it was developed. In a recent issue of Educational Policy, Papagiannis (1991) identified the Florida policy-making community as national leaders in addressing educational problems. As early as the mid-1970s, Florida policymakers took a national leadership role in implementing policies to set the Florida school system on track for educational excellence. When the flurry of educational reform reports appeared in 1983, Florida had already put into place many of the recommendations found in those reports. In the nine years since those first major reports, a host of reform possibilities have been recommended to combat the apparent slide in student achievement.

Concern about what students are learning and how they are learning continues in 1992 as educational scholars and policymakers proceed to grapple with declining student achievement and increasing public dissatisfaction with the nation's schools. However, the 1992 approaches to these problems are different than the ones taken in 1983. Whereas the earlier efforts attempted to stretch the existing system, the latest efforts are seeking fundamental and pervasive changes in policies as well as classroom life.

The publication of A Nation at Risk (National Commission on Excellence in Education, 1983) marked the beginning of an era in education that is often referred to as the "first wave" of reform. Early waves of reform can be considered the "back to basics" movement. Across the nation educational scholars and influential legislators called for schools to alter curricular guidelines to promote basic reading, writing, and arithmetic skills, and increase graduation requirements.

Many of these early 1980s reform efforts were viewed with skepticism by scholars such as Cuban (1984) due to their top-down nature, i.e., initiatives stemming from state education agencies and legislatures and not from local schools. The ability of the state to greatly influence what happens in local school districts and classrooms in order to improve the teaching and learning environment was at the heart of the skepticism. However, many of these reform efforts were considered successful in the sense they were embraced and implemented at the local level (Firestone, 1989; Murphy, 1990).

Since that first wave of reform efforts, subsequent concerns shifted to a more systemic and comprehensive focus on school improvement. Odden and Marsh (1987) indicated that reform policy implementation became more complex and demanding as the reform movement moved from conquering the basics to radical curriculum reform and school restructuring. The primary emphases changed from a firmer grounding in the basics to an overhaul of the entire curriculum which centered on active learning, problem-solving skills, application of technology, and small group interpersonal skills. In addition, teacher education activities began to center on professionalizing teaching and restructuring school organizations.

Focusing on Mathematics and Science Education Reform

Another aspect which framed the Florida policy and influenced implementation was the growing national emphasis on mathematics and science education. For example, having United States students be world leaders in mathematics and science achievement is included as a national education goal in the America 2000 plan (U.S. Department of Education, 1991). Likewise, a number of states have drafted or enacted similar goals emphasizing excellence in mathematics and science. Recent years have seen considerable interest in improving the state of the mathematics and science curriculum, especially in the elementary schools. Most of this interest stems from a plethora of reports such as the National Assessment of Educational Progress [NAEP] and international assessments indicating that students in the United States of America are deficient in their mathematics and science knowledge and skills. Lack of student ability to compete in mathematics and science with students from other industrialized nations has often been cited as an indicator of present mathematics and science curricular weaknesses (Jacobsen, 1986; McKnight, Crosswhite, Dossey, Kifer, Swafford, Travers, & Cooney, 1987). Scholars and policymakers alike have given special attention to National Assessment of Educational Progress reports which document that most students are reasonably proficient in computational skills but are unable to apply the basic skills even in the simplest problem-solving situations and that both basic understanding and higher order reasoning have not improved (Romberg, 1988).

Higher standards and more intense instruction in mathematics and science were at the heart of many of these proposals. Recommendations for better mathematics and science education often included longer class periods and more credits to be earned as well as a curriculum which emphasized "concepts rather than isolated facts, thinking and the creation of meaning rather than passive knowing, and problem-solving and expression so that knowledge could be used to address meaningful problems" (Marsh & Odden, 1991, p. 219). A corresponding shift in teaching and learning strategies which promote active learning were also noted. Rather than improve direct instruction, a variety of instructional strategies were advocated which could foster inquiry, group cooperation, and social negotiation of meaning.

One of the earliest major reports that focused on both mathematics and science education was Educating Americans for the 21st Century (National Science Board Commission on Precollege Education in Mathematics, Science and Technology, 1983). That report has had far reaching consequences as it provided a focal point for the renewed interests in improving mathematics and science education. Subsequent reports by national groups responded to the call for reform heralded in this report.

State-Stimulated Reforms in Mathematics and Science

Attention to improved mathematics and science curricula is not a phenomenon associated solely with the reports of the 1980s. Although there have been many reform efforts which specifically focused on an improved curriculum during the past 30 years, the National Science Foundation supported science education curriculum projects of the 1960s and 1970s exemplify the direction most improvement efforts have taken. Marsh and Odden (1991) contended that although many of the national curriculum packages were sophisticated, they often did not fit state or district curriculum priorities, nor most testing or textbook policies. Furthermore, teachers, in some cases , attended summer institutes to assist them in implementing programs in their schools. Atkin and House (1981) and Sarason (1982), reported about the apparent failure of many of these early curriculum reform efforts. They asserted that failure often stemmed from the lack of understanding of program objectives by key players at the school sites such as principals and curriculum supervisors, and a lack of vision to fully implement reform ideas by these players as well as teachers.

Implementation lessons from curriculum reform efforts can be useful as states and districts attempt to implement thinking skills-oriented curricula, alter teaching as a profession, and restructure the organizational aspects of schools. Several new dimensions were added to understanding local implementation from studies of more recent curriculum reform efforts, such as the California mathematics and science frameworks and the Florida mathematics, science, and computer education plan.

The California Story

California's curriculum reform initiatives can be viewed as representational of many of the reform movements that call for changes that see students learning content with greater depth of understanding and applying content knowledge to seek solutions to issues and problems. The California mathematics and science frameworks explicitly stated a vision of teaching that encompasses thinking, problem-solving, and application. The frameworks required that teachers learn new content and ways to teach it. Mathematics content reflected the moves away from basic arithmetic algorithms to concepts such as number sense, measurement, and statistics. Marsh and Odden (1991) studied the implementation of these frameworks in a select group of California school districts. They concluded that change of the scope indicated in the frameworks began to take hold in schools and promised to be a systemic change due to parallel reform activities that were also taking place in the state.

In addition to the frameworks, California concurrently launched general reform efforts such as change in textbook adoption criteria, development of a statewide school improvement program which emphasized local adoption of "good" curricula programs, provision of mentor teachers at the school level to assist in the development and implementation of new curricula units, creation of curriculum centers across the state to assist teachers in curriculum development and learning of new pedagogical practices, and the creation of a statewide system of professional development that utilized curriculum reform and change as its focus. These integrated efforts supported change in all areas of reform, especially in the areas of mathematics and science (Marsh & Odden, 1991). Success in local implementation was noted and credit was given to the massive, fundamental, and systemic nature of these reforms.

The Florida Story

Florida has also attempted to enact a statewide reform package for mathematics and science education. Responding to crisis situations lamented by many educational critics, the Legislature of the State of Florida passed landmark legislation in the early 1980s in which the condition of mathematics and science education was a major focus. The 1983 Educational Reform Act mandated that specific competencies be generated which would guide the improvement of mathematics and science education throughout the state. Three products came from this effort: 1) a list of minimum standards, 2) a list of "standards for excellence," and 3) course frameworks.

During the later 1980s, Florida again responded to the crisis situation in mathematics and science education by developing a statewide plan to coordinate all of the proposed and enacted initiatives in mathematics, science, and computer education. A Comprehensive Plan: Improving Mathematics, Science, and Computer Education in Florida (Task Force to Improve Mathematics, Science and Computer Education, 1989) was published in April 1989 as a result of the efforts of a collaborative group of members of the business and educational communities. The broad mission of the group was to prepare recommendations to make Florida a world leader in mathematics, science, and computer education by the year 1999. The Comprehensive Plan listed both strategic goals and practical suggestions for their attainment. In short, the document highlighted the immediate need to develop and implement efforts to ensure that students in Florida have the best opportunities to learn mathematics, science and the application of computer technology.

The Comprehensive Plan was goals-oriented. Restructuring the curriculum, making learning more exciting, preparing outstanding teachers, reaching out to all students, and adjusting the way learning is assessed were some of the goals set forth in the Comprehensive Plan. Many Florida school districts have used the Comprehensive Plan as a guide for curriculum reform and improvement, but to what extent have the recommendations of the Comprehensive Plan been implemented in Florida schools as a means to achieve radical curriculum reform?

The broad issues of how state policies and plans can enhance local curriculum reform efforts and the impact of those policies in classrooms were the foci of this study. To accomplish these purposes, a case study of the implementation of the Comprehensive Plan was conducted. This study provides a systematic statewide profile of what is being done in schools, districts, and the Florida Department of Education to reach the goals of the Comprehensive Plan. It was intended by the Task Force to Improve Mathematics, Science, and Computer Education that the Comprehensive Plan would take ten years to fully implement. It should be noted that this evaluation took place during the second year of implementation. The results of this study should be of use to school district officials, implementors of mathematics, science, and computer education programs, and state policymakers to evaluate current efforts and plan future endeavors toward fully implementing the goals of the Comprehensive Plan during the seven remaining years.

Design of the Evaluation

An evaluation of the implementation of the Comprehensive Plan was undertaken from April to December 1991 by the Science and Mathematics Education Program at Florida State University. The evaluation attempted to determine to what degree progress towards reaching the eight goals of the Comprehensive Plan was being made in the State of Florida. The full results of this evaluation were reported to local policymakers and decisionmakers in early 1992 (Dana, Tobin, Shaw & Engler, 1992). Three levels were identified as being important in this evaluation: state, district and school. Studies were conducted at each of those levels and subsequently synthesized to generate a profile of what was happening with respect to implementing the Comprehensive Plan across the three levels.

The state level study consisted of interviews conducted with state officials with responsibilities for implementation of mathematics, science, and computer education initiatives and analyses of data routinely collected by the state. Thirty-eight people were interviewed and transcripts were analyzed for patterns. Data pertaining to course enrollments, etc. were also collected and analyzed.

Data for the district level study came from questionnaires and telephone interviews. Curriculum supervisors with responsibilities for mathematics and/or science in all 67 school districts were sent questionnaires regarding what is happening at a district level to meet the goals of the Comprehensive Plan. Eighty-six supervisors representing 41 districts responded. Forty-four supervisors with mathematics responsibilities and 42 supervisors with science responsibilities returned questionnaires. These supervisors represent all grade levels with 60% of the supervisors having the responsibility of K-12 general curriculum supervision.

The school level evaluation consisted of questionnaires sent to K-12 teachers, site visits, and classroom observations. Participating in the study were 747 K-5 teachers, 87 middle school science teachers, 91 high school science teachers, 108 middle school mathematics teachers, and 110 high school mathematics teachers. The respondents were from 77 schools in 33 out of 67 possible school districts, representing all regions of the state.

An in-depth case study was done of one Florida school district. Teachers responding in this county were 237 elementary teachers, 16 middle school mathematics teachers, 24 middle school science teachers, 32 high school mathematics teachers, and 33 high school science teachers. Data were also collected from 264 students. Forty-seven elementary students, 52 middle school students, and 45 high school students responded to a mathematics survey and 53 elementary students, 30 middle school students, and 37 high school students responded to a science survey. The student survey targeted students attitudes and beliefs about mathematics and science teaching and learning.

Implementation Efforts

The purpose of this section is to present an analysis of implementation issues that pertain to the Comprehensive Plan and to categorical programs of mathematics, science, and computer education. The framework of analysis used to critically view the implementation of the Comprehensive Plan rests on three main factors: coordination, commitment and vision, and technical assistance. A discussion of observations and implications about policy implementation follows.

Coordination

The issue of coordination became a driving force in understanding how the Comprehensive Plan had been implemented. One of the major reasons for using the concept of coordination as framework for understanding implementation issues stemmed from the fact the Comprehensive Plan was never legislatively mandated and that its implementation was more of a local and philosophic decision than a legal one. As such, programs and initiatives put forth at the state level over the past two years may or may not have promoted the goals of the Comprehensive Plan.

As an example of the lack of coordination of programs that fall under the auspices to the Comprehensive Plan, out of 17 categorical programs in mathematics, science and technology funded for 1990-91, only two projects identified Comprehensive Plan goals as a justification for content or scope of the program. Furthermore, each of those projects purported to serve different needs in the state. Yet, there was no way to determine to what extent they were effective because six had no evaluation component, five had process evaluation but no follow-up evaluation to assess impact on student learning, and only two included site visits to determine classroom impact as part of the evaluation.

That example was typical of what was learned about mathematics, science, and computer education programs administered by the Florida Department of Education. By way of a different example, the issue of coordination, or more correctly lack of coordination, is again highlighted. In conducting this study, data regarding all aspects of mathematics, science, and computer education programs needed to be collected from the Department of Education. However, the needed information was not centrally available, further supporting the notion that there was a lack of coordination in the state for these types of programs. To support this point, five instances are offered:

1) to obtain information on expenditures for mathematics and science at least five different offices had to be contacted.
2) to obtain information on curriculum guidance at least four different offices had to be contacted.
3) to obtain information on instructional technology at least three different offices had to be contacted.
4) to obtain information on staff development at least five different offices had to be contacted.
5) to obtain information on the federally funded Eisenhower Mathematics and Science Program at least three different offices had to be contacted.

There was no single Department of Education entity where complete, up-to-date information and data were readily available that indicated the effectiveness of schools and programs with regard to mathematics, science and computer education.

A major barrier to achieving the goals of the Comprehensive Plan may be the lack of a coordinating agency for mathematics, science, and computer education projects for the State. Using Firestone's (1989) concept of "dominant coalition," there had been no dominant coalition at the state level promoting the implementation of the goals and recommendations of the Comprehensive Plan. The Office of Policy Research and Improvement, for example, was designated as the office responsible for the implementation of the plan, but had no direct influence over other offices that administer mathematics, science, and computer education programs. In turn, the variety of offices with programs had no responsibility to coordinate their efforts with the Comprehensive Plan or any other efforts being put forth by other programs. This lack of a dominant coalition with the power or authority to fully implement the ideals of the plan have been a limiting factor in the overall implementation plan.

During February and March of 1992, the issue of internal coordination of mathematics, science, and computer education programs at the Florida Department of Education came to the forefront after a "Report Card" version of this study was disseminated (Dana, 1992). Establishing coordination structures has become a focus for the Department. The director of an administrative unit indicated that further implementation of the Comprehensive Plan was shifted to his office. He also indicated that he was uncertain to what extent he will be successful in promoting implementation. He cited problems associated with authority as his limiting factor as many of the recommendations in the Comprehensive Plan call for changes in programs or policies that are outside the realm of both his administrative unit and outside the Division of Public Schools in which this bureau is administratively housed. By way of an example, of which this director says there are many, the director indicated that he believed it would be impossible for the staff in his office to influence what happens at the university level in science, mathematics, or education classrooms. The director stated that he felt constrained because it was highly likely that if he was to make a recommendation to Florida universities that would require changes called for in the Comprehensive Plan, the Chancellor for the university system would rebel. He cited some of the coordination problems, such as the university example, as issues of "turfdom" and added that he had never experienced the level of "turf protection" that he has found at the Department of Education.

On a more positive note, oversight of the mathematics, science, and computer education plan by this official is likely to achieve some of the benefits that a coordinating office can provide. The majority of categorical programs for mathematics, science, and computer education improvement are located in that bureau and he has the authority to require coordination among those programs. Additionally,the state received approximately $8 million from the National Science Foundation to improve science education in grades K-8 as well as in lower level undergraduate courses. The Project Director of this Statewide Systemic Initiative as well as the bureau chief cited above have stated that it would be prudent to coordinate all mathematics,science, and computer education efforts directed at K-8 and lower level university with the NSF project. Discussions in late March 1992 centered around the possibility of the Project Director also being the coordinating officer for the other programs and initiatives to ensure that the goals of the project were being addressed. The NSF project goals were firmly grounded in the goals of the Comprehensive Plan, so promoting the NSF project would in essence also promote the goals of the plan.

Another issue surrounding implementation has been referred to as "vertical and horizontal coordination" by McLaughlin and Marsh (1978). The efforts at the state level appeared to be more aligned horizontally now than they were over the first two years of implementation. Previously it could have said that there was a lack of horizontal alignment as there were great differences in the purposes/goals of various mathematics, science, and computer education programs. As another example, Florida adopted six of the seven National Education Goals set forth in America 2000 (United States Department of Education, 1991) as the basis of the statewide Accountability/School Improvement Program. The single goal that the state did not adopt was the goal to have U.S. students become world leaders in mathematics and science achievement -- a goal that would directly complement the Comprehensive Plan.

The concept of vertical coordination can be useful in understanding implementation as well. This concept is generally associated with the terms "top down" and "bottom up" with the notion that policies that have both types of implementation are well coordinated and are likely to be successful in implementation efforts. At the state level, there was a lack of vertical coordination in the sense that the Legislature never mandated the implementation of the plan. It was neither "top down" nor "bottom up" as the office that had initial responsibility for the plan had little influence on the day-to-day operations within the schools.

Coordination is also crucial at the district and school levels. At many school districts, there are different coordinators for elementary, middle, high school, staff development, technological support, etc. Often these coordinators work independently without full understanding of what is occurring at other levels or other areas. Similar to the state level, it was necessary to discuss with each coordinator the issues of curriculum, pedagogy, staff development, instructional technology, and financial expenditures. In some cases superintendents and assistant superintendents had only limited knowledge of what was happening at the school level due to a heavy administrative responsibility. Lack of communication and coordination at the district level can foil any attempt for reform which may be initiated at the state level.

The issue of vertical and horizontal coordination is critical at the district level. Horizontal coordination among the district administrators and principals is of critical importance if worthwhile change is to occur in the schools. Administrators need to be aware of the issues of the reform, have a voice in shaping the reform for the district, have ownership and a commitment to the reform, understand their role in the implementation phase, need to understand the other adminstrators' roles, and encourage reform not as top-down mandate, but allow teachers to have a voice in the pertinent issues and the implementation phase. The vertical coordination between administration and teachers is likewise critical. Teachers and administrators must work as a team (both with equal voices) in developing their vision of what a reformed school and classroom will be. This will take encouragement and support from the administrators as they provide an environment that is conducive for change to occur.

Vertical coordination should be extended also to coordination between state, districts, and schools. The data from this study generally supported the position that there was a lack of an articulated vertical coordination between schools, districts, and state. In most cases it was apparent that members from each of those groups were uncertain as to their role in relation to those from the other groups. Only in a few instances did it appear that district supervisors transcended the boundary between district and state and between district and school. Those curriculum supervisors were most knowledgeable about the ideals set forth in the Comprehensive Plan and could relate those ideals to state initiatives and district policies that were assisting classroom teachers to achieve those goals.

Commitment and Vision

Another frame that is useful in understanding implementation issues is McLaughlin's (1987) concepts of will and capacity. Will refers to a desire to implement a certain program or policy and capacity refers to having knowedge of how a program or policy can be implemented. The concepts of will and capacity are important issues, but can be a limited framework for understanding issues associated with implementation. Both terms place a limit on an individual's abilities and do not recognize the complexities of individuals as they endeavor to understand the intent of a program or policy and attempt to implement it in a highly localized context. Consequently, we have chosen to view these implementation issues as commitment and vision. These terms allowed us to understand implementation from a perspective that acknowledges an individual's role. Commitment is an internal contract to make a change and to persevere to make that change become a reality. Once someone decides that change is indeed desirable, a vision of what change will look like needs to be developed. Vision points to the notion that ideas about implementation are not abstract. Rather, the individual considers change in relation to the state, district, or school context in which they primarily find themselves. We believe that vision and commitment are much stronger concepts that convey our findings in a meaningful way.

There appeared to have been three temporal pockets of commitment for implementation: 1) in the late 1980s when the plan was first announced, 2) in early 1992 after the release of the "Report Card" (Dana, 1992) and 3) during the promotion of the NSF/Florida Statewide Systemic Initiative Project also in 1992. These three events served to consolidate the commitment of several groups of "key players" to implementation. In the three or so years in between inital implementation and now, the commitment to implement the plan was tempered by other critical issues such as the rising visibility of School Accountability and Improvement Program and dramatic cuts and reductions in the budget. The School Accountability and Improvement Program is seen by Department of Education personnel as a feature that will greatly influence what happens in the Florida education system for years to come. As such, the passage of Florida's School Accountability and Improvement legislation is sure to have profound effects on how the state and districts sets priorities.

What will be the fate of the <u>Comprehensive Plan</u> in light of the move towards school accountability? Several Department of Education personnel indicated in interviews that they wished to promote the <u>Comprehensive Plan</u> as a tool schools can use as they set local objectives for improvement. Using the policy as a focusing planning tool would facilitate both horizontal coordination within Department of Education and vertical coordination between the Department of Education and schools and show evidence of a commitment to integrate mathematics and science curriculum reform into the larger reform picture. While this seems like a reasonable approach, little explicit work has been done to put this idea into action.

Aside from the state, school district curriculum supervisors and classroom teachers demonstrated little commitment toward implementation. The <u>Comprehensive Plan</u> was not known to most teachers and some supervisors and, in the cases where it was known, was not a major influence in setting local mathematics and science education priorities. The <u>Curriculum and Evaluation Standards for School Mathematics</u> (National Council of Teachers of Mathematics [NCTM], 1989) had more influence than the <u>Comprehensive Plan</u>. In addition to commitment, it might also be said that both curriculum supervisors and teachers lacked the vision to implement the plan. Not understanding the nature and intent of the plan may be a critical factor in explaining why there is little evidence of the plan influencing local school district activities. The vision of local implementation of the plan was apparent in only a limited number of cases, mostly supervisors who were directly involved in the original formulation of the goals and recommendations of the plan. In those cases, the plan did not serve as a tool to initiate and promote change at the local level, but as an opportunity to justify the vision already in place. These supervisors had extensive knowledge of the intentions of the plan and the state programs that could be tapped into to enhance local mathematics and science education improvement efforts. These supervisors also were limited to curriculum supervision in mathematics and/or science only while other supervisors were responsible for all curriculum areas. In this sense, the ability to construct a vision about implementing the Comprehensive Plan at the local level was limited by the knowledge of the supervisor and the scope of the supervisor's responsibilities. Of special note, one county provided opportunities and resources to a small number of teachers that facilitated the creation of a vision of what mathematics and science teaching and learning could be. The teachers then utilized that vision as a framework to reflect on their teaching and learning. Furthermore, the school district provided these teachers with resources that allowed them to meet throughout the year to support one another in improving their teaching practices. This support system flourished in the district over the past two years. There are now nearly 100 participating teachers. This, however, was a very isolated case.

At the state level the vision to implement, as already mentioned, was weakened by a bureaucratic structure which did not facilitate the coordination of mathematics, science, and computer education initiatives. Mathematics and science personnel at the state level reported having competing demands for their attention with the increased attention given to the school accountability movement. In short, state personnel did not have the authority or resources to implement the plan and any implementation that occurred did so despite the pressures for autonomy and decentralization within the Department of Education. It should also be mentioned that this evaluation of the implementation of the Comprehensive Plan came as a result of the efforts of a small number of Department of Education personnel and others who attempted to maintain the commitment and vision to implement the plan as intended. It has been their efforts in conjunction with the reports of this evaluation that have rekindled implementation efforts.

Technical Assistance

Implementing the vision of the Comprehensive Plan is directly related to the availability of technical assistance. As noted before, the state was not coordinated in its efforts to implement the plan. The state personnel leadership knowledgeable about mathematics, science, and computer education was confounded by the increasing demands on these people which broadened responsibilities beyond the scope of mathematics and science. Furthermore, as cited by many individuals whose voices have been included in this report, there were insufficient funds available for implementation. In fact, the Florida Legislature never enacted a funding package to implement the plan and as a consequence the state and districts focused their attention on implementing legislatively mandated and funded policies before giving attention to the Comprehensive Plan. It might be said that there was a lack of commitment and vision throughout the entire state with respect to the mathematics and science plan due to the lack of financial resources to assist in implementation.

Several products and projects that might be considered technical assistance were initiated by the state and have supported the implementation of the Comprehensive Plan, however. For example, a model mathematics curriculum for grades K-5 was developed and released to schools as an alternative to current K-5 programs. The model curriculum was based on the NCTM Standards and supports the recommendations of the Comprehensive Plan. Another example is the formation of several model high schools where a variety of instructional technology, especially computers, were being used to enhance teaching and learning in all subject areas. Again, the intentions of this project were consistent with the general recommendations in the Comprehensive Plan. It remains unclear, however, whether these projects were a direct influence of the plan or are a result of other activities. Nonetheless, the projects were viewed in a supporting role that assisted schools in implementing the Comprehensive Plan.

Technical support was not evidenced in other areas such as textbook adoption procedures or funding policies. It was recognized by some Department of Education personnel as well as curriculum supervisors that changes of the scope called for in the Comprehensive Plan required changes in policies which influence what districts were expected to do. For example, flexibility in use of funds for texts and other instructional materials was cited as a way that might encourage schools to purchase a variety of instructional materials that could be used in "hands-on" lessons. At present the state supports funding for acquiring new texts but not for acquiring additional instructional materials such as manipulatives that might be needed to initiative a "hands-on" mathematics or science program. The policy which permits little flexibility to districts in the way they spend these funds might be perceived as a lack of technical assistance on the part of the state.

Technical assistance was indirectly available to districts in the area of teacher professional development. Funds for programs such as Title II and Mathematics/Science Teacher Education Training [M/STET] were available to districts on a competitive basis and generally required staff development efforts to focus on promoting innovation in mathematics and science teaching. As far as can be determined from an analysis of the 1990 M/STET proposals, activities to acquaint teachers with the Comprehensive Plan itself were not an official part of any of the funded programs. The staff development generally centered on instructional strategies such as cooperative learning and use of manipulatives. Furthermore, in only a few cases was on-going support an explicit part of the staff development program making technical assistance in implementing innovative instructional strategies the exception, not the norm.

The district level technical support for implementing the Comprehensive Plan stemmed heavily on the support they received from the State. However, some technical support was occurring at the district level. It should be noted that this technical support was not necessarily motivated by the Comprehensive Plan, but ran parallel to its goals. Districts provided resources for teachers to attend professional meetings and professional workshops to gain new knowledge of how to improve their instruction and curriculum. Some districts also provided teachers with release days to visit other teachers' classrooms or to meet with other teachers and discuss issues of improving the teaching and learning of mathematics and science. Many districts created partnerships with local businesses to promote excellence in the schools. Business support can be categorized as financial support as they donated technology or other materials or as personnel support as they provided role models for minority or disadvantaged students and provided experts to assist in science projects. As the financial problems in the state continue to mount, utilizing local businesses for their expertise and financial support may become more critical. It is worth mentioning that in one school district the business partnership coordinator established over 100 business partnerships with financial or in-kind contributions totalling more than one million dollars. However, due to the budget shortfall, she was relieved from her duty and returned to the classroom.

Observations

Several observations are relevant regarding the influence of a state policy initiative on local mathematics and science curriculum reform efforts. First, there were and still are competing forces within the Florida Department of Education that each have a say about the future of mathematics, science, and computer education in Florida. New policies will likely be required to be consistent with the intent of the Comprehensive Plan as well as "fit" with the goals of the Statewide Systemic Initiative if those policies affect K-8 science education. There was great concern from members of the business community familiar with the state's efforts in mathematics, science, and computer education that the State has failed improve student performance in these subjects. The major reason for the limited acceptance and influence of the Comprehensive Plan, according to business leaders at a recent advisory council meeting, was the lack of commitment and vision by those in authority to take charge and mandate the kinds of action suggested in the plan. This group of business leaders has a strong voice that is heard by many people in authority positions in the state. Any new policies that affect mathematics and science education will likely be strongly supported by the business community.

Second, many of the recommendations and goals in the Comprehensive Plan were not considered to be new or innovative to some educators. That perception allowed curriculum supervisors and teachers to say that they have always done the things that were recommended. Part of the reason may stem from a greater focus on implementing some parts of the Comprehensive Plan over others. Many examples have been presented where the plan has been used in a piecemeal fashion -- only those goals that promoted the immediate needs of state and district personnel were addressed. The concept of "comprehensive" was supposed to indicate the need for pervasive and systemic change. Accordingly, a major limiting factor in the full implementation of the plan was the belief by some that change is not needed at all and by others that it was needed only in certain areas.

Another issue that should be raised is that districts often received initiatives from the state, some of seemingly less importance than others. When the Comprehensive Plan was disseminated to all the districts, an official implementation plan never followed. Districts could easily place the Comprehensive Plan on a shelf with other Department of Education recommendations and choose to refer to it only when necessary or convenient. There was no conceptual implementation plan to suggest how the goals of the Comprehensive Plan could be integrated into the classrooms nor was there funding to support changes at the district and school levels. It was a visionary document. It was left up to the districts to determine if they would use it as their vision.

Finally, this study has provided some data regarding what teachers are doing in their classrooms when they teach mathematics and science. It can be inferred from the questionnaire data on change in the past two years that some teachers are changing their instructional practices in ways that are consistent with the ideals of the Comprehensive Plan. The purpose of this study was not to definitively describe what was happening in classrooms in terms of the impact of the Comprehensive Plan. However, the data collected allowed several trends to be documented such as an increased use of cooperative learning, problem-centered activities, and manipulatives in both mathematics and science since 1989.

Implications

Implications for various groups have been interspersed throughout this report. In sum, implementing a policy such as the Comprehensive Plan is complex and all people who are involved in mathematics and/or science education should be affected by such a policy. This study provided several specific lessons regarding policy implementation and its influence on local level reform. First, commitment and vision are important ingredients in the reform implementation process. It is likely that commitment and vision cannot be "given" to persons expected to implement the Comprehensive Plan. Accordingly, ways must be found that allow the key players to develop both the commitment and the vision to implement. Officially requiring coordination among mathematics, science, and computer education programs at the state may be a way to generate the feeling of commitment and vision by the various entities since they will be required to collaborate, set common goals, and determine how to best achieve them. District officials and teachers also need to have commitment and vision in order to implement the plan. This might be best accomplished by leaving the specifics of implementation to local leadership groups composed of both teachers and supervisors who understand the local conditions and what is needed to make implementation work at specific sites.

Second, the issue of vertical coordination comes into play with the Comprehensive Plan. Although not legislatively mandated, the plan was still viewed as a "top down" policy by district supervisors. In reform efforts in California (Marsh & Odden, 1991), the establishment of a linkage between the "top" and the "bottom" is credited with the overall success of the implementation of the California Mathematics and Science Frameworks. The Florida story might turn out successful over the next seven years if future efforts at implementation are geared more to teacher leadership than state leadership in order to forge stronger "bottom up" links.

Third, the lack of coordination of policy initiatives and categorical programs was a severe inhibiting factor to the implementation of the Comprehensive Plan during the past two years. The state initiated numerous programs to improve mathematics, science, and computer education without requiring efforts between these programs to be coordinated to achieve the same goals -- the goals of the Comprehensive Plan. The plan has the ability to provide a framework for a collective vision of mathematics and science in the state. Some state programs and school districts were using the plan explicitly in their planning and goal setting. Many others have yet to capitalize on the goals and recommendations. As a collective vision, the plan should assist all people with a hand in mathematics and science education such as teachers, curriculum supervisors, state personnel, and business leaders to compare their current efforts with those proposed and make and implement plans for revisions where needed.

The last lesson is perhaps the ultimate key to successful implementation -- continued professional development for all involved in implementation. The ideas reported in the Comprehensive Plan required paradigm shifts in understanding mathematics and science, as well as teaching and learning. It is unreasonable to expect that the kinds of changes discussed in the plan will occur overnight. The good news was reported before: changes were happening in some schools and they seemed to be consistent with the changes called for in the plan. On-going professional development for not only teachers but for administrators and policymakers is called for as well. It seems important to provide opportunities for all members of the mathematics and science education community to develop a personal and institutional rationale for the changes called for as well as develop some concrete strategies for implementing those changes.

Specific Findings and Recommendations

The findings and recommendations were based on analyses of quantitative and qualitative data and represent the collective judgment of the evaluation team. The findings are organized by the eight goals of the Comprehensive Plan. Recommendations for improving the implementation of the Comprehensive Plan are presented at the end of the findings section. Most progress has been made in the first two goals. The study found that much is happening to strengthen the curricula and promote hands-on student-centered learning. These areas are also the ones clearly supported by national and state professional associations. The areas showing least progress are in student and program assessment and increasing participation of females and minorities. While even in these areas there has been some progress towards achieving the goals, there has not been a systemic or comprehensive implementation of the recommendations throughout the state.

Goal 1: Strengthen the K-12 curricula in mathematics, science, and computer education. The emphasis should be on student learning rather than merely content coverage so that students are prepared to succeed in a society requiring a high degree of technological and scientific literacy.

1. Consistent with recent national reform efforts, the emphasis for mathematics and science curriculum improvement in the State of Florida has been largely at the elementary school level. State, district office, and school personnel have a heightened awareness of the need to strengthen the elementary curriculum as evidenced by the focus of curriculum improvement in state and local efforts. Publication of the NCTM Standards for mathematics has been a significant factor in encouraging school districts to consider reforms of mathematics curricula.

2. Teachers used textbooks as the primary mode of instruction in mathematics and science. Since textbook quality and innovativeness generally lags several years behind any reform movement, most textbooks being used in schools were not consistent with this goal. In addition to textbooks, current curricula guidelines and assessment procedures placed pressure on teachers to cover many topics in little depth. These practices continue to be a major barrier to the goal of helping

students achieve higher order understanding of subjects required for application in the real world, especially at the middle and high school levels (see Figure 1).

3. Nearly half of all teachers in this study related mathematics and science content to other areas of the curriculum on at least a weekly basis.

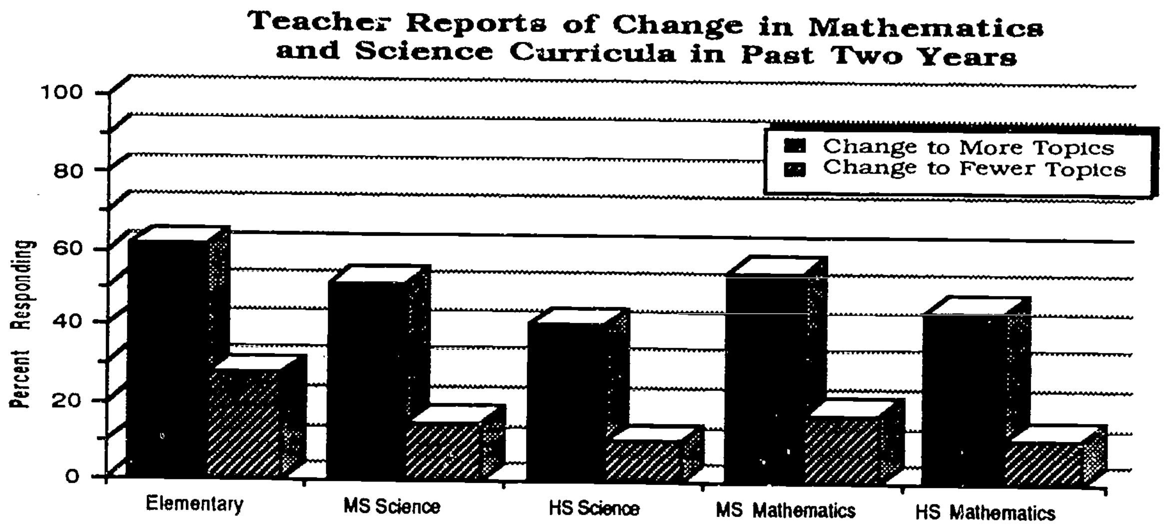

Figure 1 source: T. Dana, 1991 MSCE implementation study

4. Grades K-5 mathematics lessons were more likely than science lessons to include student use of computers. Seventy percent of teachers integrated computers into mathematics lessons while 20% did so for science.

5. By 1994, eleven remedial mathematics courses at the secondary level will be eliminated and replaced with four courses that reflect new mathematics standards.

6. Elementary school students were engaged in mathematics education activities more frequently and for a longer duration than science activities. Mathematics lessons averaged 5 days per week and 1 hour per lesson. Science lessons averaged 3.9 days and 0.5 hours per lesson.

Goal 2: Make mathematics, science, and computer education more exciting. Provide incentives to restructure schools and school systems to maximize student understanding, and share successful efforts statewide.

1. The primary strategy for improving instructional strategies was professional development opportunities for teachers.

2. The State had been aggressive in allocating resources toward building and renovating laboratory facilities and in expanding the availability of instructional hardware and software in the schools. However, the 1991 Legislature cut categorical programs that support this goal by 50%.

Florida Elementary Teachers' Use of Class Time for Mathematics and Science Lessons

Of the five days in a typical week, how many days is mathematics and science taught?

PERCENT OF TEACHERS

	Mathematics	Science
0 days	0.2	0.5
1 day	0.2	4.6
2 days	0.2	12.7
3 days	0.4	28.9
4 days	3.3	18.9
5 days	95.6	34.4

How much time is spent on a typical mathematics and science lesson?

	Mathematics	Science
0 to15 minutes	0.4	3.5
16 to 30 minutes	8.6	24.8
31 to 45 minutes	26.3	50.2
46 to 60 minutes	48.5	18.9

Figure 2 source: T. Dana, 1991 MSCE implementation study

3. Over 75% of elementary school teachers sampled reported weekly use of hands-on activities in mathematics and science. While the figures for middle and high school science teachers were similarly high, weekly use of materials and strategies which support active learning fell to 50% in middle school mathematics and 30% in high school mathematics (see Figure 3).

4. Daily use of textbooks with mathematics students was reported by two-thirds of elementary teachers and 100% of middle and high school teachers.

5. Eight out of ten curriculum supervisors with responsibilities for mathematics and/or science reported an increase in the active learning strategies in their district in the past two years.

Use of Hands-On Mathematics or Science Activities on at Least a Weekly Basis

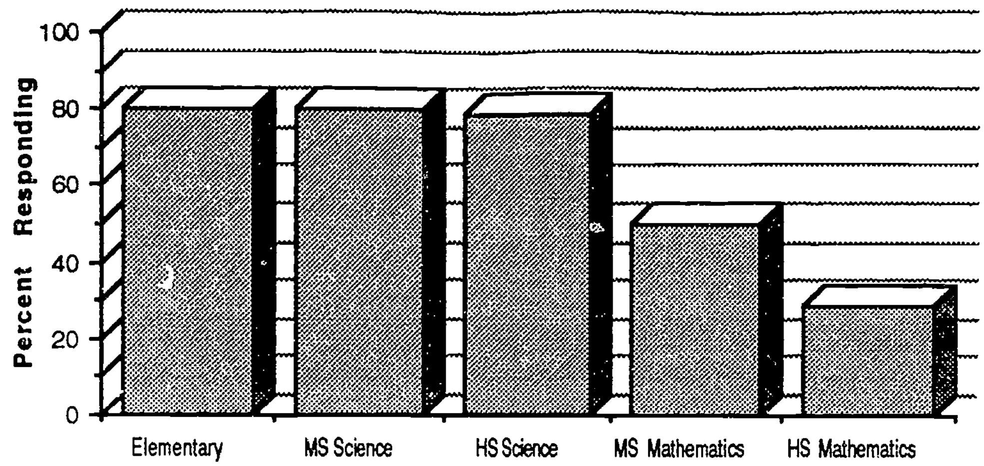

Figure 3 source: T. Dana, 1991 MSCE implementation study

6. Use of field trips, cooperative learning, problem solving activities, and other hands-on instructional approaches were limited by funding for manipulative materials and teacher education, perceptions by teachers that they take time away from covering the curriculum. and teacher insecurity in using unfamiliar techniques.

Goal 3: Increase the availability and use of state-of-the-art instructional technology to improve the productivity and effectiveness of mathematics, science and computer education.

1. Florida public schools reported an increase of 22.5% in the number of instructional microcomputers available to teachers and students during 1990-91. This represents one computer for approximately every 14 public school students.

2. Legislative appropriations to educate teachers about integrating technology into the classroom were eliminated for the 1991-92 school year.

3. Teachers at all levels of school reported an increase in their use of computers for mathematics and science over the past two years. However, the greatest increase occurred among elementary teachers by a 2 to 1 margin over middle and secondary teachers.

4. During the 1989-90 and 1990-91 school years, school self-report data collected by the DOE indicated that 54% of students used computers for computer literacy, 51% used computers for mathematics, and 32% used computers for science. The top five subjects where computers were used by students are listed in order of decreasing frequency in Figure 4.

Top Five Subjects Where Computers Are Used for Instructional Purposes

1. Computer Literacy
2. Mathematics
3. Language Arts
4. Reading
5. Science

Figure 4 source: Florida DOE, 1991

5. Data collected in this study provided an additional dimension to student use of computers. Approximately one-third of the teachers in this study involved students in using a computer as a way to enhance students' mathematics and/or science learning at least once a month during the school year.

6. Two-thirds of all teachers in this study reported they had access to computers for instructional purposes. Figure 5 contrasts teacher access and student use (on at least a monthly basis) by grade/subject area.

7. Other instructional technologies such as calculators and video players were generally available and commonly used in all levels of school.

8. Calculator use by students increased with an increase in grade level while computer use by students decreased with an increase in grade level.

Goal 4: Increase the number of qualified teachers of mathematics, science, and computer education.

1. Based on state data, there appears to be no immediate shortage of mathematics and science teachers. In the past two years there have been nearly four times as many certificates awarded as there have been vacancies. However, over 50% of school district officials in this study indicate that they have difficulty in finding qualified new teachers to teach physics, chemistry, computer science, and Advanced Placement mathematics and science courses.

2. In order to draw reasonable conclusions regarding the supply of qualified teachers, data such as the number of certificates awarded in each mathematics and science certification area, the number of vacancies in each certification area, and the percent of teachers assigned out-of-field are required. Those data have not been made available for analysis and subsequently are not included in this study.

Computers for Mathematics and Science: Teacher Access and Student Use

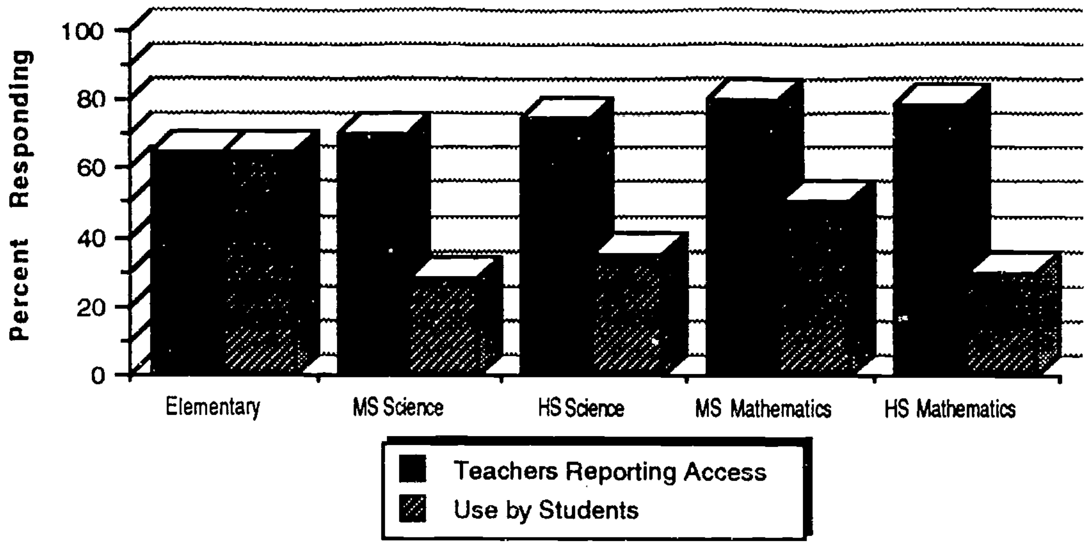

Figure 5 source: T. Dana, 1991 MSCE implementation study

3. Other findings of this study, such as the satisfactory progress towards Goals 1 and 2, was in areas where teacher education efforts have been strongest in the past several years. In areas where teachers reported staff development was weakest, such as alternative assessment and meeting the needs of female and minority students (Goals 5 and 7), progress was substantially less than satisfactory. Teacher enhancement programs may be crucial to achieving comprehensive curriculum reform and improved student outcomes.

4. Appropriation levels for teacher enhancement programs in mathematics, science, and computer education decreased or remained the same for all programs except the Eisenhower Mathematics and Science Program which saw increases in the past two years. The Eisenhower and the Mathematics/Science Teacher Education Training programs resulted in a district level focus on improving mathematics and science through localized teacher education efforts.

5. Professional development funds were administered by five different DOE offices only one of which included staff with expertise in mathematics, science, and computer education. Each of these programs operated independently and, as a consequence, there was little coordination in initiatives which should have resulted in improved curricula, student learning, or educational equity.

6. About 50% of teachers in this study participated in some type of professional development activity geared towards enhancing mathematics, science, or computer education.

Goal 5: Provide greater motivation, incentives, and opportunities for minority, female, at-risk, disabled, and gifted students to pursue programs and careers in mathematics, science, and computer fields.

1. For the past three years, the proportion of African American students enrolled in remedial mathematics courses was greater than the proportion of these students in a school's population. Enrollment data for other courses by race, ethnicity, and gender were not available, but will be collected for the first time in the 1991-92 school year.

2. Only 17.5 percent of the state's elementary schools addressed the goal for increasing the involvement and achievement of under-represented students as a part of Mathematics/Science Teacher Enhancement Training (M/STET) reaching only 14% of the state's elementary teachers.

3. Assisting teachers to learn strategies for encouraging underrepresented students in mathematics, science, and computer applications has been a focus of staff development efforts in 15% in the Florida school districts sampled.

Goal 6: Implement and refine the Comprehensive Plan as necessary to make substantial, measurable improvements in mathematics, science and computer education by 1999.

1. Although the Comprehensive Plan was intended to coordinate statewide efforts both horizontally and vertically, there is in fact no operational plan for reaching the eight goals of the Comprehensive Plan in a systematic manner.

2. There is a lack of consistency in the evaluation component of categorical programs in mathematics, science, and computer education making it relatively impossible to determine the effectiveness of schools and programs. Also, data that are collected about mathematics, science, and computer education programs are not centrally available as they are maintained by different DOE entities.

3. Although all 67 school districts have formally adopted the Comprehensive Plan, there is considerable variability between districts with respect to the extent in which efforts have been made to implement the goals of the Comprehensive Plan.

4. When asked to identify state and federal programs and initiatives that have been most helpful in local efforts to improve mathematics, science, and computer education, district curriculum supervisors overwhelmingly chose programs with the greatest flexibility and entitlement. The top seven programs, ranked in order of degree of helpfulness, are listed in Figure 6.

State and Federal Programs Identified as Most Helpful by District Curriculum Supervisors

Most Helpful

- **Summer Inservice Institutes**
- **Eisenhower Program (Title II)**
- **Mathematics/Science Teacher Enhancement Training (M/STET)**
- **Teacher Stipends**
- **PECO funds for science laboratories**
- **High Cost Science Lab Materials**
- **State Science Fair**

Figure 6 source: T. Dana, 1991 MSCE implementation study

5. The extent to which school districts use the five Regional Centers of Excellence in Mathematics, Science, and Computer Education around the state and find their services useful depends largely on the specific Center, although Centers received a wide range of ratings from districts in their service area. Over 50% of the responding curriculum supervisors said they received newsletters, staff development opportunities, and information about curriculum resources as services. However, 86 supervisors representing 41 districts responded to our survey and indicated that their level of overall satisfaction is not very high. Fourteen percent of supervisors found services to be highly satisfactory, 47% thought the services were adequate, and 39% were not satisfied with the services of their Center.

6. Nearly 90% of all teachers in this study reported they were not aware of Florida's Comprehensive Plan. Furthermore, of the 10% of teachers that acknowledged awareness, nearly 80% indicated that the plan did not influence the way mathematics and/or science was taught.

Goal 7: Re-examine and adjust the statewide testing program to support the goals of the Comprehensive Plan.

1. Science scores on standardized examinations administered by districts are not collected by the DOE. Accordingly, many school districts do not rank improvement of science instruction or assessment as a priority.

2. In early 1991, a statewide task force was charged with exploring alternative assessments in all subject areas. A performance assessment for writing (grade four) is planned for April 1992, but no other performance or alternative assessments are being considered at this time.

3. In addition to little state-level attention to alternative asssessment procedures, less than 10% of the school districts in this study are formally

exploring district-wide alternative assessment techniques such as portfolios and performance-based measures to monitor student progress in mathematics or science. Yet, approximately 70% of elementary teachers, 50% of science teachers, and 30% of mathematics teachers report they regularly use these kinds of assessments with their students.

Goal 8: Expand the productive collaboration of educators with parents, community resources, business and industry.

1. At least 4 statewide mathematics, science, or technology related initiatives generated $22.7 million in matching support from business and industry in the past two years.

2. Nearly 40 state-funded partnerships were lost when the Math/Science Challenge Grants were not funded by the 1991 Legislature.

3. In 1991, the Florida Chamber of Commerce implemented a program called StarMaker bringing together 40 Florida companies, 15 school districts and over 30 schools to promote mentoring of high potential students from under-represented populations.

4. Community resources such as museums and environmental centers were used by teachers on a funds-available basis.

5. Florida School Board Association President Bill Gene Smith served as an Ambassador to school districts for the DOE. He convinced all districts in the state to endorse a resolution to adopt the Comprehensive Plan as local policy.

6. Nearly 70% of all teachers in this study perceived that there was some degree of parental involvement in school-related activities. Figure 7 shows that parental involvement has increased more at the elementary and middle schools than at the high schools in the past two years.

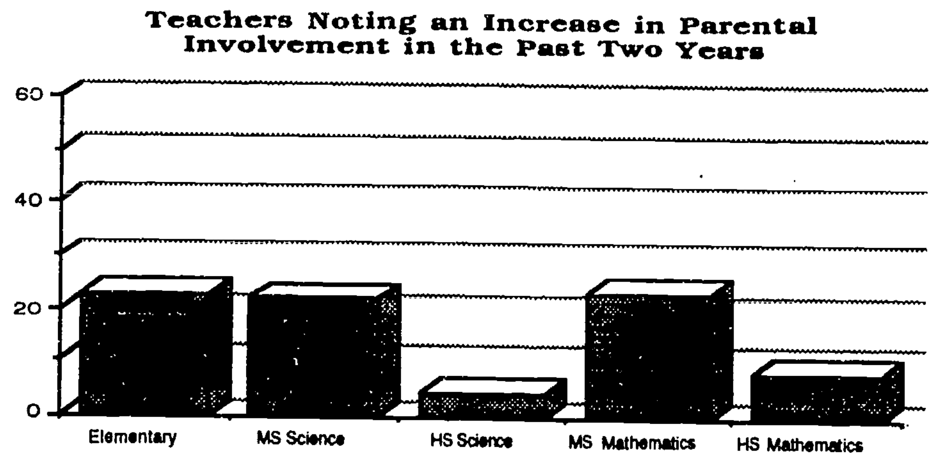

Figure 7 source: T. Dana, 1991 MSCE implementation study

Recommendations

A series of recommendations resulted from this study. The purpose of the recommendations was to facilitate future implementation of the Comprehensive Plan at the state, district and school levels. Those recommendations are:

1. Efforts at strengthening the curriculum, as well as efforts to implement the other goals of the Comprehensive Plan, should continue at the elementary school level. In addition, a renewed focus on middle and high schools is needed to truly develop a comprehensive approach to mathematics, science, and computer curriculum reform.

2. Leadership is needed in reversing the trend of students having to cover a large number of topics in courses or grade levels. Leadership might involve establishing uniform approaches to curriculum guidance which is consistent with the latest research and supported by national groups such as the National Council of Teachers of Mathematics and the National Science Teachers Association.

3. The Florida Department of Education should provide leadership through technical assistance and resource development to help curriculum supervisors and teachers better integrate mathematics, science, and the use of instructional technology.

4. The Legislature should make a renewed commitment to implementing the goals of the Comprehensive Plan and making Florida a leader in mathematics, science and computer education by reinstating cuts made in these programs.

5. The Florida Department of Education, in all its programs and initiatives, should continue its aggressive promotion of teaching strategies which support active involvement and meaningful student learning.

6. Restrictions on the use of instructional materials funds should be relaxed to allow for greater flexibility and less reliance on textbooks, especially during this time of rapid restructuring of educational programs.

7. The state and school districts should encourage flexibility in scheduling and use of discretionary funds to promote innovative implementation of instructional approaches advocated in the Comprehensive Plan and supported by national mathematics and science reform movements.

8. The criteria used to identify qualified mathematics, science, and computer education teachers need to be clearly identified in order to ascertain the status of teacher supply. The criteria need to go beyond measuring teacher preparation. Although somewhat vague and elusive, skill in teaching mathematics and science must be included in the set of criteria which define qualified teachers.

9. Mathematics and science teacher preparation programs at post-secondary institutions should be encouraged to use the Comprehensive Plan to frame the improvement of their programs of study for new teachers.

10. Enhanced teacher professional development in mathematics, science, and computer education must be made a priority to ensure the success of efforts by the Department of Education and school districts towards reaching the goals of the Comprehensive Plan. A systematic approach to teacher professional development needs to be established which:

- Centralizes mathematics, science, and computer education staff development funds so they can have a systemic impact on reform in these areas.
- Coordinates efforts at improving mathematics, science, and computer education with School Improvement Plans.
- Links initial teacher preparation with continued teacher development. Teacher preparation programs should consider the establishment of Professional Development Schools, as outlined by national organizations such as the Holmes Group, as a means to achieve this recommendation.

11. The Department of Education should develop strategies geared toward the district and school levels to promote an understanding of the rationale for the goals of the Comprehensive Plan and assist supervisors and teachers to construct a commitment to personally improving mathematics, science, and computer education. These strategies should be incorporated into present and future staff development opportunities.

12. Districts should conduct needs analyses to determine what special efforts will be useful in encouraging under-represented students to pursue high level courses. A plan for the elimination of all Level I courses is a step in this direction. Additionally, districts should develop and implement plans, under the guidance of the Department of Education, for monitoring underrepresented student participation in mathematics, science, and computer courses.

13. While progress was made toward achieving some goals of the Comprehensive Plan, other goals need much improvement. It is time to revisit the goals and recommendations of the Comprehensive Plan in light of progress that has been made to date. Priorities and procedures should be revised to ensure that Florida can reach all goals of the plan by 1999.

14. The state should establish one entity to oversee implementation of the Comprehensive Plan and give them resources and authority to coordinate the work of all offices involved with mathematics, science, and computer education programs. One of the activities this entity might also do is collect successful strategies being used by programs and school districts in meeting the goals of the Comprehensive Plan and disseminate all programs and districts. The Commissioner of Education also should direct the establishement of a centralized program staff to coordinate programs and initiatives that can further the goals of the Comprehensive Plan. Coordination might involve

reassignment of programs, restructuring offices, or stronger accountability of managers for cooperation and coordination.

15. Program staff should also be required to establish evaluation models that result in outcome and impact measures that can be used to guide programs, and indicate how their program assists the state and schools in reaching the goals of the Comprehensive Plan. It should be the responsibility of this staff to set evaluation criteria and guidelines which can be used by all offices involved in implementing the Comprehensive Plan.

16. Districts need to know that the state values how students are doing in mathematics, science, and computer literacy. The Department of Education in cooperation with districts should develop a protocol for collecting and reporting data from districts which will allow student progress in these areas to be monitored. A move known as alternative or performance-based assessment is being explored nationally for mathematics and science. The state should make the establishment of performance assessments or alternative paper and pencil measures for mathematics and science an immediate priority. These kinds of measures could be incorporated into the Accountability program, district assessments, the High School Competency Test, or writing assessments.

17. The state should continue to enlist the assistance of business, community members, parents, and universities in improving mathematics, science, and computer education. These kinds of activities pay for themselves as they maximize effective use of human as well as financial resources. Funds provided to these groups might be leveraged against their level of involvement.

Conclusions

The implementation of the Comprehensive Plan at the state level has been hampered by the decentralized responsibility for administering mathematics, science, and computer education initiatives within the Department of Education and the lack of full support by the legislature. Within the DOE, responsibility for implementing the Comprehensive Plan was assigned to one office but this office did not have the authority to coordinate the initiatives of the many program offices involved. Most program offices cooperated by linking their program goals and priorities with the goals of the Comprehensive Plan. However, there was significant variation in the degree of implementation.

Additionally, the legislature never enacted a coordinated funding package to implement the goals of the Comprehensive Plan. In fact, programs that contribute directly to the attainment of the goals have seen major cuts since the initial implementation year. Furthermore, present and future Comprehensive Plan implementation strategies will be profoundly impacted by the passage of the School Improvement and Accountabiity legislation.

With heavy focus on the implementation of specific programs, few school districts have developed a comprehensive approach to improving their mathematics, science, and computer education programs and are not using the Comprehensive Plan to any great extent in their improvement efforts. Changes in instructional strategies of teachers are highly consistent with the intentions of the Comprehensive Plan. Although there remains a heavy reliance on passsive learning activities such as textbook readings and lectures, hands-on/minds-on activities are being used on an increasing basis. Elementary teachers have demonstrated the most progress in reaching the goal of actively involving students in problem-solving and hands-on activities, and high school mathematics teachers appear to be the most resistant to these kinds of changes.

This study has shown that teachers, schools, districts, and the state are responding positively towards most of the goals of the Comprehensive Plan. However, a reformed curriculum which emphasizes higher order thinking requires substantial changes in classroom and supervisory practices which are likely to take many years to fully implement. To that end, three major recommmmendations emerge:

- The Comprehensive Plan should be revisited to strategically address the most critical needs areas in light of progress to date. A plan should be developed to focus on how the Comprehensive Plan can come alive on a school by school basis. Authority for making decisions on coordinating program initiatives should be given to a centralized steering committee within the Department of Education. Future Comprehensive Plan implemention efforts should be closely linked to the school improvement initiative as a means for reaching all schools.
- The Florida Legislature should enact a consolidated funding package designed to support the goals of the Comprehensive Plan. This package should include a heavy emphasis on supporting formal and informal staff development for teachers and curriculum supervisors. Findings from this study suggest that a critical factor to successful implementation of the recommendations of the Comprehensive Plan is high quality staff development.
- Student assessment may be the basis for the final judgment of success in the mathematics, science, and computer reform movements. To that end, the state should spearhead the development and implementation of a substantial and worthwhile student assessment system, which avoids the emphasis on basic skills. The purposes of assessment should be to engage students in problem-solving and application of knowledge. These assessments should complement, not constrain, the reform efforts taking place at the classroom level.

This study was conducted to determine where Florida stood with respect to the implementation of the Comprehensive Plan and to what extent state policies influenced local reform. In Florida, teachers, schools, and districts were barely involved in the mathematics and science reform effort; there was little evidence of "bottom up" reform. This result might have been different if the Comprehensive Plan was accompanied with a plan of implementation specifically designed to: 1) coordinate vertical and horizontal efforts at the school, district, state, and university levels, 2) incorporate administrators' and teachers' ideas in the reform movement, and 3) motivate administrators and teachers to become committed to making appropriate changes to enhance the quality of education for all students.

Further Information about this Evaluation

This study was conducted by the Science and Mathematics Education Program at Florida State University under contract to the Florida Department of Education, Office of Policy Research and Accountability. The Principal Investigators were Kenneth G. Tobin and Kenneth L. Shaw, and the Project Director was Thomas M. Dana.

A full report of the findings and recommendations of this "Year 2" look at the implementation of the Comprehensive Plan has been submitted to Florida Department of Education, Office of Policy Research and Accountability, Suite 544 FEC, 325 W. Gaines St., Tallahassee, FL 32399, (904) 488-1611. Additional information regarding this evaluation, the final report, or supporting technical reports may be obtained from:

Mathematics and Science Education Programs
Comprehensive Plan Implementation Evaluation
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