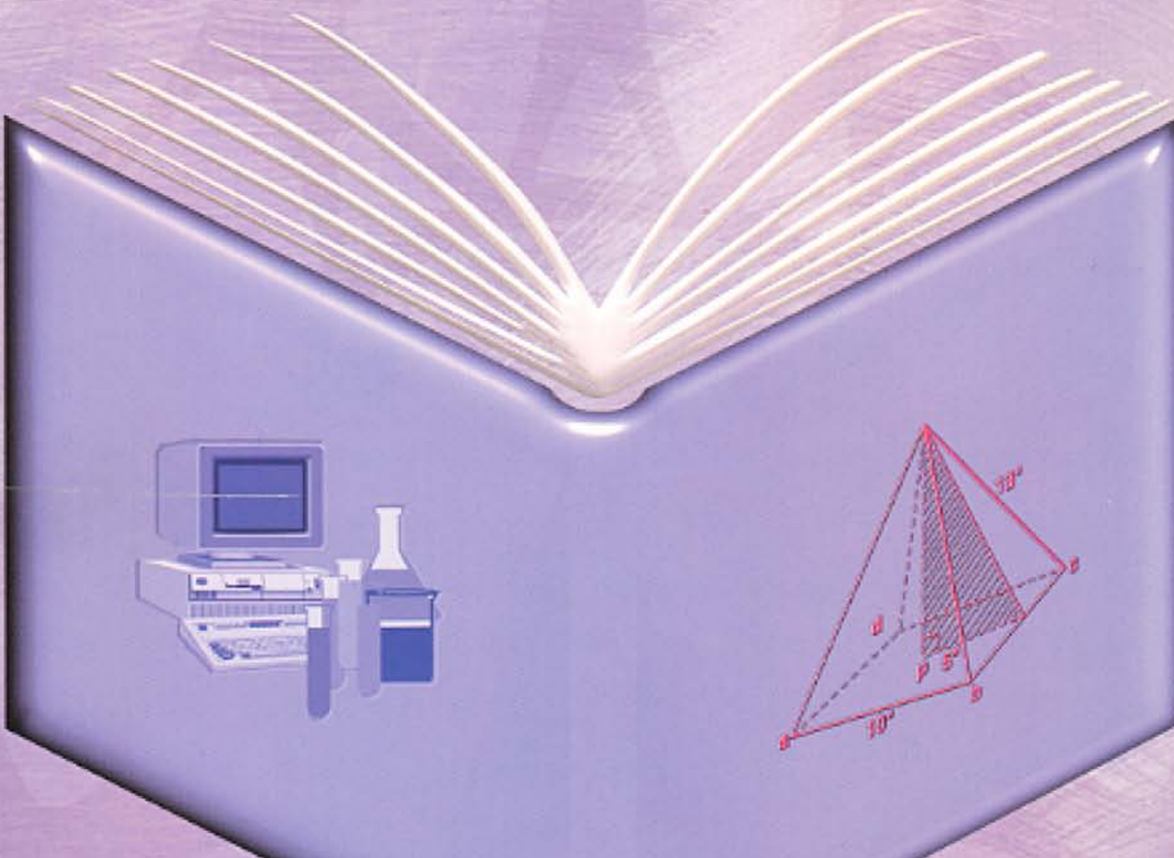
Final Report on the Evaluation of the National Science Foundation's Instructional Materials Development Program



National Science Foundation
Directorate for Education and Human Resources
Division of Research, Evaluation, and Communication

WestEd Abt

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RED Contract 90-010

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INTERPRETIVE SUMMARY OF THE EVALUATION OF THE INSTRUCTIONAL MATERIALS DEVELOPMENT PROGRAM

WestEd and Abt Associates Inc. conducted an evaluation of the National Science Foundation's (NSF's) Instructional Materials Development (IMD) program that focused on issues related to the development, dissemination, adoption, implementation, and impact of materials created with NSF support. An Expert Panel comprising scientists; mathematicians; science, mathematics, and technology educators; educational administrators; and teachers provided input into the study (see Appendix 1 for the members of the Expert Panel). At the conclusion of the study, the Panel met to develop an interpretive summary of the evaluation, which is reflected in this document. The summary offers insight and advice to NSF, future developers and publishers, and others with interest in the development and use of high-quality materials in science, mathematics, and technology education.

Development

The Expert Panel praised NSF for supporting the development of materials that support reform of mathematics, science, and technology education. Further, the members noted that materials are one element in efforts to bring about change in schools, and believed that use of the IMD-supported materials is likely to increase as the education community becomes more aware and supportive of reform. At the same time, the Panel raised several concerns about the processes recipients of IMD support used to develop instructional materials. The Panel members suggested some modifications in the development process in order to mitigate the difficulties encountered in securing adoption and implementation of innovative materials, especially those designed as comprehensive curricula, because they believe that a number of the problems arose from the processes used. The following summarizes the Panelists' views with regard to development:

- The products that resulted from IMD support are of high quality when judged against standards for mathematics and science education. Consequently, the Panel supports the approaches NSF is using to select projects for support.
- The Panel noted that NSF seems to hold two different goals for the program. On the one hand, NSF seems to seek the development of materials that can serve as *ideal models* of curriculum and pedagogy. If NSF seeks ideal models, issues of dissemination and use are less important than whether the models encourage publishers, teachers, and others to consider the implications of deep change in mathematics, science, and technology education. On the other hand, if the goal is to develop innovative materials and curricula that would be widely adopted and implemented in schools, then judgment about the extent of use is appropriate, and materials should be amenable to adoption within the current capabilities of schools. Although the Panel deemed both goals as worthy of support, members believed that NSF might consider funding each approach in a separate program. If NSF did so, developers would be guided by clearer expectations as they designed projects.
- Whatever the goals of the program, the most successful projects were informed by the realities of kindergarten to grade 12 classrooms. In this regard, it seems important for developers to include teachers at every stage of development, pilot, and field testing to ensure that their voices are heard. Further, although NSF may wish to demonstrate the potential value of technology to student learning and to preparing students for a life in which technology has a central place, but should be aware that many schools are not yet capable of using a number of technology applications. Panel members agreed that it was important for NSF to demonstrate the possibilities of cutting edge technology, but also noted the limited immediate impact of such support.
- In addition to ensuring that materials meet national science and mathematics standards, developers should include information that helps potential adopters relate the materials to state and local standards. NSF can facilitate this by providing developers with information about state mathematics and science standards and state-mandated assessment programs.
- Assessment of student learning is essential for IMD success. The Panel believed that devel-

opers should provide data comparing how well students learn using the IMD materials, including how well they retain knowledge and skills over time, with student learning from conventional curricula, using appropriate standards and benchmarks. In addition, the materials should contain assessment approaches that teachers can use to determine how well their students are learning.
- In addition to providing information about student learning, developers should engage students in qualitative assessments of the materials.
- Developers should include information in their dissemination materials that reflects an analysis of management issues, such as the time required for preparation, materials needed for implementation, and administrative and financial support required. Even more important, developers should assess the need for professional development, both in content and pedagogy, to support implementation. Such support can come from a variety of sources, and NSF should increase program integration to ensure that professional development is sustained and comprehensive (see Implementation, below).

Dissemination

The Expert Panel expressed concern about approaches to promoting, disseminating, and marketing the materials funded through the IMD program. In part, the concern related to the perceived lack of clarity about program goals, because approaches to dissemination would differ if the goal were to create ideal models of curricula from what they would be if widespread adoption were the aim. The Panel recognizes that the insight and advice offered may reflect a similar lack of clarity about goals, but believes that its comments will be useful to developers and disseminators. Further, the Panel is aware that the publishing industry is in a phase of great consolidation, and the number of publishing outlets and actively marketed programs has decreased. Consequently, the suggestions offered below should be placed in the current context:

- NSF should consider a variety of approaches, including amending the program guidelines, to encourage greater levels of commitment from publish-ers to publish and market materials emanating from IMD projects prior to making grant awards. To the extent possible, the level of publisher commitment should be a factor in selecting projects, with letters expressing support in vague terms given limited weight as compared to those that outline specific steps that the publisher is willing to take to market the materials. The Panel recognizes that publishers cannot make final decisions about materials without reviewing actual samples. However, publishers can play a supportive role during development by working with authors on ways of organizing the materials to make them marketable.
- In order to facilitate publishing and marketing, NSF should provide developers and their publishers with information about specific difficulties, including legal and financial problems, that previous IMD projects have encountered. Such information could help new projects avoid actions that have led to past difficulties, thereby leading to better product design and marketing plans.
- The Panel encourages NSF to develop policies about using the World Wide Web in development, publication, dissemination, and support of IMD-funded materials. For example, substantive policies regarding continued maintenance of web-based materials for developers and disseminators who make use of the Internet would enhance marketing efforts.
- Although many adopters of IMD-funded products were associated with other NSF programs, such as the State Systemic Initiatives (SSI), Urban Systemic Initiatives (USI), Rural Systemic Initiative (RSI), and the Local Systemic Change (LSC) projects, a number of teachers, schools, and districts adopted and implemented products without such associations. NSF should sponsor a study of such "non-associated" sites to find out what prompted their choice and how they experienced implementation. Such information could be useful to both developers and publishers.
- On a technical level, the Panel expressed concern that current consolidation in the publishing industry might place NSF-supported products at risk. Such risk could result from the merger of publishers of IMD materials with

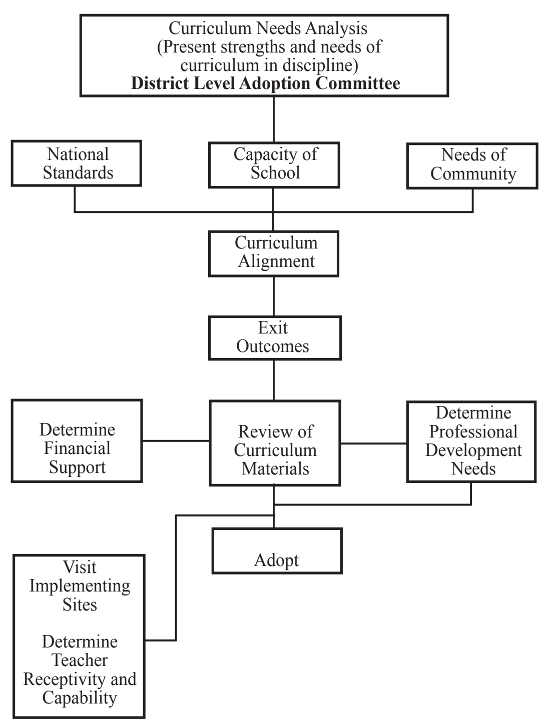
companies less supportive of reform. Consequently, the Panel recommended that NSF should consider requiring a reversion of rights clause in IMD publishing contracts to cover cases of bankruptcy, if this is feasible. Further, the contracts should include minimal marketing requirements, such as continuous inclusion of the materials in the publisher's catalog and inventory maintenance, to the extent feasible.

Adoption

The Expert Panel noted the paucity of data about adoption and expressed three major concerns about the findings of the study related to adoption. First, Panel members noted that materials are often adopted opportunistically, either by teachers or at the school or district levels. Second, they remarked that a large number of teachers who play a major role in curriculum selection are frequently unprepared for making such choices. Third, they were concerned that the study was unable to include data related to how widely the materials are actually adopted, and the lack of such information limited knowledge about the effectiveness of the materials beyond the sites identified by developers. The Panel, therefore, offers the following suggestions:

- NSF should support efforts that provide information about products aligned with reform of mathematics, science, and technology education. Teachers and others in schools are not aware of the full range of materials available and, therefore, cannot make appropriate choices. NSF should encourage developers and publishers to work with state and national professional organizations, state education agencies, and schools, colleges, and departments of education as they disseminate their materials. In addition, NSF should support web-based dissemination activities. Developers and disseminators who understand the adoption process as it actually occurs will be better able to offer useful information, and including teachers on development teams may enhance this understanding.
- In order to assist teachers, schools, and districts to develop thoughtful, professional approaches to adopting materials, NSF should support programs that assist them in learning appropriate models for adoption. Figure 1 provides an overview of an ideal model for adoption. In this model, district committees consider the needs of their communities, the demands of the curriculum, and the goals they wish to attain. Further, once materials are adopted, the committee develops a strategic plan for implementation, including sufficient and sustained professional development and community support. The model could be adapted at the school level in site-based management schools. NSF should consider a variety of structures through which to support better curriculum decision making.

Figure 1
Suggested School District Adoption Model



- Whatever the approach to curriculum selection, teachers are likely to play a significant role in the process. Consequently, it is important that preservice education courses address the issues and processes involved in selected materials. Further, the reform-oriented materials tend to have strong, coherent, and challenging mathematics and science as their base. To understand such material and teach it well to students requires teachers who are prepared with solid mathematics and science backgrounds. NSF should continue and strengthen its attention to preservice education, including concern for curriculum materials.
- NSF needs better information about the extent to which the IMD materials are adopted, the types of districts that adopt them, and the reasons that some choose these materials and others do not. Although developers, disseminators, and some adopters claim that the market for reform-oriented materials is small, if NSF's goal is to broaden implementation of the materials, better information is needed to support the claim. The Panel recognized the difficulty of collecting such information, and recommended that NSF consult with publishers, researchers, and school- and district-based professionals to design a study that will provide the necessary information.

Implementation

The findings of the Evaluation of the Instructional Materials Development Program continually emphasize the essential role of professional development to ensure appropriate selection and use of the materials. The Expert Panel underscored the importance of ongoing, sustained, supportive professional development, beginning with preservice and continuing throughout teachers' careers. The members noted that the materials developed with IMD funding could foster fundamental change in the teaching-learning environment. As such, the products make great demands on teachers, who are faced with the difficulty of changing their practice. As a result, the Panel focused on ways NSF could facilitate and support professional development for those who are implementing the materials.

- Strong collaboration among programs throughout NSF would build the support structures that will enhance implementation of IMD products. The new IMD Implementation and Dissemination Sites have a potentially strong role to play in building such support. Further, recognizing the role of developers in disseminating and facilitating implementation, NSF should create incentives and processes that put their knowledge and skill to good use. NSF-sponsored programs in preservice education, as well as teacher enhancement projects and the various systemic initiatives, can be part of the support structure.
- Because NSF has a number of programs that could provide professional development to facilitate implementation, the Panel urges agency staff to continue to explore ways to integrate program efforts effectively.
- NSF should explore a variety of additional ways to provide the necessary professional development. The Panel notes that particularly powerful models build on the knowledge and credibility of teachers who are already implementing the materials and involve them in networks of users. In addition, support through 24-hour help lines and the web may prove useful.
- Implementation is enhanced by community support for the use of the materials. Consequently, the Panel recommended that NSF encourage projects to devise materials and activities that build parent and community support, through demonstrations, parent- and community-oriented materials, and the use of technology.
- Implementation is also enhanced when teachers have strong subject-matter backgrounds. The Panel noted that preservice and inservice education that strengthens content knowledge will support increased use of standards-based instructional materials.
- Developers and publishers should be clear that implementation is a difficult and uneven process. Such clarity will create appropriate expectations, and help teachers, schools, and districts persist during periods in which they are experiencing problems.

Impact

The Expert Panel emphasized that the development of materials is the first step in a long process. Consequently, the members believed that NSF should continue to fund studies that document the implementation and impact of the materials. The Panel also returned to the question of IMD program goals in their discussions of impact. From the perspective of Panel members, the current study's examination of development, dissemination, adoption, implementation, and impact is an appropriate approach for materials designed for widespread use. In contrast, panelists believed that materials created to exemplify cutting edge approaches to mathematics, science, and technology education should be judged in terms of how well they meet standards and not on their use. However, with either goal, Panel members agreed that better data about student learning essential. The Panel suggests the following:

- The Panel noted that where the materials were well implemented and data related to instructional approaches and student learning were collected, the materials had a positive impact.
- Measures of the impact of the materials should focus on student learning. The key question to ask is the extent to which appropriate use of the materials enhances student learning of important content in mathematics, science, and technology.
- The Panel identified a number of questions that NSF should ask as it assesses impact:

1. Do the materials change how mathematics, science, and/or technology is taught and learned?
2. Are the learning outcomes strong enough to show an impact and convince publishers to adopt similar approaches and/or districts to adopt the materials?
3. Does the technology used in a project improve learning and expand appropriate use of technology in schools?
4. Is there sufficient and appropriate staff development to make the project worthwhile over time and extend its benefits beyond initial users?
5. Does the project fit in sufficient numbers of real school situations to allow it to survive long enough to have the intended impact?

Conclusion

The Expert Panel believed that the IMD program has produced high-quality materials, and the ones included in this study reflect national standards in mathematics, science, and technology education. The insights and suggestions they offered were intended to improve the program. Indeed, Panel members urged NSF staff to view this evaluation as a mid-course, formative evaluation. In that regard, the panelists recommended that NSF sponsor a similar study in five years, when many of the materials will have been available and used for a sufficient period to assess their impact on teaching and learning.

Panel members emphasized that a successful approach to developing materials that will support and facilitate reform should be marked by some key elements:

1. Content and pedagogy based on the standards of the field and what is known about effective approaches to instruction;
2. Assessment of student outcomes;
3. Appropriate use of technology, including delivery using the World Wide Web;
4. Structures and processes that ensure that developers and publishers understand the environment of public school teaching; and
5. Long-term, sustained staff development.

The Panel members believed that some of these elements are currently included throughout the IMD program and others are included in specific projects and should be continued and strengthened. Further, the panelists suggested NSF coordinate existing programs so that preservice and inservice teacher development and the use of IMD materials work together to enhance reform of mathematics, science, and technology education.

Summary of Findings

- Content experts affirmed that the IMD materials reviewed for this study embody the national standards for science and mathematics and reflect current thinking about best instructional practice.

- All projects used a development process that was well grounded in research and involved the participation of a variety of individuals representing different professional positions and areas of expertise. The involvement of teachers was particularly important.

- Although the development process involved field-testing, evaluation, and revision, few projects included assessment of student learning in the evaluation. Rather, the focus was on ease of use and student engagement.

- For virtually all products, the field-test sites became the initial target market.

- Large publishers consider the market for reform-oriented materials to be narrow and controversial, and they tended to shy away from carrying IMD products.

- Effective marketing depends on developers and publishers sharing a vision of the products and the role of materials in advancing the reform agenda.

- Marketing was most effective when it involved professional development in the form of in-person seminars and hands-on workshops.

- Both developers and publishers agreed that NSF should engage in a major communication campaign with teachers, decision makers, and the public to encourage educational reform. This would, they believed, expand the market for IMD materials.

- Fewer adoptions, even of comprehensive materials, were made by district or school teams and more by individuals than was anticipated.

- The most successful approaches to adoption involve processes and criteria that foster teacher investment in and parental support for the materials.

- The availability of professional development is an important influence on adoption decisions.

- The materials challenge teachers to reform instructional practices, which many teachers find difficult. The reform emphasis may stimulate both teacher and community resistance, but also may improve the teaching-learning environment.

- The presence of visible advocates in the district or school enhances implementation.

- Successful implementation, particularly of comprehensive curricula, is supported by sustained professional development, including introductory and refresher workshops and on-site support.

- Elementary school teachers, especially related to science, believe the materials increased their content knowledge, in sites in which the materials were well implemented.

- The materials stimulated the use of student-led investigations and discovery activities, hands-on exercises, and exploration of mathematics and science concepts in sites in which the materials were well implemented.

- Most teachers reported high levels of student engagement in mathematics and science in classes in sites in which the materials were well implemented. A few materials were criticized for having reading levels that were too difficult for the students.

- Although data related to student achievement are limited, existing information shows positive outcomes.

- Overall, the IMD program produces high- quality products. However gaps between program and project intention and actuality appeared at every transition point—as the materials moved from development to publication; from publication to marketing; from marketing to adoption; and from adoption to implementation. When developers and publishers shared a vision about the material, when the materials were marketed in ways that facilitate understanding of the intent of the products, and when adopted in ways that build investment, and when implemented with the support of sustained professional development, the materials have a positive impact.

CHAPTER I

Introduction

The National Science Foundation (NSF) has provided funding for systematically developed, research-based curriculum materials beginning in the 1960s. Over the years, there have been changes in the levels of funding for such instructional materials, reflecting changes in public support and educational concern for such endeavors, with the low point following congressional criticism of *Man, A Course of Study* (MACOS), an NSF-funded anthropology-based curriculum. More recently, however, concerns about student achievement in mathematics and science have focused attention on the need for strong curriculum materials (Flanders, 1987; McKnight, Crosswhite, Dossey, Kifer, Swafford, Travers, & Cooney, 1987; O'Day & Smith, 1993) to support "systemic reform."

NSF has responded to these needs by increasing attention to research-based instructional materials. Materials developed through NSF funding have been reviewed by content experts on at least two occasions. Both groups found the materials to be of high quality and meet the demands of the National Council of Teachers of Mathematics (NCTM) and National Science Education Standards (NSES).

Questions remain about the adoption and use of such materials. Some research indicates that teachers and others are more likely to use materials developed locally than those developed by experts (Fullan, Anderson, & Newton, 1986). Other studies show that teachers and school and district decision makers are concerned with the quality of materials, and that, at least for some, quality is judged by some "external" development or validation process (Louis & Rosenblum, 1981; Crandall et al., 1982). Most recently, Slavin has argued that the seeming failure of educational reform is rooted in the lack of clear and well-developed models for classroom instruction (Slavin, 1997). Carefully developed, research-based curriculum materials, such as those sponsored by NSF, could be seen as meeting the need for such models (Schmidt et al., 1996).

Recognizing a lack of information about the adoption and use of NSF-sponsored instructional materials, two divisions within the agency funded a study of the adoption and use of materials developed through the Instructional Materials Development (IMD) program. WestEd and Abt Associates Inc. are carrying out a research study of the quality of a selection of the materials, the development process used, reasons for their adoption, and implementation issues related to teacher use.

The IMD program supports the development of materials and strategies that promote improved science, mathematics, and technology instruction at all levels. The study is designed to answer the following questions:

1. To what extent do instructional materials embody the national standards, including an emphasis on thinking skills and making connections across curriculum topics?

2. To what extent do they reflect what is currently known about good instructional practice?

3. How well have they been marketed?

4. To what extent do adopters and teachers use the materials?

5. What supports do teachers and other school-based professionals need to make the best use of the materials?

6. What is the impact of the materials on classroom practice?

As the report indicates, the study was best able to provide solid answers to the first two questions posed by NSF and was more tentative about the others. The findings about the last four questions lay the groundwork for future NSF-sponsored studies.

The evaluation comprised five phases:

- An expert panel review of the quality of the materials;
- Telephone interviews with developers and marketers;
- Telephone interviews with key school or school district personnel;
- Focus groups with teachers; and
- Observations of classrooms.

Working with IMD staff, WestEd and Abt Associates Inc. selected 30 products, including elementary, middle, and high school science and mathematics; full courses and supplemental curricula that were intended to be used only as part of a course of study; and technology education and use of technology in education. NSF recommended products that not only illustrated the types of products funded, but also represented both fairly new and more "mature" materials. This selection was intended to ensure that the evaluation would identify differences in approaches to development and dissemination under evolving NSF guidelines, as well as issues related to adoption and implementation when products were quite new and when they were well established. In addition, the contractors selected 15 widely used mathematics and science products that did not receive NSF funding. The "non-NSF" products were not reviewed by experts, nor were there interviews with developers. For those products, the study began with adopters.

As is clear, this study was designed to answer questions about the development and use of products in classrooms. However, an equally valuable study could be based on the premise that the purpose of the IMD program is to provide *models* of curricula for a variety of audiences. From that perspective, an evaluation study would focus on how IMD products, taken as a whole, influence mainstream publishers, developers of state and local guidelines for adopting materials, and pre- and inservice educational opportunities. The alternative study of the influence of the products would start from the premise that the value of federal funding for curriculum materials lies in providing the field with "ideal" examples, rather than solely on their use in classrooms. Indeed, we believe that NSF should sponsor a study based on an image of the role of the materials in facilitating a vision of mathematics and science education rooted in conceptions of educational reform.

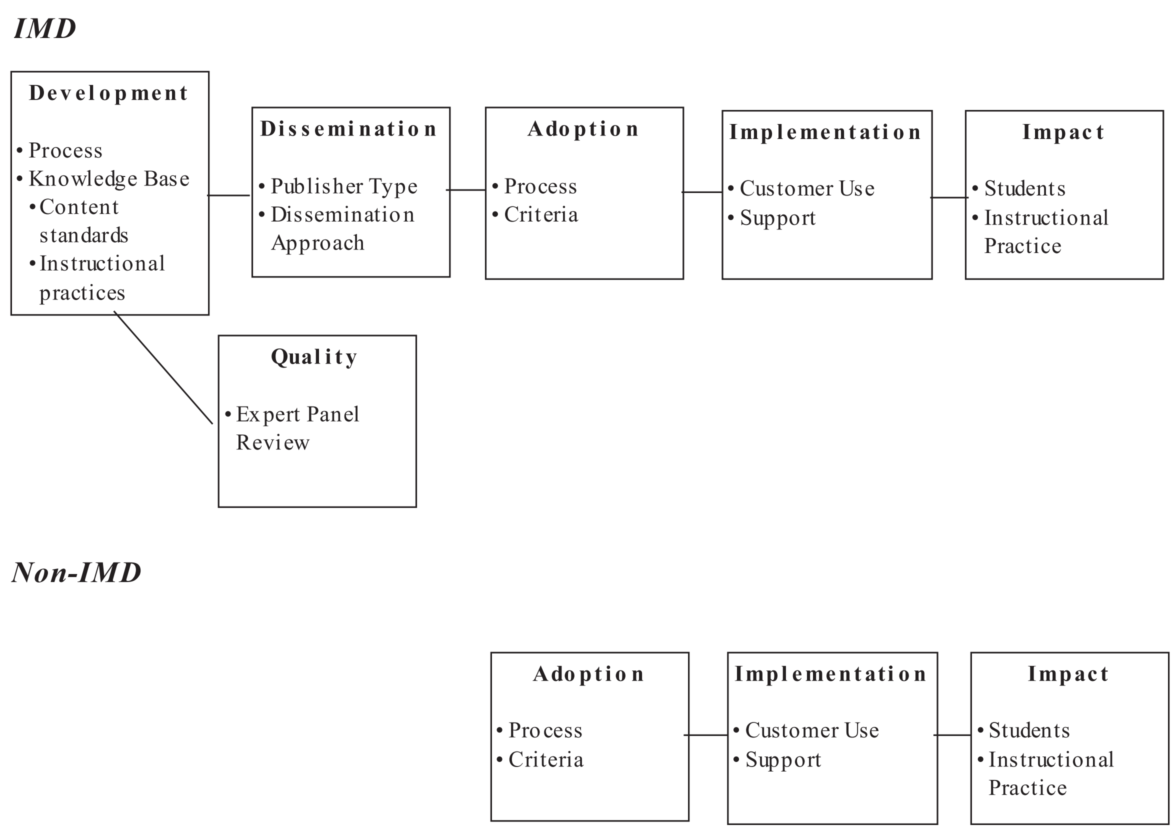
Whatever the merit of a study of product development as an instrument for presenting ideals to the field, it was *not* the question posed by NSF for this study. Rather, NSF was interested in actual use of products, including an analysis of the barriers and facilitators of such use.

Evaluation Methods

The IMD program evaluation was a mixed methods study, based on a design for gathering information at each step in a chain from product development to classroom use. It combined an expert panel review of curriculum materials, telephone interviews, focus groups, and classroom observations. In addition, the expert panel served as interpreters of the meaning of the study. This section will begin with a description of the overall design of the study and then move to a discussion of each method used, the data collected through its use, the evaluation questions answered, and the rationale for the choice of method.

The IMD program evaluation was designed to answer questions related to the development, dissemination, and use of NSF-supported materials. The questions reflect concerns at each stage of development and use, starting with issues related to the quality of the materials and ending with their application in classrooms. The design was intended to inform NSF and others about the relationship of the development process to quality, and how both quality and approaches to marketing affect adoption and use. Further, the design provided contrasting information about marketing, adoption, and use through our identification of widely used non-NSF products and how they were disseminated, adopted, and used. Figure 2 shows the evaluation framework.

Figure 2
Evaluation framework



Each approach to data collection was designed to answer questions about a specific stage in the chain from development to use. This approach is in contrast to some multimethod studies in which multiple sources of data are used to answer one question. Table 1 presents the evaluation question, data sources, and methods.

Table 1
Evaluation question, data source, and method

Evaluation Question	Data Source	Method
To what extent do instructional materials embody content standards and current knowledge of effective instructional practice?	Expert panel review (IMD) Developers (IMD)	Structured written review Telephone interview
How well have materials been marketed?	Marketers (IMD)	Telephone interview
To what extent are users of IMD and non-IMD materials satisfied with them?	Decision makers Classroom teachers	Telephone interview Focus group
What supports do teachers and other school-based professionals need to make the best use of the materials?	Classroom teachers	Focus group
What impact do the materials have on classroom practice?	Classroom teachers	Observations

Development

Information about the extent to which the materials embody national content standards, including an emphasis on thinking skills and making connections across curriculum topics, comes from two sources. First, the Expert Panel reviewed the products, using a structured format that directs attention at key quality concerns. Content and pedagogical experts brought to bear their knowledge and judge the output of the program. Their ratings (and subsequent discussions) provide indicators of project and program effectiveness.

The members of the Expert Panel (see Appendix 1) were identified by NSF and included scientists and mathematicians; science, mathematics, and technology educators; a former publisher; school and district administrators; and classroom teachers. WestEd and Abt Associates Inc. adapted an instrument for evaluating the quality of the materials that was previously developed by Inverness Research under contract to NSF for a study of year-long courses in middle school science (see Appendix 2). The adaptation was designed so the instrument would be applicable to the broader range of materials included in this study.

The Expert Panel met to explore its role in the study and develop shared understanding of the instrument used to evaluate the materials. The meeting included an opportunity to rate some products not included in the study and come to agreement on the meaning of each element in the rating form. Then, two members of the panel with relevant background rated each product. The group met again to resolve differences in the ratings and share their views on the quality of the materials.

Second, interviews, lasting from 45 minutes to over an hour, with key members of the product development teams of the projects identified by NSF included questions related to the intellectual underpinnings of the product, including bodies of scientific, cognitive science, and pedagogical knowledge used to inform their work. The developer interviews also included questions about the development process, including formative and summative evaluation efforts. The interviews not only reconstructed the development process, but they also provided developers with an opportunity to reflect on their experience and how they might approach the task in the future. During the interviews, we also asked developers to share supporting documentation from their project, including evaluations, field-test results, annual reports, and dissemination materials. As a result, the study made extensive use of already existing information.

Dissemination

High-quality materials must be appropriately disseminated to ensure their impact on teachers and students. Consequently, the evaluation included a focus on marketing and dissemination.

We gathered information about dissemination through telephone interviews with publishers and distribution houses that package and disseminate kits and other materials for IMD developers. The non-IMD products were identified through a review of adoption lists in states that have such a process, because we believed that materials included on the list would have widespread use. Our original intention was to conduct similar interviews with the publishers of non-IMD developed materials, but those publishers refused to participate in the study in any way. Consequently, the final report does not include their perspective on marketing. As a result, we cannot compare and contrast the marketing approaches of IMD and non-IMD publishers.

Interviews with publishers were the method of choice for two reasons. First, they allowed us to probe for the reasons that particular marketing decisions were made. Second, given the reluctance of commercial vendors to release information related to sales, telephone interviews seemed less threatening than written questionnaires or surveys, or even in-person interviews. Telephone interviews are also cost effective.

Adoption

Cost effectiveness was the major reason for using telephone interviews of adopters, the customers for the products. Although the original design called for a random selection of adopters from lists provided by publishers, the publishers would not share that information. (Nor would they share information about the numbers of adoptions.) As a compromise, we asked for names of "some" adopters, allowing the publisher to select those to include, but pressing for variation in type of setting and students served. From these lists, we selected schools and districts throughout the nation, representing rural, urban, and suburban settings. This approach is less desirable than randomly sampling adopters because it is likely that the names we receive represent "good adoptions"—districts that participate in publisher- and developer-sponsored staff development, purchase related materials, and provide feedback to the marketer.

The adopters of non-IMD products were identified by asking the IMD adopters to identify nearby schools or districts that used more mainstream products. Although we attempted to select adopters in areas with demographics similar to those in the IMD group, we were not always able to do so.

The interviews yielded information about the process and criteria used for adoption. Further, adopters reported on their use of the materials. Adopters of both IMD and non-IMD products were interviewed so we could see if there are particular processes and criteria associated with the selection of IMD products. Further, differences in use and impact may emerge.

Classroom Use

We elected to conduct focus groups of classroom teachers to gather information about their use of the materials. Focus groups are an efficient method to gather information on specific topics defined by the evaluator. The evaluator can direct the group in a manner that encourages interaction and reveals much about how consumers use the materials. The focus groups explored both strengths and weaknesses in the materials through the eyes of the users, as well as encouraged discussion of how teachers were (or should be) supported through workshops and other professional development opportunities. Further, teachers were asked to reflect on how the use of the materials affected their classroom practice and student learning.

We were not always able to form focus groups, particularly for supplementary products. In those cases, we conducted telephone interviews with users.

Finally, classroom observations, using an instrument that reflects content standards in mathematics and science and knowledge of effective instructional practice, enabled us to contrast classroom practice and student response to IMD and non-IMD materials (see Appendix 3). WestEd and Abt Associates Inc. staff members conducted the observations. Only classrooms using full-course products were observed because the logistics of scheduling observations of supplementary materials in a variety of settings across the nation was an overwhelming prospect. Such materials are frequently used on an *ad hoc* basis, and teachers cannot predict when they will be drawing upon them.

Summary

The study employed a variety of methods to examine issues at each step from development to use. The design assumes that the purpose for developing materials is for them to be used in classrooms, although it does not assume that IMD materials should dominate the market. In fact, our approach will enhance NSF's understanding of the circumstances under which IMD-supported materials lead to high customer use, as well as affect classroom practice. Such understanding may be just as useful for the design of dissemination and professional development programs as for materials development programs.

From an evaluation methodology perspective, the study extends the use of multiple method approaches to evaluation. Most earlier multimethod evaluations are either integrative or sequential (Caracelli & Greene, 1997). Integrative studies use a variety of methods to illuminate a complex phenomenon by employing such devices as consolidated coding, concept mapping, or nesting qualitative methods in an experimental study. Sequential multimethod evaluations typically use qualitative methods to gather information that helps in the design of quantitative instruments, which are then used to confirm or extend findings. This study, however, uses various methods in a sequential fashion in order to build an integrated picture of the development, dissemination, and use of instructional materials.

Limitations of the Evaluation

As with most evaluations, the implementation of the design faced some realities that limit the strength of the findings. The major limitation of this study has been alluded to above—and that is publishers' (both of IMD and non-IMD products) refusal to share information with us. As a result, the evaluation cannot report on market penetration. It also cannot include an analysis of similarities and differences between approaches to marketing by the publishers of the two different types of products.

Publishers of IMD materials were willing to speak with us about the issues they faced in marketing the products, and they also provided names of some adopters. Their lists enabled us to select adoption sites that varied in demographic qualities, including urban, rural, and suburban districts. However, we are cautious in generalizing the findings about adoption and use because the sites in which we conducted interviews, focus groups, and classroom observations were sampled from what is likely a biased list.

Organization of the Report

The final report of the IMD study is organized around the questions originally posed. It begins with an analysis of the IMD products that are included in the study, starting with the assessment of their quality by the Expert Panel, as well as descriptive information about them. The report then moves to a focus on the development process, followed by a discussion of marketing and dissemination. We then turn to adoption, including an analysis of approaches to adoption that seem most likely to affect implementation. Implementation itself is the focus of the section that follows, and, along with providing information across products, the section looks at issues that facilitated or impeded successful implementation.

The concluding section summarizes the findings, and provides recommendations to NSF that are intended to enhance the impact of the IMD program.

CHAPTER II

The Products

The study focused on 30 products developed with IMD funding, selected by NSF staff to reflect a variety of characteristics. Seven products were designed for elementary schools students, including three in mathematics and four in science; twelve were designed for middle schools students, with five mathematics, six science (including two that were science and technology), and one technology; and eleven for high school, including five mathematics and six science. Further, the materials varied from full course, sometimes covering multiple grades, to supplementary materials. NSF also included materials that received funding fairly early, and some that were more recently funded in order that we might see differences in development, marketing, adoption, and use between recent and more mature programs. Differences also existed in the extent to which the products used instructional technology and the types of technology they used. (Throughout the report, the products are referred to as "Project x," with a number replacing the product's name. The numbers were assigned randomly to maintain the confidentiality we promised developers, marketers, adopters, and teachers.)

Tables 2-4 list the products by grade level and content area, with (S) indicating that the materials are supplementary.

Table 2
Elementary school products included

Mathematics	Science/Technology
TERC	INSIGHTS
Everyday Mathematics	Science and Technology for Children (S)
MathTalk (S)	Full Option Science
	Project ARIES (S)

Table 3
Middle school products included

Mathematics	Science/Technology
Middle School Mathematics Through Applications (MMAP)	Science and Technology (BSCS)
Math in Context	Science and Technology (IMaST)
Connected Math	SEPUP
Jasper Woodbury (S)	Science 2000 (S)
Sky Math	Middle School Life Science
	A World in Motion (S)
	Random Universe (S)

Table 4
High school products included

Mathematics	Science/Technology
Interactive Math Project	Adapting Beyond the Mechanical Universe (S)
Core Plus	Biological Sciences: A Human Approach
Project Mathematics	Chemistry in the Community
Visual Geometry	ARGUS (Geography)
Data-Driven Curriculum Strand (Statistics) (S)	Fast Plants (S)
	Human Genome Project (Videodiscovery) (S)

We selected the non-IMD products from the lists generated by state adoptions, because we believed that such materials would be widely used, which would allow us to pursue adoption and implementation issues in schools and districts with similar characteristics to the ones using IMD products. The non-IMD products also included one curriculum developed by a school district, to enable us to gain some insight into differences between the effects of external and local development. The products were:

- Local district-developed elementary science, K-8
- Scholastic Science, K-3
- Prentice-Hall Middle School Science, 6-8
- Honors High School Chemistry (used a combination of texts, including ones published by Prentice-Hall and Glencoe)
- Saxon Mathematics, K
- Creative Publications Mathematics, 2-3
- Addison-Wesley Middle School Math, 6-8
- Houghton-Mifflin Mathematics, 9
- Houghton-Mifflin High School Geometry, 10

Content Quality

Experts and users judged the IMD materials to be of high content quality, although materials held up less well on those criteria related to implementation. This section provides information about the assessment of quality from each perspective, with some hypotheses about the reasons for differences.

Expert Panel

The panel of national experts affirmed that, overall, the IMD materials included in this study embody the national standards and successfully reflect current thinking regarding best instructional practice. The materials are designed to promote critical thinking and problem solving skills and address the needs of all students regardless of background, gender, or ability level. They make connections to real-world topics that span and integrate various subject matter areas.

The content experts used measures of quality based on the National Council of Teachers of Mathematics (NCTM) standards and the National Science Education Standards (NSES) to review the materials. Each set of materials was reviewed by two experts and discussed within a larger group. The panel reflected knowledge of science, mathematics, and technology, as well as expertise in pedagogy and learning. The reviews were largely positive; the experts scored most items above 3.5 on a 5-point scale—5 being the highest score (e.g., “the image of science is current and accurate,” “high overall quality of science/mathematics”), and 1 the lowest rating (e.g., “the image of science is out of date, inaccurate, or non-existent,” “low overall quality of science/mathematics”). Tables 5 and 6 present key findings (high-and low-rated items) for science and mathematics materials developed under IMD support.

Table 5
Key findings in science

Questions	Score (using a 5-point scale)
Do the materials provide sufficient activities for students to develop a good understanding of key science concepts?	4.5
Do the materials accurately represent views of science as inquiry?	4.4
To what extent do the materials provide students the opportunity to make conjectures, gather evidence, and develop arguments to support, reject, and revise their preconceptions and explanations?	4.4
Do the materials include information and guidance to assist the teacher in implementing the lessons?	4.3
Does the content align with all 8 areas of content standards as described in the National Science Education Standards?	3.7
Do the materials provide information about the kind of resources and support system required to facilitate district implementation?	3.6
Do the materials provide information about the kinds of professional development experiences needed by teachers to implement them?	2.8
Do the materials provide guidance in how to link them with district and state assessment frameworks and programs?	2.2

Table 6
Key findings in mathematics

Questions	Score (using a 5-point scale)
Are mathematics concepts accurate and correct?	4.7
Do the materials provide sufficient activities for students to develop a good understanding of key mathematics concepts?	4.4
Do the materials provide sufficient opportunities for students to apply their understanding of key mathematics concepts?	4.2
Do the materials accurately represent views of mathematical problem solving?	4.1
Do the materials emphasize mathematical reasoning?	3.9
Do the materials reflect current knowledge about effective teaching and learning practices?	3.9
Do the materials include information and guidance to assist the teacher in implementing the lessons?	3.7
Does the content align with all 13 areas of the curriculum standards in the NCTM Standards?	3.4
Do the materials provide information about the kind of resources and support system required to facilitate district implementation?	2.6

As noted throughout the report, the implementation stage was the most problematic in the process. The content experts noted that the materials were weakest in their written guidance for how best to provide professional development, gather community support, and align the products with local and state standards, all of which are essential for strong implementation. Further, we found that, for the most part, neither developers, publishers, nor districts mitigated the problem through in-person assistance on these issues. Those who did so had the most successful implementations.

Users

Although users agreed with content experts that the materials met the content standards espoused by the curriculum organizations, they brought additional criteria for quality to bear upon them. From the perspective of teachers, "usability" was equally important as the elements of the national standards. And, although the product developers paid great attention to usability, the classroom teachers in the focus groups raised questions about whether the products were, in fact, usable in classrooms.

The usability criterion had three major dimensions. First, teachers were concerned about the timing and pace of instruction. For example, at least two products at the high school level were judged as requiring greater reading ability than the students had. As a result, teachers made a number of accommodations to students' inability to read the texts, including in-class reading and pairing students. However, these adjustments slowed the pace of instruction to a point that raised teacher concerns. Another product contains units that do not map onto schools' normal divisions, such as grading periods or semesters. Further, its content did not neatly reflect requirements at the middle school in a number of states.

A second dimension of usability relates to the use of technology. Products that rely heavily on technology have limited usefulness to teachers in many schools, although this may change as more schools gain access to computers. However, even with increased access, there is little likelihood that many teachers will have the number of stations one product required. Some teachers who used that product without sufficient computers simply copied pages from the curriculum and had students use them as worksheets, rather than interactively with a computer.

The third dimension involved the degree to which the materials required changes in teachers' classroom practices. For the most part, the IMD-funded products demand fundamental changes in how teachers view content, moving from a perspective that emphasized "coverage" to one that focuses on student understanding; how they view their role as teachers, moving from a perspective that puts teaching in the center to one that puts learning at the core; and how they view students, moving from a view of students as recipients of knowledge to one that emphasizes their role in creating understanding. All these changes are difficult. To the extent that NSF-funded materials stimulate such basic change in practice, they will support efforts to reform science and mathematics education. However, as will be seen, materials are not enough, and teachers need a wide array of support mechanisms to implement the materials in ways that support student achievement of new standards.

Articulation

The products included in this study raised questions about articulation between and among NSF-sponsored materials. Although it may be an artifact of the products the IMD staff selected for inclusion in the study, there seemed to be a heavy emphasis on middle school. Further, a number of teachers mentioned their concern that students came to their classrooms without the necessary preparation for the type of curriculum and instruction embodied by the NSF products. This concern was particularly strong at upper grade levels where teachers believed they had to "retrain" students who were seeking "correct" answers or algorithms to memorize because they were used to having them. Teachers at lower grade were sometimes worried that students who completed curricula in their classrooms would not be prepared for the demands at higher levels. One student said, "This curriculum prepares us for life, but I'm not sure it prepares us for high school." Similar concerns were raised at the high school level about readiness for college work.

Non-IMD Products

Although the Expert Panel did not assess the quality of the non-IMD materials, staff used the same criteria to make judgments about them. Staff placed the non-IMD materials on an informal scale ranging from low-orientation to reform to "reform oriented." As will be seen, some of the same implementation issues arose with the more reform-oriented non-IMD materials as with the NSF-supported materials.

CHAPTER III

Development

This section presents key findings about the process by which the 30 IMD products were developed. The original study design included parallel data collection and analysis related to the non-NSF-funded materials, but the publishers of those materials refused to cooperate with the study. Nonetheless, the findings about efficiency and effectiveness of development of IMD materials provide important information to NSF.

The section begins with an examination of the processes used to develop the materials, including the nature of development teams, approaches to pilot and field testing, and challenges faced by developers.

The Development Process

Almost without exception, the development and field-testing processes were iterative and intertwined. Early versions would be drafted, piloted (most often with teachers from the local area), and revised based upon their feedback. Then, more refined versions of the materials were field tested in multiple national sites and revised still further before being turned over to publishers.

Here is a fairly typical development and field-testing process as exemplified by one project:

1. Identify the important content to be covered within the larger area (e.g., within the geometry segment).
2. Brainstorm about types of stories or powerful concepts that could be featured.
3. Meet with the writers and review the content with them. Generate a first draft.
4. Send the treatment out multiple times ("Drafts went back and forth ad nauseam. We had at least 4 garbage cans full of old drafts!") to the advisory board for feedback regarding content, dialogue, cultural sensitivity, and gender equity.
5. Conduct focus groups of teachers, scholars, and community groups to review the treatments.
6. Pilot an early version of the module in local classrooms.
7. Revise module if necessary, based on pilots.
8. Field-test final version of module in national sites, revising as necessary.

The Development Team

The overall approach to product development relied heavily on the composition of the development teams. All projects involved a wide variety of individuals representing many different professional positions and areas of expertise in the development process. Core teams usually consisted of three to five members, but could include anywhere from 20 to 400+ expert advisors and editors. These teams worked collaboratively to develop and test the materials. An impressive array of content and pedagogical expertise was typically represented within each product's development team. Most frequently, these areas included:

- Science and/or mathematics
- Science and/or mathematics education
- Developmental and/or cognitive psychology
- Curriculum development

- Classroom teaching experience
- Technology and multimedia production

The involvement in development of a broad range of perspectives afforded clear benefits with respect to the accuracy and thoroughness of the content covered by the materials, as evidenced in the expert review of the products. However, only half of the projects included teachers, either using release time, summer work, or a semester- or year-long leave, as members of the development team.

A few developers believed that broad-based involvement of stakeholders helped to diffuse potential controversy and gather support for the products.

> "Development is a very tough process, because you have to please multiple audiences that all have different interests—teachers, state people, political groups, etc. A valuable lesson for us was to have a national advisory board. You can defend the content because of having had their approval." *(Developer Interview, Project 1).*

> "It [development] was a very broad-based process...Each revision involved input from an advisory board that included teachers, people from industry, laboratories, and professors...One thing we learned is how political this process is, especially if you are trying to do something different. It is not enough to do well and throw it out there. You have to work with and build a constituency. You must be vigilant that things can go wrong; you need to stroke, explain, and have patience." *(Developer Interview, Project 2).*

A little over half of the development teams included classroom teachers, and both developers and publishers of the products emanating from such teams repeatedly highlighted their importance in ensuring that materials would fit real-world teaching contexts. They agreed that extensive involvement of classroom teachers in the development process was beneficial, and the consensus was that a lot of involvement is good; more is even better.

> "All of us had lived in a university research environment for a long time...I can't overstate how important their [teachers'] contribution was. One teacher we hired half-time and another 3/5 time. They'd teach and be with us on a daily basis. It was like having a school walk through the door." *(Developer Interview, Project 7).*

> "It is important that teachers be involved with the development of new materials. If materials do not make sense to teachers and are not able to be customized by them, teachers will not use them." *(Developer Interview, Project 5).*

When development teams did not include teachers, it was more likely that the products would fail to meet teachers' criteria related to "usability." For example, two products included "humor" that implementing teachers reported as escaping students. Others required reading levels far higher than students were able to achieve:

> The most vexing problem to the teachers is the reading level of the text. The students, in general, do not seem able to read with comprehension. Teachers say

> they are spending more of their time teaching basic reading and comprehension than anything else. The second problem students have had is that they are so frequently absent that they fall behind and cannot catch up. Falling behind has greater consequences than usual because of how the text structures group work. Teachers wonder, "how are the absent students supposed to fit back in when they come back?" *(Summarized from Focus Group, Project 12).*

In addition, the products that were developed without teacher input at the earliest stages were more likely to demand more understanding of science or mathematical content than most teachers possessed.

The Research Base

Without exception, materials were well informed by research on cognitive development, child development, and learning processes. In some instances, materials developed under IMD support were an extension of previously developed curricula or the developer's own research on curriculum, instruction, and the learning process. For others, the IMD program provided the impetus or initial opportunity to produce innovative instructional materials that embody principles of learning that have emerged from work in fields such as developmental psychology and cognitive science.

As evidenced by the high marks given the products by the expert panel reviewers, the purposes, design, and intended uses of the materials developed under the program are in keeping with the larger standards-based reform agenda. Without exception, developers were quick to offer examples of and clearly demonstrate how the content and pedagogy of their products are a direct reflection of the principles underlying reform, such as inquiry-based learning, constructivism, anchored instruction, and authentic assessment.

> [The product] is standards-based. The developers infiltrated the standards-writing process. Its units are cited as an exemplary way of meeting more than half of the standards–54 out of 72. One state listed it as one of the exemplary units for its standards. *(Summarized from Developer Interview, Project 11).*

> "To maximize student understanding of the content, math should arise from realistic situations so that the students have a need and a reason for doing the operation. That was the primary theoretical focus, but we also built in problems that encouraged student interaction, which is in line with social constructivism. For example, in introducing students to similar triangles and the notion of slope, the math problems might be presented in the context of hang gliding or building a bridge. Activities are organized from less formal to more formal, and they begin with what students already know about the particular problem being posed." *(Developer Interview, Project 15).*

Students Served

In keeping with the tenets of reform, products were designed with "all" students in mind within the particular grade level(s) targeted.

> It is intended to be used by all high school students in grades 9-11, and has also

> been used with high-ability 8th graders. Materials were designed to increase the performance of students with a variety of aptitudes and talents. The curriculum allows students to look at material in many different ways. *(Summarized from Developer Interview, Project 16).*

> "Our first concern was that the materials wouldn't reproduce the bias toward serving suburban communities...So for example, a unit might ask kids to explore cracks in the sidewalk to see what grows there, as opposed to talking about pond life." *(Developer Interview, Project 10).*

One project's attempt to level the playing field among science-oriented students and other students received mixed reviews from consumers:

> "Instead of the traditional sequence, we focused on societal issues that involve [science]...The intent was to design a high school...course for students who are going to college, but are not scientifically oriented. The reaction of high school...teachers varied. We have teachers who love us and some who don't love us. Some believe that [science] must be taught in a traditional way. They might say that we watered it down." *(Developer Interview, Project 2).*

Another potential pitfall of attempting to target all students surfaced in connection with a mathematics project: instruction targeting *all* students that does not specifically address different learners' diverse learning needs can inadvertently create the problem of "teaching to the imaginary middle." So rather than one fitting all, it can look more like one size fitting only a few. One product was described as being, "developed for all students," and yet at the same time the developer described the materials as targeting "the middle 60 percent of students in terms of achievement."

Comprehensive and Supplementary Materials

Opinions regarding the relative advantage of comprehensive versus supplementary materials as a stimulus to reform arose with fairly equal incidence. Those favoring the comprehensive approach believed quite strongly that it represented the best way to achieve meaningful reform:

> The developers believed very strongly that the material should not be available as modules because it would permit schools to adopt only parts of it. They felt this would not bring about the complete curriculum change that they wanted. *(Summarized from Developer Interview, Project 16).*

> "We never considered replacement modules as an option. Always, the idea was: If you're going to do it, do it. It was a philosophical decision. If you're going to change how teachers teach and how children learn math, you have to change everything." *(Developer Interview, Project 15).*

> The team moved from supplementary to comprehensive materials in part for reasons having to do with equity. They felt that teachers in urban schools could not easily buy supplemental materials, so a comprehensive curriculum would be more widely available. *(Summarized from Developer Interview, Project 18).*

Less strongly held views favored a supplementary approach, although the reasons for that position differed among respondents. Some viewed supplementary materials as being more responsive to the needs and realities of the school market, while others viewed the development of supplements as the best or at least most feasible first step toward designing comprehensive materials.

> "We made the decision to produce modules rather than a comprehensive curriculum...Mathematics teachers are fiercely independent and like to do things in their own way...By producing separate modules, the teachers would be free to choose whatever materials they felt would be helpful and could better integrate these modules into existing curricula." *(Developer Interview, Project 8).*

> The market partly directed this decision. People want to be able to pick and choose. Teachers need flexible, supplemental materials, and the developers wanted to provide something that teachers could add to their existing plans. *(Summarized from Developer Interview, Project 12).*

Role of Assessment

There were vast differences across products in terms of the extent to which they incorporated student assessment within their design. Somewhat surprisingly, roughly 20 percent of the projects included no student assessment at all, at least not initially.

> Assessments are not included and were "not a heavy emphasis" in the eyes of the developers. It was assumed that teachers using the modules would "create their own tests." *(Summarized from Developer Interview, Project 1).*

> Originally, they had no vision of student assessment. After field testing, however, teachers expressed a strong desire for assessment items. Developers then responded by creating the Teacher's Resources Package. *(Summarized from Developer Interview, Project 19).*

> In the words of a developer, "We are not in the assessment business." The products carry the suggestion that students develop portfolios based on the materials, but there was no intention to build in assessment as part of the product. *(Summarized from Developer Interview, Project 20).*

When assessments were included in the materials, nearly all tended to emphasize curriculum-specific, performance-based assessment as opposed to more traditional measures, although here were exceptions to this.

> Most traditional assessment, according to the Co-PI, tries to find out what students don't know. Their vision of student assessment, according to all three interviewed, is to allow students as many ways as possible to demonstrate what they have learned in class, which in turn gives teachers many more ways of understanding what their students know and understand. They try to make teachers see that assessment is something that you do every day, and is distinct from grading. The teacher and student materials offer multiple modes of assessment:

> oral presentations, self-assessment, problems-of-the-week, and take-home assessments that extend the ideas embedded within a unit to a different context. *(Summarized from Developer Interview, Project 21).*

> "We offered suggestions for teachers on how to make observations, suggestions for helping kids put together portfolios and cumulative folders, and guidelines for helping kids decide what to showcase that would show improvement over the course of the module. Kids don't consider them tests, but these activities give the teacher an idea of where kids are." (*Developer Interview, Project 4).*

Pilot and Field Testing

Development included pilot and field testing. Pilot tests were generally of early versions of the materials and involved teachers who were geographically close to the developers, and field tests included a wider variety of sites and teachers. Pilot-test teachers gave feedback to developers, who also frequently observed in classrooms. The teachers provided information about how easily the materials were used, student reaction to them, and problems encountered. The value of the feedback is demonstrated by the changes developers made following pilot testing. However, we note that pilot-test teachers were drawn from those with whom developers had an earlier relationship, either through professional associations or prior work with the school districts that employed them. Consequently, they were likely to be sophisticated, reform-oriented teachers who had participated in earlier professional development activities.

Products were field tested in a wide enough range of settings representing students with a variety of backgrounds. Local and national field-test sites included students from all ethnic backgrounds; ability levels; geographic areas; and from an appropriate mix of urban, rural, and suburban settings. There were two exceptions to this. One developer felt that too few urban schools were included in the field tests, which reportedly, "led to a myth that the materials were only good for suburban and higher level students." The other noted that the project would have benefited from, "better representation in the field-test groups of high-ability and accelerated students."

The realities of school schedules, governance, and agendas often resulted in delays and other challenges to the field-testing process.

> Field testing suffered from many problems related to school independence. Schools were doing so on a voluntary basis, and implemented the materials to meet their own needs and commitments. Implementation varied across schools. Five of the ten schools put their best students into the control group and below average students into the project group. One school put all their students into the project group. Sites used different standardized tests and different testing schedules. Also, many schools did not have adequate technology to implement all the activities. *(Summarized from Developer Interview, Project 24).*

Delays experienced in the field-testing process contributed to the widely held desire on the part of developers for funding to be granted for longer periods of time.

> The publisher recommends that developers be funded for a 6-7 year cycle, rather than the more typical 3-4. This would cover two years of research and development to get the materials field-test ready, three years for field testing, and then a

> year or two to get the materials market-ready. He thinks that NSF needs to be better aware of the fact that curricular materials can't really be developed any faster than students and teachers can try them out and developers can redesign them. *(Summarized from Developer Interview, Project 6).*

The vast majority of data collected during field testing consisted of teachers' and students' perceptions of the usefulness of the materials, anecdotal evidence of students' engagement with or apparent benefits received as a result of the use of the materials, and measures of teacher or student satisfaction and attitudes regarding science and mathematics.

Even among the more recently funded and most commercially successful projects, there was a conspicuous lack of emphasis on evaluating the instructional materials' effect on student learning, either immediately following the experience or to assess student retention of concepts, information, and skills. Indeed, some of the quotations below indicate that developers believed that the sole focus of the required formative evaluation was on how readily teachers could use the materials. While perhaps disconcerting, it is not surprising that approximately 70 percent of the projects conducted no evaluation of student outcomes (comparative or otherwise) that would enable them to measure the impact of the materials on student learning of specific content.

> "It [outcome evaluation] was not required by NSF. Measuring student gains wasn't required; it wasn't necessary. We collected qualitative information only—observations and comments, input from developers, teachers, trial coordinators, and observers...No other evaluation was performed. NSF doesn't pay for assessment and data analysis...so the real research on the materials will have to come independent of us...." *(Developer Interview, Project 4).*

> The evaluation did not include attention to student outcomes. One team member did an evaluation of student attitudes early, after the first commercial edition (1988-89). Other results were anecdotal (e.g., impressions of the number of students continued in another course and were successful.). There was no concerted follow up to track the relative success of students. *(Summarized from Documents, Project 2).*

> There is constant evaluation and feedback from teachers through the developers' 1-800 phone number. [Name] has been the external evaluator for several years. While she has done a number of evaluations, they all focus on teachers rather than the actual material. They looked at how well the product worked as teaching material, with a secondary focus on students. *(Summarized from Documents, Project 23).*

> An evaluator was named in the proposal and carried out a very small scale evaluation, mostly because it was obviously required in the RFP. There was very little money to do evaluation—just a few days for evaluation and expenses—his role was more like an auditor's. He would come in and be present at key points and would provide feedback to the developers on what he was hearing and observing. He focused on the development process, not on the content. One bit of advice the evaluator offers to NSF: 10 days over three years is not adequate. *(Summarized from Evaluator Interview, Project 11).*

There were exceptions—some projects used part of their IMD funding or were able to secure additional funding to conduct or contract for evaluations of the impact of the materials on student learning. Several project evaluations indicated that the materials had a positive effect.

> The developers believe that there is no purpose in developing materials that are unproven. If schools are going to adopt a program, there must be evidence that the program improves student achievement. The program received a third-party evaluation that indicated that students in the treatment group performed significantly higher than students in the control group, and that treatment students scored higher than the control students regardless of pretest difference in their achievement levels. *(Summarized from Developer Interview and Project Documents, Project 17).*

> The staff completed both a formative and summative evaluation. Students who used the materials had higher raw scores than students in the control group. The treatment students answered more test questions and answered more of them correctly than students in the control group. On standardized tests such as the California Achievement Test, students in the treatment group made gains of one and a half to one full grade-level over scores from the pretest. Attitude shifts about science were also monitored for girls, Latinos and African American students. Positive shifts were found for female students from all ethnic backgrounds. The subgroup samples of Latino and African American students were too small to generate any significant data. *(Summarized from Documents, Project 19).*

> "Students using the materials outperformed control group students on measures of complex problem-solving and did better on some of the subtests. On computation and application of skills, the students did as well or better than the controls." *(Summarized from Developer Interview, Project 1).*

> Field testing involved 12 schools with 6 treatment and 6 control schools. Impact evaluation was done during the field testing phase. Among other impacts, the evaluation assessed whether there were differences in student outcomes related to gender, SES, or cultural background. The group's mean achievement score was significantly higher than that of the comparison group, and the difference was significant at the .04 level. Student attitudes showed no significant differences between treatment and comparison groups at both the pretest and post-test. *(Summarized from Project Documents, Project 5).*

Evaluation of student learning did not uniformly favor IMD products. Some materials evidenced little or no differences between IMD and other materials.

> The developers' philosophy is that all activities that have measurable outcomes need to be assessed. Both formative and summative evaluations were done during both the pilot and field-test phases. A control group design was used to measure basic skills, higher-order learning skills, and science attitude between students using the materials and those in regular classes. Standardized achievement tests were used along with problem-solving measures. The major result of the evaluation was that there was no significant difference on content knowledge gained

between students using the product and those in regular classes. *(Summarized from Interviews and Documents, Project 24).*

Development and Marketing

For virtually all products, the field-test sites turned out to serve as initial target markets. The involvement and participation of teachers as product developers led quite naturally to their buy-in and subsequent interest in adopting the materials.

> "...what they did was to bring together teachers to participate in training workshops during the field-testing even before the products were published. This created a cadre of people who keep coming back. It's been a fabulous way to get a stronghold in the market...You've got ready customers out there because of the field testing, and those contacts require care and feeding. You've got to manage the demand that the field testing creates, as opposed to just waiting to recontact them two or three years later." *(Summary from Publisher Interview, Project 27).*

> Purchasers have primarily included teachers, schools, and districts that have been directly involved in field testing. *(Summarized from Publisher Interview, Project 15).*

> "The field test touched on Texas, California, New York and Colorado, and a lot of the initial sales moved out from there. There were teachers there ready and willing to adopt the course and materials." (*Publisher Interview, Project 20).*

Role of Developer in Marketing

For many projects, developers played a critical role either directly or indirectly in assisting their publishers to identify target markets and the strategies for reaching them. Both developers and publishers agreed that IMD developers—given their still forming market niche—played a greater role in developing marketing strategies than is typically the case between a publisher and developer in the traditional textbook market.

> "[After some preliminary difficulties], NSF then gave us 90 days to find a publisher. All of the other programs that had made their initial agreements with standard textbook publishers had found that those publishers stayed with them until the materials were completed, but then they would eventually walk away without signing contracts. We had been seeing what was happening, so we had deliberately avoided them...Eventually, we approached one company with the idea that [we] would put them back in the marketplace. Up till then, they'd only been selling movie films, and had been losing money. I showed them how to go into video lessons, laser discs, computers, plus hands-on science materials. They got involved in 1987, and the [grades] 3-6 materials turned them around to where they started making a profit, and were later willing to invest more in the [K-2] materials." *(Developer Interview, Project 4).*

> "In marketing the materials, it also adds credibility to be associated with prestigious groups. The recognized name and credentials, combined with NSF funding,

> is stronger than NSF funding by itself." *(Publisher Interview, Project 4).*

> The publisher did not actively seek out or otherwise proactively identify members of the target market. Rather, they have relied largely on the training and professional development activities undertaken by the developers themselves to generate interest in such alternative curriculum materials. The publisher also relies quite heavily on word of mouth referrals between users, and on the fact that NSF's IMD program is known within the math community and people have been awaiting the products funded within it. *(Summarized from Publisher Interview, Project 7).*

In a few instances and for different reasons, developers doubled as the publishers of their own materials. For a small number of projects (less than 10 percent), the decision to self publish was a conscious one designed to circumvent the commercial publishing arena in order to make the materials available to teachers free or at minimal cost. For another small set of projects (again less than 10 percent), the decision to self publish was driven by difficulties encountered in finding or keeping a publisher to carry the materials.

In roughly 20 percent of projects, the developers played a far less active role in marketing, choosing instead to leave the marketing to the publishers once development was completed. This approach has met with mixed results in those instances where publishers were less experienced or otherwise hampered in their capacity to carry out their agreed-upon functions.

> Marketing and dissemination were problematic. These functions ended up with a group that was just starting in the elementary school market and had neither the knowledge nor the enthusiasm to market effectively. In the words of the marketer, "We did not have a lot of experience in the elementary school market. The sales force wasn't comfortable with the materials and they didn't put much energy into it. They didn't follow suggestions." *(Summarized from Publisher Interview, Project 20).*

Conclusion

Although the vast majority of the development teams receiving IMD funding produced high-quality materials that meet content standards, the development process itself contains the seeds of ultimate success or problems. For example, the composition of the development team influenced the degree to which materials were judged usable by adopters. More positively, field-test sites became early adopters and champions of the materials and the fit with content standards was frequently cited by adopters as influencing their decision.

Few projects collected data related to student outcomes, so there is little evidence besides expert judgment that the materials will help students meet high standards. On the other hand, few adopters asked for information about student achievement to influence their decision to adopt, although parent and teachers concerns during implementation frequently raised questions about how well students would perform.

CHAPTER IV

Dissemination

The relationship between the developer and publisher is a crucial link in the chain from development to implementation and use. In many projects, developers and publishers shared a vision, resulting in published materials that matched the intention of the developers. However, in others, differences between the two led to changes in the product and deviation from the original goals. Such deviation, when it occurred, led to problems related to adoption, implementation, and use.

As materials move from developer to publisher, they are considered in the context of the market. If a market for reform-oriented materials exists, mainstream or other commercial publishers would use their resources to support dissemination because the materials could be profitable. However, the major barrier faced was the perceived absence of a market for reform-oriented materials.

Most developers did not systematically identify an appropriate market before proceeding with development of materials. Except for those developing extensions of earlier materials, developers were more concerned with creating innovative materials than with their eventual use:

> "We were not trying to produce a curriculum that was market driven. Instead, we reviewed current middle school curriculums and tried to produce an innovative curriculum where one did not exist." (*Developer Interview, Project 11).*

Both developers and publishers repeatedly spoke of a reform-oriented market as comprising 20 to 30 percent of the total market, although no one was able to provide a reason for that number. However, the widespread belief that the market was small meant that few major publishers were interested in accepting the materials. Further, even those who published the IMD materials cited the need to build the market for reform before significant market penetration could be gained. In addition, although developers and publishers believed that professional development served an important function in disseminating the materials and acted upon that belief, publishers noted their own limited ability to provide the type of professional development required.

Marketing success largely built on positive relationships between developers and publishers. A further element in success was the activity of the developer in assisting marketing efforts.

This section begins with a look at developers' perspectives on why large publishers seem reluctant to publish IMD-funded materials. The original intent of the study was to ask major publishers about their views of NSF-supported projects and the reasons they were either willing or unwilling to publish them. However, major publishers refused to take part in the study, so the voices reflected in this section are those of developers only.

The section then moves to a discussion of the relationships between developers and publishers, highlighting elements that support active dissemination and those that seem to be barriers to widespread use. The third part focuses on what developers and publishers called "building a market for reform" as essential to successful dissemination, adoption, and implementation of NSF-funded products. The section concludes with a look at the marketing strategies used and notes the importance of professional development as an approach to marketing, but also acknowledges the limitations in relying on publishers to provide that professional development.

Reluctance from Larger Publishers

There were a few projects where developers signed with larger publishers, either from the start, or after first working through a smaller publisher. However, to their chagrin, most developers discovered that the majority of the larger publishers were unwilling to publish the materials. The developers stated that major commercial publishers consider the reform market to be narrow and controversial and tended to shy away from carrying IMD products. Because those publishers would not talk with us, we can only report on the developers' perspective.

> "We've been looking to get another publisher, but prospective purchasers are seeing the potential controversy. Also, other publishers typically have their own line, and they don't want to cannibalize those sales...We came to the realization that publishers are very reluctant to take on these new curricula and the expenses associated with them. Unless you find one, usually a smaller one, that's willing to take a risk, they're just not interested...The publishing industry has not been known for its innovations. If anything, they're known for the opposite." *(Developer Interview, Project 15).*
>
> Developers felt that getting a publisher is of critical importance, and that they were lucky to have found who they did. The PI emphasized that you have to get a good publisher, not just a publisher. Many publishers are so large that they don't pay any attention to those doing projects like this. The teacher/developer commented that she wasn't sure what would have happened to their project if they hadn't connected with the publisher. She's not sure they could have gotten the materials out. *(Summarized from Developer Interview, Project 6).*
>
> "There is still a bottleneck in terms of problems in the publishing field. It is unrealistic to expect publishers to participate in killing their own cash cows. The standard textbook people are still a problem. The reason [our publisher] is amenable is because they see educational reform as their publishing niche." *(Developer Interview, Project 2).*
>
> "Most curriculum products are published by big publishing companies who can afford to give good deals to districts that buy large numbers of books. Big publishers are not willing to invest in new curricula, so new curricula are often published by small publishers who cannot afford to offer such deals. This makes dissemination of new products difficult."*(Developer Interview, Project 19).*

One publisher in particular identified itself as focusing on the reform-oriented niche of the general market. Its focus has both positive and negative aspects for the IMD program. On the one hand, the editing and sales staff understand reform-oriented curriculum and can work closely with developers. On the other hand, the limited size of the market it pursues constrains the funds it can invest in dissemination and staff development.

Relationships Between Developers and Publishers

Effective partnerships between the developer and publisher were often characterized by a shared vision of the education reform agenda or shared knowledge of important content principles embodied in the materials, which made the niche market publishers attractive to developers. In the best situations, developers and publishers took seriously the need to be full partners in promoting and disseminating the materials. On the developer side, this meant that from the outset, members of the team realized the importance of finding a publisher who felt comfortable in taking the risk to publish niche materials, understood the developer's vision, and valued the need to provide professional development to potential adopters. On the publisher side, the best relationships were characterized by a strong commitment to professional development, understanding of the type of material with which they were working, and knowledge of the actual content.

In one successful partnership, the developers were savvy about their relationship with the publisher, in part because a member of the development team was familiar with marketing and the business aspects of publishing. The developers included contractual provisions related to their major concerns:

> "…We were careful to write into the contract that we were to participate in all aspects of marketing and development. In fact, their sales staff had to be okayed by us…We wanted to build a relationship with the publishers and be partners all the way…" *(Developer Interview, Project 4).*

The publisher also understood the nature of the materials:

> "It's clear that this wasn't competing against textbooks—we had to appeal to schools, districts, and states who were interested in looking at fresh approaches to improving science education for children. We were competing in a huge market but as an entirely new entity." *(Publisher Interview, Project 4).*

In addition to the shared understanding between developer and publisher, successful dissemination of the materials built on the existence of earlier, related materials, which created an initial market.

Another successful partnership involved extensive efforts by the developer to build a support network before making the materials commercially available. Building the network was possible because the product was fairly well developed prior to receiving IMD funding. At the same time, the publisher's staff spent time with the developers and members of the network so they could understand the materials.

> The sales manager and vice president of marketing have gone through the training for the materials so they can understand at a deeper level how to represent the materials in the marketplace. *(Summarized from Publisher Interview, Project 5).*

Less effective developer-publisher relationships were often characterized by a gap in understanding between the two parties, which, at its most extreme contributed to a mismatch in goals. In such cases, developers were naive in selecting the publisher, and publishers did not understand the product, the developer's vision for it, and the difference between the IMD-funded materials and more traditional curricula. The potential for conflict between developer and publisher is great because each brings its own perspective to the partnership. Although the developers would like the materials to be widely disseminated, their main goal is to have the materials implemented in the classroom to advance an approach that they deem important:

"…we don't want people buying the materials for the wrong reasons…We felt it important to argue the integrity of the materials…Since they were into the money and we weren't, we viewed [working closely with the publishers in marketing] as counterproductive to our purposes." (*Developer Interview, Project 7).*

"NSF needs to keep encouraging innovation. The market will do nothing itself to encourage the development of better science curricula... Publishers do not care about producing innovative curricula but only textbooks, which can be sold for a profit." *(Developer Interview, Project 26).*

"...because publishers are commercial, meaning that they have a focus on the bottom line, they're really only willing to work with something that already has a market. A commercial enterprise doesn't have lots of room to *create* a market. To expect publishers to deeply engage in something that steps outside of the current market is naive. They simply won't invest huge amounts for something where there's not yet a substantial market. Educators and publishers have different business practices and goals, and we're totally at the mercy of the publisher and the business decisions they make. NSF used to worry about the product sitting on the shelves of the developer, but I tell you, I worry more about it sitting on the shelves of a publisher." *(Developer Interview, Project 10).*

In some cases, developers experienced what they believed were "bad deals" with publishing houses:

No member of the development team knew if [the publisher] was offering professional development for teachers. One suspected that they did not, and if they did, [the publisher] was probably charging extra for it. He also contends that because [the publisher] has separate divisions for math, science, and technology, the logistics involved in [the publisher] conducting teaching development are likely to be difficult. The developers feel that the greatest lesson they learned was the difficulty in dealing with a major publisher. The developers have felt powerless in getting [the publisher] to respond to their concerns. [the publisher] has published only four modules, which developers feel has turned [the product] from a comprehensive curriculum to a supplemental one. The developers are upset because they cannot take their materials to another publisher because of the agreement they made with [the publisher]. *(Summarized from Developer Interview, Project 17).*

The developer said this was a different kind of curriculum—it was for teachers not students. It required a new mindset that publishers didn't have. For example, publishers routinely give away copies of the Teacher's Edition as a marketing come on. When they did that with [the product], they were giving away what they were trying to sell….The sales force is not motivated because it's not that profitable selling books to teachers as opposed to selling books to students. There is one teacher to 30 students, so you sell one book when you could sell 30. *(Summarized from Developer Interview, Project 10).*

In other instances, the developers believed that the publishers were simply not ready for the types of products that were being developed with IMD funding.

> These are the most complicated materials that he has ever tried to market. There is no formula for selling them and no opportunity for rapid sales. People must be trained first. This will never be a runaway best seller. Sales will be slow and progressive, and there will only be an incremental increase in market share, with lots of work at each level. There are not structures in place to support rapid growth. As a result, this type of project is less profitable for them and more risky, particularly since they have not control over the professional development side. If NSF pulls its support for that, then they will basically lose their investment—that's the number one lesson he's learned. *(Summarized from Developer Interview, Project 5).*

> According to the project developer, they wanted to find a publisher who was willing to market all three pieces….At that time, publishers were not touching software, and distributors of manipulatives tended not to market books. Some were willing to take on one piece, but not the rest. *(Summarized from Developer Interview, Project 6).*

Interview respondents frequently raised the issue of the size and nature of the market that might be expected to invest in reform-oriented materials, and the general estimate was that the market was between 20 and 30 percent of the total market. Most developers and publishers believed that was the market share for which they were competing. However, a few developers thought that the market size was underestimated, leading to weak approaches to dissemination:

> "There doesn't seem to be any overall marketing strategy on the part of [the publisher]. Why? They underestimated the demand for these materials in spades. They've seen them as niche products because the school district has to be ready to stretch to do this over choosing a hardbound text. So they only printed 2,000 copies in the first run. But later on, at one time, they had $2.5 million in back orders, and we don't know how many of these ever got filled….I don't know if the publishers even have a rep just for us…There's not much devoted attention to [the product]. Our stuff is far out compared to the hard cover stuff they carry, but the hard cover texts sell better." *(Developer Interview, Project 19).*

> While one of the developers is concerned that the "early adopters" have all bought the curriculum by now, the publisher disagrees. She says that [the product] had "gone beyond the cutting edge and that there are now large scale district adoptions taking place, winning people from [a mainstream publisher]." *(Summarized from Publisher Interview, Project 15).*

For the most part, the publisher's goal is to generate a profit.

> "We can't force people to buy our materials, and sometimes I wonder if [the developers] realize that." *(Publisher Interview, Project 21).*

The conflict between a developer and the commercial publisher they chose is illustrated by a problematic partnership. Features of the materials (Project 24) make it complicated for any publisher to market because the project involves integrated curriculum, designed to promote inquiry-based and cooperative learning. The curriculum is activity- rather than textbook-driven. Given the complex nature of the materials, the selection of a commercial publisher with no experience with reform-oriented curricula led to clashes between the developer and the publisher. In marketing the materials, the publisher used techniques that had been successful with traditional materials. Although the materials were designed as a comprehensive set, the publisher turned them into supplementary modules, and only published some of them. The publisher justified the decision by arguing that cost factors would influence teachers to buy supplemental rather than the comprehensive set. In addition, the publisher promoted different modules according to the relevance of the materials for different regions. From the developer's perspective, the marketing approach contradicts the intention of the materials, and almost guarantees that they will not have the intended impact.

Sometimes, publishers were able to convince developers of the need to change their stance. For example, a set of materials (Project 10) included only a teacher's manual. The publisher had great difficulty in determining how to sell it because the sales force continued their practice of giving away the teacher's manual to generate interest in the materials. According to the publisher, the lack of a student component has implications for the success of the materials. First, there is little fiscal incentive for the sales force so the product is less competitive. Second, parents traditionally view student materials as a source of information about their children's lessons. Perhaps in response to both concerns, the new edition of the materials will include student workbooks and family worksheets.

The importance of a full intellectual partnership between developer and publisher is illustrated by publishers of two successful supplementary products. Staff at these companies had content knowledge that enabled them to identify secondary markets for the products, thus enhancing their profitability.

In sum, it appeared that effective partnerships between the two tended to be associated with a shared vision of the education reform agenda or a shared knowledge of important content principles embodied in the materials.

> "Make sure that whoever is developing the product can develop a relationship with a publishing group that has not only the monetary resources to mount a good marketing program, but who is committed to the product's underlying principles." *(Publisher Interview, Project 4).*
>
> They selected the publisher because they have a lot of respect for their professional standards. The staff includes many ex-high school teachers and educators. The company also has a strong track record of working with schools and districts interested in innovation, which will help them reach their target market. *(Summarized from Developer Interview, Project 21).*
>
> The publisher attributed much of the success of their relationship with the developer to their ability to relate as colleagues to each other. This is largely possible because it has people on staff who can 'speak the language' of the developer, since they possess the technical knowledge. Working toward a common goal is crucial to the success of a product. *(Summarized from Publisher Interview, Project 23).*

“Selling” Reform

A common refrain from both developers and marketers was that success of the IMD program rests on creating a market for reform, which they judged did not currently exist.

> “Teachers thought the developers were pushing the envelope on changing the way mathematics is taught to children, and they said schools and districts were not ready for all the parts of the curriculum.” *(Publisher Interview, Project 22).*

> “High school coordinators are strongly committed to using textbooks and not more activity-based materials. Coordinators have a difficult time understanding a curriculum which has no textbook.” *(Publisher Interview, Project 26).*

> “NSF needs to market itself to those teachers who need to change what they do. Lots of teachers have the viewpoint that NSF is out there in the ivory tower and doesn’t have a clue about life in a classroom. NSF would do [itself] good by getting out and promoting themselves as not just ivory tower pointy heads. They need to do a little public relations of their own within the teaching population.” *(Developer Interview, Project 10).*

> “Frankly, the majority of teachers out there are not interested in changing the way they teach...Districts are looking to us to help change teachers’ attitudes regarding teaching methods, and that’s a tall order...If there’s any one thing NSF should do...in the next decade, it is *not* developing curriculum—though that’s important—[it is] the grassroots retooling of teachers...We’ve changed the books, now let’s change the teachers.” *(Publisher Interview, Project 10).*

Professional development is key to developing a critical mass of teachers who feel comfortable with changed roles and pedagogical approaches engendered by the materials. Publishers benefited from staff development as a marketing technique (see below), but they were frustrated by their own lack of capacity to provide the professional development necessary to prepare a wide variety of teachers to use the materials. For example, the publisher of one of the mathematics curricula reported:

> As a publisher, they will do the “up and running” inservice, but they have neither the resources nor the skills to do the more in-depth version. (*Sum marized from Publisher Interview, Project 10).*

Another publisher, of a number of the IMD products, said that staff had recently been grappling with the distinction between offering training required to support local implementation and offering much more extensive professional development that lays the groundwork for changing deeply rooted traditional teaching practices.

> The publisher strongly believes that the scope of what is required to adequately prepare and equip teachers for doing things differently is far beyond any publisher’s capacity or responsibility to carry off. *(Summarized from Publisher Interview).*

In addition to using professional development to convince teachers of the need for reform of science, mathematics, and technology education, both developers and publishers argued for community outreach to develop support for reform. Developers at the high school level were particularly concerned about community support for reform.

> "When thinking about reform, NSF needs to look far more broadly than just the teachers and the school districts. Parents and communities need to be educated and informed about the need for modifications in the curriculum." *(Developer Interview, Project 23).*

> The biggest single lesson he learned had to do with the level of public and community education that absolutely has to take place when introducing curricula like the one he helped develop. Because the product looks and is so radically different from what parents are used to, they experienced much more backlash against the product than they had anticipated. *(Summarized from Developer Interview, Project 5).*

In the absence of a large market, and without the necessary resources to provide adequate professional development and support to teachers to help create the market, some publishers focus on more superficial elements of the material in an attempt to sell to the "average" teacher. One large publisher believed it was important to package the materials so that they would look like traditional texts, even though the content is dramatically different from what is contained in those texts.

> The product has lots of change and math reform in it. If you're trying to make a program palatable to the middle ground teacher and you want them to try something new, you have to give them some of their comfort factors. *(Publisher Interview, Project 15).*

Marketing Strategies

To build awareness of the materials, all but two products were marketed using some combination of in-person seminars, hands-on workshops, booths at trade shows, brochures, presentations at professional conferences, catalog mailings, advertisements in journals, information on a web site, connecting with professional networks, and direct mailings. Two developers placed their materials on the web, and they did not reach a wide audience. Only two actively sought approval by state adoption authorities, and they were successful in marketing in the states in which they appeared on adoption lists. Others maintained that state adoption processes were expensive and conflict ridden, and were unlikely to yield enough to be worth the time and cost of pursuing approval. And, there was no effort by developers or publishers to build a market by targeting preservice educators.

Virtually all respondents agreed that in-person awareness seminars or hands-on workshops were by far the most effective means of increasing potential users' understanding and interest in the materials. Marketers and developers found that giving such seminars at gatherings, such as professional association conferences, attended by members of existing professional networks yielded much interest.

In some cases, less expensive approaches were first attempted with less success, which led the players to conclude that building a customer base requires face-to-face interaction.

> "We found that what works best is an educational approach to marketing. We educate people to understand the product, as opposed to just purely promoting it and trying to wow them. Then the product sells itself." *(Publisher Interview, Project 4).*

> Direct mailings, videodisk demonstrations, brochures, NCTM conference presentations and displays, journal advertising, publications, and website postings were all used. However, marketers discovered that "you need a person there doing a demonstration. To market something at this level and price requires more hand-holding, and this caught us off guard." *(Summarized from Publisher Interview, Project 1).*

> A video has been produced promoting the materials along with brochures. But the most successful tool in promoting the product has been the hands-on teacher workshops. Here teachers get to try out the product for themselves. A marketer commented, "It's like going out to dinner. Would you rather see pictures of the food or would you rather be allowed to try it?" *(Summarized from documents and Publisher Interview, Project 9).*

However, the high cost of professional development may provide the upper limit for dissemination through staff development.

> "There is no way that we could structure the price of the materials in a way that would also support the cost of training…Publishers will sometimes earmark up to 5 percent of sales for professional support. In our case, that amount wouldn't even come close to what would be necessary to adequately train teachers. For instance, if a teacher were going to teach 100 students, the district would spend $3,500 [on instructional materials], which would provide $175 for [teacher] training. The developers estimate that teachers need at least 2 weeks of training during the course of a school year, and it would cost them $1,500 to provide that training—and that's just for one year." *(Publisher Interview, Project 28).*

Summary

The first sign of deviation from intention to implementation came when developers sought publishers, who, in turn sought to sell the materials. Even when publishers and developers shared the vision for reform-oriented materials, they faced real problems in the marketplace. Both groups talked of facing a small market share and the need to create demand for reform. Both also spoke of the limits publishers faced in providing the type of staff development that would increase the market share for IMD-funded materials.

Despite the costs, no other dissemination strategy was as effective as professional development, particularly with educators, including those who had participated in field tests or were active in professional networks, who were ready to embrace reform.

CHAPTER V

Adoption

The IMD program funds the development of materials that meet high content and pedagogical standards. A common view is that potential adopters would use similar criteria in selecting the materials. Our interviews with adopters indicate that the picture is more complex, and adoption decisions are made in many ways, using a variety of criteria. Interviews were conducted with 15 adopters of supplementary products and 17 adopters of comprehensive products.

We found that the most successful adoptions were those that engendered teacher investment in the materials. In addition, although the criteria used can be seen as elements of a rational approach to adoption, in fact, adoption decisions were much more opportunistic—a teacher would see materials at a conference and become excited by their possibilities, without analyzing how they fit with other school and district priorities; or a marketer would claim that the materials fit the standards and a school or district would adopt them, absent an independent assessment. The adoption process is also vulnerable to political changes in the district.

Further, to foreshadow the following chapter on implementation, the process by which materials were adopted, along with the substantive criteria used, had an influence on implementation and use. Our findings concerning the variety of ways sites approached curriculum adoption, and the limitations of the assumption of rationality, provide additional reasons that there are gaps between the intentions of IMD products and their actual use.

Adoption is the point at which control passes from those with whom NSF had direct or indirect involvement to those whose actions are independent of NSF influence. Consequently, gaps increase, particularly for products that are best implemented in multiple grades through a planned process.

We found adoptions of specific materials clustering geographically. In part, the clusters were associated with pilot- or field-test sites, and in part, by the presence of other NSF programs, such as Statewide Systemic Initiative projects. In both cases, the original adopters served as models to later users. Perhaps increased attention to dissemination efforts that target well-respected individuals and districts will yield increased adoption (Rogers, 1962).

No single approach to adoption is universally related to satisfaction and appropriate implementation. However, our study indicates that processes and criteria used to identify and adopt curriculum influence the depth of teachers' investment in its success. In some cases, the degree to which an adoption committee represents key stakeholders (teachers, parents, district personnel) influenced the amount of acceptance from eventual users. In others, an individual teacher built support through successfully modeling use of the product. In still others, adopters' attention to specific criteria, including state and national content standards, state testing programs, and pedagogical strategies affected the way teachers respond to and accept new curricula.

The section begins with a discussion of the levels at which adoption decisions are made, district, school, or individual teacher. We then move to a discussion of the substantive criteria used for judging curricula. The interaction of the process used at whatever level and the criteria influence teachers' investment in the product.

Levels for Adoption

The materials we studied were adopted at three different levels: district, school, or classroom. At district and school levels, committees were frequently involved in the decision to adopt, although even in those arenas an individual was able to influence the decision.

Differences existed in the adoption processes for comprehensive and supplementary curricula. IMD-funded comprehensive curricula were adopted by district committees, school-level processes, and individual teachers. In our sample, fewer than half of the comprehensive curricula were adopted at the district level, and the remainder at the teacher or school levels. (School adoptions were often led by individual teachers, blurring the line between school and teacher adoptions.) About two-thirds of the supplementary curricula were adopted by individual teachers.

District-Level Adoption

In general, district-level adoptions were led by the district curriculum specialist, but the details of the process took many forms. First, although most districts created teams responsible for adoption, the teams varied in their composition and scope. For example, the district that adopted Project 27 included one teacher from each of the district's elementary schools; and the district that adopted Project 19 had two teachers from each grade level, one principal from each school level, and the curriculum coordinator. In some cases district-level staff chose participants, and in others, schools nominated their representatives.

A second difference lay in the scope of the committee's assignment. For example, the committee that selected Project 17 simply looked at the list of state-approved materials and selected one that seemed "exciting" to the group. In contrast, a district that adopted Project 11 used a committee that: 1) developed criteria for selecting materials; 2) used the faculty from the content area to review the available materials and select a few that met the screens; 3) brought in all staff and got their input for the best curriculum to meet the curriculum framework; 4) sought parent input; 5) distributed and analyzed rating sheets from teachers, parents, and others; and 6) made a recommendation to the Board of Education.

Although district-level adoptions exemplified quite rational and thoughtful approaches, they are the most likely to be affected by political change, as indicated by two adopters:

> "The committee process will be used again, but the adoption method may be changed. Currently, the state has its own standards, but districts are allowed to choose their own textbooks. The state is now working on an assessment students will need to pass if they are to graduate from high school. If this is done, districts will have to adopt curriculums which meet the state standards." *(Adopter Interview, Project 30).*

> "The adoption process represented massive reform in the district…Next time there will be different parents, a different board, and different teachers…If these people oppose reform, the process could look very different." *(Adopter Interview, Project 19).*

In the group of products we examined, 44 percent of the comprehensive products and 8 percent of the supplementary products were adopted at the district level.

School-level Adoption

School-level adoptions reflected a variety of strategies. Most often, an individual teacher, principal, or group of teachers took responsibility for locating a new product in order to better serve the school's learning goals. Such a process occurred with Project 17, when a principal had been seeking an integrated learning experience for the students for a number of years and read about the opportunity to work with the project developer as a pilot site. In contrast, Project 5 was adopted at the school level, but:

> "At each school, the adoption process has been different…The schools that have a unified mathematics department do much better, because there is a shared commitment to using the product. At those schools where the mathematics department is not unified, there can be problems." (*Adopter Interview, Project 5).*

Of the products we studied, 32 percent of the comprehensive and 15 percent of the supplementary products were adopted at the school level.

Classroom-level Adoption

Teachers frequently initiated adoption by bringing the materials into their classrooms. In these cases, teachers did not spend their personal funds to buy the materials, but rather they used school or district money by recommending the purchase. Initiating teachers heard about the materials either through conferences, their professional networks, or because they were involved in a pilot or field test. For example, Project 12 was adopted in a number of schools because the state professional association presented a workshop on it, and a teacher saw Project 29 at a national conference and was impressed by its hands-on nature and links to the community. In contrast, Project 20 was brought to a school by a teacher who had been in a field test at another location. In both cases, their work gained the respect of colleagues, who asked to use the materials. The diffusion process reflects the findings of earlier studies of dissemination (Rogers, 1962), which points to early adopters as models that stimulate interest in change.

Teacher-led adoptions comprise 24 percent of the comprehensive and 77 percent of the supplementary products.

Criteria Used in Adoption Decisions

Whether the product was adopted at the district-, school-, or classroom-level, adopters applied multiple criteria in making their decisions. The importance of a particular criterion varied in the settings we visited, and we found no sites that used all the criteria in the decision making process. Each criterion is discussed in the following section.

Fit with Standards and State Tests

Standards were in the forefront of the conversation among committee members and in the minds of individual adopters.

> The state standards were the primary consideration for one adopter. He has been a key player in the state's process of defining the content standards, and his criteria for selecting materials comes directly from working on state standards. *(Summarized from Adopter Interview, Project 12).*

> The district had been working with experts and consultants to try to develop their own "problem-solving" curriculum materials that would meet national standards,

which the district had adopted several years ago. This was a very expensive process, and they realized they wouldn't be successful. They were pleased to discover the materials that met their needs. *(Summarized from Adopter Interview, Project 11)*

However, local concerns could supersede the standards; buy-in from the community, especially parents, was as important to local success as were the standards; and some teachers were capable of sabotaging the implementation process by raising local "scare" issues:

"Much of the controversy came from the parents of children who were in classrooms where the teachers were not implementing the curriculum well, and students were frustrated. This stemmed from several issues. In some cases, the teachers sabotaged the new curriculum because they were not comfortable with it. 'I don't like the curriculum, but I have to use it.' Other teachers did not understand the curriculum enough to defend it to parents and students….Some teachers tried to teach it like a textbook, and this didn't work." *(Adopter Interview, Project 11).*

According to the co-PI, the biggest single lesson he learned had to do with the level of public and community education that absolutely has to take place when introducing curricula like [the product]. They didn't do nearly enough to help lay a receptive foundation in the school community for change. Because it looks and is so radically different from what parents were used to, they experienced much more backlash…than they had anticipated. *(Summarized from Developer Interview, Project 5).*

"When thinking about reform, you need to look far more broadly than just the teachers and the school district. Parents and communities need to be educated and informed about the need for modifications in the curriculum." *(Developer Interview, Project 23).*

Tests were sometimes mentioned along with standards by adopters. In the best cases, the adopters understood how the product helped prepare students for statewide testing. In contrast, difficulties arose when standards and tests were not aligned or when the state test changed after decisions were made.

Originally, the teachers believed that the materials would prepare their students for the state assessment. However, the assessment changed, and there is some concern. Nonetheless, the materials seem to stimulate students so they intend to continue with them. *(Summarized from Adopter Interview, Project 27).*

By the year 2001, science competencies will appear on the state test, and students must pass this test in order to graduate from high school. The staff believe that the product will prepare their students adequately for the test. *(Summarized from Adopter Interview, Project 12).*

Quality of Teacher Guides and Other Support Materials

When potential adopters, especially those without strong content background, reviewed materials, they often looked at how much the teacher guidebook or other supporting materials could help them use the product. Guides were more important when there was limited professional development opportunity. As noted in the reviews of the content experts, overall, products were weak in either providing the necessary guidance to teachers or indicating the extent of professional development required.

> The committee picked materials that teachers could use….These materials included teacher videos that demonstrated in a short period how the modules could be taught. *(Summarized from Adopter Interview, Project 27).*

Availability of Professional Development

Adopters looked at the extent to which professional development was available and judged whether it was adequate to the demands of the materials. They also looked at the expense of training, how much was provided by the publisher or developer, and whether there were ongoing opportunities to receive assistance. To some extent, the widespread adoption by field-test sites was related to the availability of professional development, because participants in field tests frequently received free inservice training.

> The teachers participated in the pilot [sic]…three of four of the teachers using the materials attended a workshop provided by the publisher and developer. This training was three weeks long, and although "there's always more to learning about using materials," the lead adopter thought this was enough to familiarize teachers. *(Summarized from Adopter Interview, Project 12).*

> The August before they began implementing the materials, the principal, the team of teachers who would be implementing them, and several other teachers spent a week in training at the developer's institution…Since they were a pilot site [sic], they subsequently had a great deal of contact with the developers, including on-site visits. The first year, there were monthly visits, during which the developers would observe, troubleshoot, answer questions, and generally just provide teaches with support. *(Summarized from Adopter Interview, Project 17).*

> The original developer conducts eight training sessions each year, sponsored by major corporations, and pays teachers for their participation in the training. *(Summarized from Adopter Interview, Project 2).*

Pedagogy

At times, adopters sought explicit pedagogical strategies in materials. Adopters mentioned student-centered pedagogy and active learning for students as desired methods.

> They chose [the product] because it fits with their philosophy of good pedagogy and content. Their philosophy is that students should be given a chance to get "their hands on the work and make their own discoveries." *(Summarized from Adopter Interview, Project 12).*

> "It is very inductive, very abstract-random. This suits my teaching style. I like to bring in everything and really mix things up. Teachers and students who are creative, non-linear (abstract-random) really thrive on the curriculum. The other half don't do well at all with it." *(Adopter Interview, Project 5).*

Student/Teacher Engagement and Interest

In general, adopters looked for materials they believed would engage students, particularly at the middle and high school levels. The concern that materials capture students' involvement was related to a focus on hands-on, inquiry-based pedagogy, because adopters tended to view such pedagogy as enhancing student interest.

> Teachers gave answers that were variations on a theme: namely, that students enjoy something different and benefit from a fun, visual approach to mathematical concepts. One adopter said, "It is fun. It has the same content as other materials but is not as serious. You can look at math from a different viewpoint." *(Summarized from Adopter Interviews, Project 29).*

> There were no well-defined criteria used in the adoption process. However, they were looking for materials that would promote students' retention of content, be hands-on to eliminate boredom…*(Summarized from Adopter Interview, Project 1).*

Cost

Particularly in districts and schools in which there were budgetary constraints, adopters made judgments about materials based on financial considerations. For example, one district moved to a second choice science program because it could put together its own kits rather than purchase expensive, pre-packaged kits. Frequently, field-test sites received free professional development, which served to attract adopters to those products. Further, teachers who were experienced with products served as trainers for others, and received free materials in return. The free goods and services stimulated wider adoption within schools and districts beyond the field-test teachers.

> "Price and flexibility are very important when deciding on materials. You don't want to spend a lot of money on something that may not work." *(Adopter Interview, Project 30).*

> She convinced the developer to donate 300 copies of the student textbook to the science program at her school [as part of her work in field testing]. *(Summarized from Adopter Interview, Project 18).*

Student Outcomes

Adopters rarely raised questions about or looked at student outcomes in deciding on materials to adopt. One example, described in the case study that concludes this chapter, exemplifies the type of rational adoption process that included a focus on student learning. In fact, only the example we cite and one other setting used information about student learning in choosing materials.

Adoption of Non-IMD-funded Materials

Perhaps because the non-IMD-funded materials we compared with the IMD materials were comprehensive and drawn from state adoption lists, we found that most sites visited used district adoption committees. Further, adopters tended to refer to state standards in their discussion of the reasons for the choice. And, while the list of criteria used for IMD and non-IMD products are similar, we found some interesting contrasts in the discussions of why materials were selected.

Users of IMD-supported products tended to be more concerned about finding challenging, engaging materials than did non-IMD users. The following quotations illustrate the lack of reform orientation in selecting non-IMD-funded products.

> "What is important in adopting new materials is that they be similar to what teachers were using previously." *(Adopter Interview, non-IMD)*

> "The materials were selected because it was a middle of the road curriculum—not too integrated. The actual integrated math was too extreme and teachers were not comfortable with it. We piloted the integrated math curriculum for two years and had to get rid of it because we did not have math major teachers to teach it. The teachers wanted the worksheets for the students to practice the skills and so we changed to the current curriculum." *(Adopter Interview, non-IMD).*

In short, adopters of non-IMD materials sought better materials than they had, but their interest was in incremental changes that would not place great demands on teachers.

An "Ideal" Adoption: A Case Study

The Product

The product is a K-6 standards-based mathematics curriculum, which was already available when the standards movement took hold in the nation.

The product was developed by a broad-based team housed at a university. Team members each had a background in mathematics, but there were also specialists with mathematics writing backgrounds and teachers with extensive classroom experience. The major developer was a nationally prominent mathematician. Two "teachers in residence" were the liaison between teachers and the writing team and wrote and edited tasks for the units. Curriculum writing involved an extensive cycle of field testing and revision.

In order to promote the product, and to a lesser extent some other products, the university helped to form a corporation, which publishes and disseminates the program. Marketing focuses on district-level personnel who are avid for change. The publisher provides support to districts and teachers through its professional development group, which sponsors user conferences, train-the-trainer conferences, and conferences for those teachers who become mentor teachers for the program at a fairly low cost. For K-6 adoptions, the publishers provide a set of implementation plans and train mentor teachers.

The District

The district is an urban school district with a student population composed of 50 percent Caucasian, 5 percent Hispanic, and 45 percent African American students. In one elementary school that showed high mathematics scores, the enrollment is 85 percent African American. The superintendent is African American, as is the mathematics coordinator, who was the driving force behind the adoption of a new math curriculum for the elementary grades.

The Adoption Process

The product was adopted by a district-level adoption committee. Thirty-five people—teachers, parents, and principals—served on the committee. The process was driven by the efforts of an energetic mathematics coordinator, who ensured attention to implementation and student outcomes.

The coordinator has a motto about curriculum, "design down and deliver up." His approach is to figure out what students need to exit the system and then find ways to help the students master those skills. Working with three teachers, he led a study of exit competencies required to turn out "quality workers and producers" at the end of the 12th grade. Since the state test is administered at grades 4, 7, and 11, the exit competencies were focused on developing benchmarks for grades 3, 6, and 8.

Once the benchmarks were in place, the coordinator introduced a complex multi-step process for selecting the elementary mathematics curriculum. Seven series were introduced and piloted— the product was the only NSF-funded curriculum. Each of seven schools piloted one product, with two classrooms at each level using the new book and the others serving as a control.

To assess the effectiveness of each series, every week the coordinator sent out unit assessment objectives, taken from Bloom's Taxonomy, asking "where are these in your book?"

Only the IMD product and one other series addressed the objectives. In addition, the coordinator kept track of students' performance. At the end of the year, when he plotted the gains made by students, he found that no other series approached the effectiveness of the IMD-funded product—it outdistanced all of them by 30 points. The coordinator termed the effects of the curriculum one of a "different way of doing business in mathematics, one of active learning and using strategies." He was committed to adopting the curriculum, although he realized it would require a lot of staff development.

At the end of the pilot year, the vote for adoption was 32 to 3. Those who voted against it believed it would be too much work for teachers. Particular issues raised were that the series entailed too much content, required too much set-up time, and had too many booklets for students to keep track of. Also, principals were concerned about how to monitor the teachers in the implementation process and how to present materials to parents. According to the coordinator, principals were accustomed to "monitoring by watching students do worksheets," so he designed a principal manual for monitoring implementation through classroom observation.

To address the issues raised by teachers, the coordinator committed the district to serve as the centralized distribution center for classroom and parent-focused materials. When teachers said the teachers' guide was "too hard" he called the developers and requested correlations for each unit with the national standards and state assessments. Then he was able to tell teachers which units had to be "mastered" and which could be "introduced." He also demonstrated model lessons to help teachers see "how it looks in action."

The product was introduced simultaneously into all the K-6 classrooms—18 elementary schools—three years ago. When asked why he chose to implement the whole curriculum at once, rather than phasing it in, as the developers usually advise, he said:

> "We had to do something right away. These kids were not getting what they needed. I couldn't stand by and watch that, knowing there was a better curriculum available. That would have been a crime. How could I withhold it from some and say, wait, I can't teach you good mathematics now; maybe three years from now. These children deserve all the breaks I can give them."

Staff development for implementation was multi-step. The developer provided inservices locally, involving all K-6 teachers in a week-long institute to give materials and impart new strategies, and assessment tools, which the school district funded. Also, the coordinator was familiar with the research on change and sent that research to teachers. He also showed them that what they had been teaching was not what was being tested—for example, the emphasis is not now on computation, but rather abstract thinking.

There are signs that the product has been successful. Test scores show that district math scores are improving. Fourth grade state test results in mathematics for the elementary school that is 85 percent minority are:

1995: 46.0 1996: 76.9 1997: 64.1 1998: 85.4

The district average shows similar gains:

1995: 41.0 1996: 52.0 1997:53.7 1998: 68.7

In addition to changes in math scores, teachers also see other signs that students are learning math. They see their students applying the strategies they learned in math to situations outside the math class. Teachers in the district commented that the product makes learning math fun for students and they believe that the use of manipulatives in the activities really aided in student learning.

In selecting a curriculum, the coordinator believes that a district should determine for itself what features are important and then design a pilot process that shows how different materials can meet the needs of their students. He says that “adoption is a very important process” and deserves a great deal of attention. He also believes it is a responsibility of the district to seek out the information it needs. In fact, an important component in making the decision to go with the product (in addition, of course, to its measured effects) was the excellent service he received. When he called with a question, he got an immediate response. “Service sold it,” he said.

CHAPTER VI

Implementation

In the chain between development and impact, the greatest deviation from what developers envisioned occurred during implementation. Problems with implementation were not inherent in the products, but rather, related to the extent to which they required changing parents' and teachers' conceptions of mathematics, science, and technology education, and teachers' ability to teach in new ways. However, when well implemented, IMD materials were perceived as having positive impacts.

As noted earlier, we solicited names and addresses of schools using IMD materials from the publishers to assess the implementation and impact of the IMD materials. However, publishers were averse to sharing complete lists of adopters and provided the names of up to 10 schools or teachers who were using the materials. As a result, we cannot assess the breadth of implementation of IMD materials since no universe of adopting schools is available. Further, publishers probably did not provide a random sample of schools, and some teachers in the schools listed had been involved in the development or field-testing of materials. We selected teachers and schools representing rural, urban, and suburban communities from among the names we received.

We conducted focus groups of teachers using the all but three, all supplementary, of the products in the study and we observed in 38 classrooms of those teaching comprehensive materials. Members of focus groups teachers may not reflect a true cross-section of teachers implementing comprehensive curricula because we asked a local contact to invite teachers, and in several cases, the teachers were those most familiar with the materials. Therefore, generalizations cannot be made from the teachers and classrooms visited. The sample's bias toward "good" sites underscores the difficulties of implementation because if such sites have problems, less favorable settings are likely to have more. We believe the focus groups and classroom observations provide valuable information about teachers' assessments of materials, their use in classrooms, the factors influencing implementation, and the perceived impact on teachers and students.

Content

Teachers using the materials in their classrooms rated the content of the materials similarly to the Expert Panel, but teachers expressed some concerns about both science and mathematics.

Teachers using the mathematics curricula generally praised how well mathematics content was connected to national standards. In addition, teachers were complimentary about the use of manipulatives and how well mathematics and technology were integrated. Teachers gave one comprehensive elementary school mathematics curriculum highest marks because "It was the first one that made a change in mathematics [in the school]."

At the same time that teachers praised the content covered in the IMD mathematics materials, they also expressed some concern. Two comprehensive curricula (one at the elementary level and one at the middle school level) were criticized for not presenting enough basic mathematics facts, while one high school curriculum received mixed reviews from teachers (some positive and some negative) for its use of graphing calculators. In addition, teachers of one very highly rated elementary school mathematics curriculum cautioned others about its sequencing. Because the curriculum so transformed the teaching of mathematics, it was difficult for students who encountered it for the first time in the upper elementary grades and for students who transferred into the school at mid-year.

Teachers using the IMD science materials also generally gave them high marks, including their linkages with state and national standards, their investigatory approaches, and their conceptual base. Occasionally, an interdisciplinary curriculum at the middle or high school level would be criticized for not having enough mathematics content, but this was rare. The single largest complaint about elementary science materials lay not with the content or the theory behind the content, but rather with keeping track of the contents of science kits provided. Someone had to ensure that the kits were complete so that another classroom of students could use them; for one product, the district shipped the materials back to the publisher to refill and then return to the school.

Teachers also expressed some concern about readability of materials and use of technology, which became barriers to implementation.

Implementing IMD Materials as Intended

The extent of implementation varied between comprehensive and supplemental materials. More comprehensive materials were adopted district-wide than were supplementary materials, requiring that all teachers implement the materials. In these cases, use of the materials and the extent of implementation varied, usually depending upon the teachers' skills and experience and the extent to which teachers were able to engage students. Teachers often needed to move from a didactic to a more investigative teaching pedagogy for both the math and science materials. If teachers were inexperienced, had received little staff development, or were reluctant to change their teaching methods, the materials were less well implemented.

Because supplemental materials were often chosen by the teachers who used them, they were used as enrichment and implemented as they were intended. These supplemental materials included videos, interactive software programs, and manipulatives of various types. However, even teachers who chose products were unaware of materials that enhanced their value. For example, none of the three teachers interviewed knew that a set of curricular materials accompanied Project 6. Similarly, a middle school and high school science supplement also came with curriculum materials at various grade levels, but the schools visited were aware of only one of the half dozen available kits.

Factors Facilitating Implementation

Multiple factors facilitate the implementation of IMD materials. This discussion focuses on the comprehensive mathematics and science materials, as they require the most supports. Among the factors that are often critically important are:

- Extensive and sustained professional development for teachers;
- District and school level support, including visible advocates for the materials;
- High teacher ratings on the quality of the materials; and
- Supportive educational technology.

Professional Development

Training and support for teachers were crucial to successful implementation of most of the comprehensive mathematics and science curricula. Support mechanisms include initial and ongoing formal training, in-class supports, product networks, and mentor teachers.

Districts and schools implementing comprehensive mathematics and science curricula found professional development to be an essential component of successful implementation. In fact, many teachers and district coordinators believed that it would be impossible to implement these curricula without training. While training involved both pedagogy and content, those sites implementing mathematics curricula placed more emphasis on the need for pedagogical training than did those implementing science products. In interviews, science teachers noted that the field always had a hands-on approach, while mathematics teachers reported less experience in the pedagogy required by IMD materials.

> "The change from traditional instructional techniques to those required by [the project] is drastic. It takes an average of four years to completely change the way instruction is provided. It is like being right-handed and being forced to become left-handed; it's very clumsy and awkward at the beginning, and takes a long time to become proficient." *(Focus Group, Project 5).*

The amount of professional development for comprehensive curricula varied considerably, with most projects receiving somewhere between one and three weeks of initial training. Training was often conducted by developers during summer institutes, with occasional follow up. The prominent role of developers in professional development may be related to the fact that so many of the sites we visited were involved in field tests of the materials.

Teachers noted that while initial staff development is important, it has to be ongoing as teachers use the curriculum throughout the year.

> "Staff development is an essential springboard for using [the product]. It has to be ongoing as you teach through the first year. You need to focus on the math content in each unit and you need staff development to do that. It's not just unit training, however, but learning to understand mathematical concepts that span the units." *(Focus Group, Project 19).*

Teachers responded positively to training in which the materials were modeled for them, they learned just as their students would be learning, and they practiced teaching the model to other participants in the training. Such professional development opportunities led teachers to become engaged and excited about working with students using the materials.

District support for professional development was a key factor in some sites, particularly in large districts where the curriculum was *the* curriculum in mathematics or science district wide. In addition to support from the developer, the district implementing Project 27 has a Professional Development Center that sent out teacher trainers to help classroom teachers with implementation. This site has also had the materials in place for a number of years and has built up a cadre of experienced teachers who now act as teacher consultants to others as they implement the product.

Because supplements are often adopted by individual teachers rather than by schools and districts and their use is optional, teachers tended to receive considerably less professional development unless they had been involved in the pilot or field test. More often, teachers had seen a demonstration or attended a brief workshop on the materials or received no training at all. In several instances, a single teacher had attended a workshop and then conducted a workshop for other teachers in the district (e.g. Projects 6 and 14). Teachers using several other supplements received support through other kinds of networks. For example, Project 20 is tied to a professional association, which regularly scheduled dinners at which participants could share their experiences using the product, thereby building and supporting a network of users.

In cases in which teachers began using materials before they received training, school-based mentor teachers proved to be invaluable resources.

Projects 2 and 5 had technical support numbers or web sites that offer assistance for sites and/or networking opportunities for teachers. However, use was low. One teacher thought it would not be useful because of 'the unreviewed garbage' that would be on the web.

District and School Support

Leadership at the top can make an important difference in the ease with which curricula are implemented at the school level. The way to acceptance of new curricula is smoothed by articulating the importance of the change, building support from teachers, parents, and the community, and providing resources. Such actions can bring about the investment in success similar to that associated with successful adoption processes. Examples of strong district leadership include the district mathematics coordinator in the case study above, who carefully built support from teachers for the curriculum, then backed up the district's decision to adopt it as the mathematics curriculum for all elementary schools by providing extensive professional development and teacher assistance.

Leadership can overcome major barriers to implementation. For example, Project 5 seems to require a visionary to convince teachers, parents, and the community that it provides high value to students because it is so different from traditional mathematics texts and entails such extensive staff development. Teachers in the site we visited received 100 hours of training and support, costing the district $10,000. In a school-wide adoption, the principal of the school implementing Project 17 provided block scheduling time to support implementation.

Centralization of some functions at the district level was also an important support for elementary science curricula, many of which include kits of consumable materials that require replenishing. By taking responsibility for maintaining these kits, districts increased the ease of use for teachers, who did not have to spend time scrounging for materials.

In contrast, the experiences of an urban district that tried to implement Project 17 provides an example of what can happen when these features are not in place. The district decided to adopt this entirely technology-based curriculum. Most schools in the district, however, did not have the appropriate infrastructure, and the district was not forthcoming with additional funds for computers. And, although the district provided staff development, the amount was insufficient to teachers' needs because they were required to learn the technology, the content of the curriculum, and new pedagogical approaches. According to the director of science for the school district, the district has not been able to keep up with the training needs of teachers. Although teachers like the curriculum, it has not been widely used.

Features of the Materials

Implementation was enhanced when teachers were positively impressed by the materials. In general, teachers of NSF curricula in both mathematics and science rated the products they were using very highly. In all but a few instances, teachers thought the materials were some of the best they had ever seen or used. Features that particularly appealed to them were: ease of use, an excellent teachers guide, activities that they believed fostered improved student engagement and student learning, and the materials' adaptability for students with diverse abilities and learning styles.

Educational Technology

Technology was more prominent in the supplemental materials than in the comprehensive curricula. The three main types of technology are computer programs, CDs, and videos. Both computer simulations and videos help teachers to demonstrate concepts in visual form that are difficult to explain, especially concepts with a high level of abstraction.

> "The hands-on activities and simulations successfully help students to see how what happens at the microscopic level drives what is observed at a macroscopic level. Unless a teacher is really good at describing this relationship, helping students to make that connection can be very, very tough to do, particularly for students who are not ready for abstract thinking." *(Focus Group, Project 16)*

Technology also functions as an important tool to save time and take the tedium out of collecting, recording, and graphing data. It allows students to see their results immediately and leaves more time for discovery and analysis activities.

> "Because of this technology, students are spending less time doing the grunt work of collecting and recording data, and more time on analysis, that is, higher order thinking." *(Focus Group, Project 17).*

Barriers to Implementation

The barriers to implementation include the reverse of the facilitating factors, as well as resistance to the type of curricula represented by the IMD-funded materials. Barriers include:

- Lack of skills and knowledge by teachers, especially for those curricula that include reform-based pedagogy and new (often interdisciplinary) content;
- Active resistance to the curriculum, especially by school staff and parents;
- Lack of alignment between the materials, district curriculum standards, and norm-referenced tests;
- Absence of supportive technology; and
- Lack of other significant resources.

Teacher Skills and Knowledge

As noted above, the IMD materials require teachers to adopt reform-oriented pedagogy that is far more student-centered than teacher-centered, more discovery and investigative than direct instruction, and more conceptual than rote. Some teachers adapt to these role changes, while others find the transition far more difficult. As a teacher reported about an IMD-funded high school program:

> "Teaching [the materials] requires a special personality and a special drive and a special person. Someone who picks up the newspaper every night and reads it. Someone who watches TV every night and knows what's going on in the world. omeone who is willing to go out on a limb and have an opinion even though they might get knocked around, but at the same time someone who doesn't have all the answers. You can't have the right answer because there are no right answers for most things. You have to present both sides of the argument. You've got to be

able to let your hair down. Have fun with the kids. Oh, but there are teachers who will stand up and say, '**This** is the way.'" *(Focus Group, Project 2).*

Very often it appeared that the materials changed role expectations in ways teachers found difficult.

> "[The product] encourages independent thinking and decision making. Answers are not given. But for teachers this can be very difficult to digest. A major lesson learned is that it is difficult to change the thinking of teachers. Teachers are not used to students getting the answers for themselves." *(Developer Interview, Project 4).*
>
> "[The product] requires teachers to give up control and let students take the lead. The materials can't simply be lectured. The teacher's materials are very extensive—giving very detailed lesson plans and ideas of what to do with problems—but more often than not, the teacher's materials don't give the answers to the questions because there are six different ways that students could answer the problem, and many teachers at first find this disconcerting." *(Developer Interview, Project 5).*
>
> "In order for these materials to be really successful, there needs to be some corresponding change in teacher strategies. The teacher becomes more of a facilitator, rather than being the person who has all of the right answers. There is lots of group work involved in the materials, and the teacher really has to direct the learning. Questions tend to be open ended. There is a low level of interpretation involved in analyzing data sets for there really isn't one right answer to any question posed. A teacher needs to be prepared for the fact that there are multiple ways of looking at the data set, and students will often come up with very different answers, which can be unsettling for some teachers." *(Adopter Interview, Project 30).*
>
> "New curricula cannot be implemented without knowledgeable teachers who understand how science research is done. Most middle school science teachers do not have a strong science background and will not gain one in a five-day workshop. A major lesson learned is that teachers do not easily change their mindset about how they should teach. Reform curricula are student centered as opposed to teacher centered, and the role of the teacher is to facilitate. Many teachers cannot change their style." *(Developer/Publisher Interview, Project 12).*
>
> "Teachers need to know the materials extremely well to do a lesson. You cannot just open the teacher's manual the day of an assignment. You need to read ahead in the lessons because it takes time to understand the program." *(Focus Group, Project 10).*

In districts that mandated a comprehensive IMD curriculum without sufficient professional development and other support, some traditional teachers refused to implement it, and others have implemented only those features most consonant with direct instruction.

Active Resistance to the Curricula

The introduction of NSF materials, particularly in mathematics, created considerable controversy in many sites implementing comprehensive curricula. Because decisions to use supplemental materials are typically made at the teacher level and do not represent a single approach to teaching the subject matter, their use has raised little resistance.

Resistance occurred on multiple levels. School board and community opposition to Project 11, for instance, was clear when the materials were adopted as the sole curriculum for the district by the narrowest of margins in the school board vote. When the materials next came up for adoption, a strong back-to-basics constituency group on the board led to a considerable struggle to keep the curriculum in place. Teacher implementation was inconsistent as well. According to the district curriculum coordinator, some teachers opposed the curriculum and tried to sabotage it. Others did not have the deep content knowledge or pedagogical skills to implement it well. Parents of students in those teachers' classes are, understandably, opposed to the materials.

In some districts, either for philosophical reasons or due to teacher, community, and/or parent resistance to the IMD products, the materials were adopted as an "alternative" curriculum, as was true for Projects 17 and 23. In one school implementing Project 17, the principal is its major advocate, and the team implementing the program has received considerable public recognition, causing deep resentment among other teachers who believe the implementing team gets preferential treatment.

Parent resistance to IMD materials arises from concern about content and the lack of homework. Parents in the district implementing Project 19, for instance, believe that computation is not adequately covered. Many also expected and wanted to see their children bring home more traditional homework assignments. In addition to worries about homework, parents in some communities raised questions about their children's preparation for the next level of schooling. Some parents think their children are more challenged by Project 17, but a substantial number also equate learning with memorization. Such parents believe that students require more "rigorous" (i.e., traditional) mathematics in order to be prepared for high school.

When parental concerns were addressed, the most common way of doing so was with ongoing conversations. As one teacher reported:

> "I spend a lot of time in the evenings talking to parents, and both before and after school talking to students. I have to work with parents and students to demonstrate to them that they are learning." *(Focus Group, Project 5).*

In addition, the district adopting Project 19 created a set of materials emphasizing computation that could be used as homework. Districts implementing Project 11 (mathematics) and Project 12 (science) also expressed the desire to strengthen connections to students' homes to overcome parental opposition.

Lack of Alignment Among the Materials, District Curriculum Standards, and Norm-referenced Tests

Both the Expert Panel and teachers agreed that the IMD materials were closely aligned with national standards in mathematics and science. However, some users told us the products were not aligned with district standards or with the norm-referenced tests that states and districts continue to use to measure student achievement. Dissatisfaction with the materials developed when these district standards and tests played a major role in the school district. As one teacher noted:

> “If standardized testing is fact-based, the curriculum needs to include more facts, not vague themes.” *(Focus Group, Project 15).*

Until assessment and district-developed standards catch up with reform-focused content and pedagogy, IMD materials will find tough sledding in these school districts.

Absence of Supportive Educational Technology

Although technology can facilitate implementation, it can also serve as a barrier. Some teachers found that materials such as videos and computer software were dated when they began using them. Teachers using Project 1, for example, found some of the early computer software products to be archaic and unsophisticated, although more recent offerings from the developer were much improved. Teachers implementing a CD-ROM program (Project 12) found it was not particularly user friendly.

Most sites using computers cited hardware problems as an ongoing barrier to usage as well. Many sites had an inadequate number of computers in the classroom, or had to schedule time in computer labs. This problem was found among both low- and high-wealth districts. In addition, maintaining hardware is a universal problem because either teachers or their students must do repairs when the machines malfunctioned.

Lack of Resources

A number of schools struggled with other resource shortages. Some schools were lacking in basic equipment and supplies to conduct laboratories. Many schools had no water source in the classroom, which presented problems for many laboratory-based projects. Students often carried water into the classroom in buckets. Others struggled with more basic shortages, such as not having enough books to go around for their students.

Implementation of Non-IMD Materials

In order to provide comparisons with the IMD-funded materials, we also studied materials that did not receive IMD funding. All the non-IMD materials selected were comprehensive curricula. Further, we selected the materials from state adoption lists from states that have curriculum frameworks or standards in place, increasing the likelihood that the products would hold similar intentions to those funded by NSF. We conducted focus groups and class observations of teachers using a wide range of curricula that were fairly evenly distributed from traditionally-oriented texts (e.g., content is presented, followed by class exercises and homework), to those described as “traditional with a few hands-on activities,” to products more similar to IMD-funded materials. Comments made by focus group participants make it clear that some commercial publishers represented in the comparison sample have made efforts to adapt their products to respond to national curriculum frameworks and standards. Staff informally rated the materials as more or less reform oriented, using the framework the Expert Panel used to evaluate the materials.

Teachers in sites using non-IMD-funded curricula were aware of both national curriculum frameworks and standards and the trend towards student-centered, discovery oriented approaches to teaching. Some districts using more traditional curricula had adopted them in the early 1990s, and teachers indicated that their districts either had already adopted or would soon be adopting new curricula incorporating a greater emphasis on discovery-oriented, hands-on approaches to instruction. One district expects to adopt an IMD-funded curriculum, while others mentioned non-IMD-funded curricula developed by large commercial publishers. One teacher commented on the impact that the movement in the professional community has had on his perception of their school's text:

> When we originally chose this text, we thought it worthy of a 5 (i.e., on a scale of 1-5), but now I'd rate it only a 2. The needs of students have changed, and the material is disconnected from real life situations. The world is data-oriented, and this book does not address that. *(Focus Group, high school mathematics curriculum)*.

Overall, most teachers in the focus groups of non-IMD users were at least moderately satisfied with the curricula their districts are using, with those using more traditional texts tending to be less satisfied. Most curricula were used as intended. However, one middle school science curriculum designed to be comprehensive was used as a supplement in one district we visited. Teachers in that district believed the reading level was too difficult for their students, reflecting an issue that was also raised about IMD materials.

Teachers using more traditional materials praised content coverage, ease of use, and the plentiful practice worksheets that accompany texts. Not surprisingly, focus group participants also reported that teachers in their district feel quite comfortable teaching with these curricula. Criticisms of traditionally oriented texts focused on: inadequate concept development, a lack of variety in instructional techniques, insufficient number of hands-on activities, and failure to make real-world connections for students. Some teachers supplemented the texts with materials intended to address these weaknesses (e.g., teachers in one school supplement their mathematics instruction with an IMD product).

In contrast, praise and criticism of more reform-oriented curricula were similar to that for IMD-developed curricula. Teachers praised them for their: development of concepts, pedagogical approaches, real-world applications, and their capacity to engage students. One teacher, for instance, commented of her curriculum:

> The manipulatives are very good. At all levels, students need some type of hands-on activity. You can't always just work off a ditto sheet—adding, subtracting, and what not. The manipulatives make them think and then they have to find a reason why they got their answer. Then they can show it to you and their classmates as well. *(Focus Group, non-IMD elementary mathematics curriculum).*

Criticisms tended to focus on insufficient content coverage, lack of drill and practice exercises so that students can attain mastery of concepts, the amount of preparation time the materials require, and the fact that the materials require tremendous change in teacher practice.

Non-IMD-funded materials faced barriers to implementation similar to those faced by IMD-funded materials. In many ways this is not surprising because both the facilitators and barriers generally arose not from the materials, but from school and district policies and practices that affect curriculum use. Users of non-IMD materials mentioned the following as facilitating or serving as barriers to use:

- Professional development
- Adequacy of resources
- Teacher skills, knowledge, and attitude
- Alignment among materials, district curriculum standards, and norm-referenced tests

Professional Development

Opportunities for professional development were important to the implementation of the non-IMD materials, although in most instances teachers reported receiving less intensive professional development than did teachers using IMD-funded comprehensive curricula. Many of the IMD-funded districts and schools had been pilot-or field-test sites, and professional development was often conducted by the developer, whereas non-IMD funded professional development, if received at all, was either provided by the publisher or the district. Training for non-IMD-funded materials was more often geared toward covering the content of the curriculum or state and local frameworks than toward pedagogy. The non-IMD materials required less change in classroom practice, overall, than did the IMD materials, and the amount and type of inservice may be related to the nature of the materials.

Insufficient professional development was a barrier to implementation of one of the more reform-oriented non-IMD-funded curricula. In one district, issues arose similar to those that affected the implementation of IMD-funded materials:

> The company supplied the district with some staff development, but because the company was small, they could not offer development for all teachers in the district. The district had to do inservice training on its own….The district made the commitment to do some inservice for some leadership teachers, but it didn't train many teachers. The next year we went into the adoption of Language Arts so that took priority. That's the way it is…The one-shot deal does not work because the teachers were lost. It was a dramatic change for them….We've had a lot of new teachers come in who were given the curriculum and not trained….We probably need more inservice on it for us ourselves to understand what we're doing. It's completely different from the way things were done. [We need] more time in the classroom for the students to process this, too. It is demanding of the time and sometimes very difficult to serve justice to it. *(Summarized from Teacher Interviews, non-IMD elementary mathematics curriculum).*

One teacher in a district that is contemplating a change to an IMD-funded middle school mathematics program was apprehensive about the shift because of the intensive staff development she anticipated the district would be required to provide in order to implement it well.

High school teachers reported receiving less staff development than did middle school and elementary school teachers; in some instances teachers received no professional development at all. Teachers in one school seemed unfazed by this lack of professional development, commenting that high school teachers in their district typically did not receive professional development.

A collegial work environment was mentioned as being important in two sites. In one site, the teachers frequently meet on an informal basis and share ideas about what works in their classrooms. The three teachers in another school receive district support through a common planning period, which gives them ample opportunity to share ideas about how to use and supplement their texts.

Adequacy of Resources

As was true for IMD-funded curricula, the presence or absence of adequate resources made a crucial difference in how well the materials were implemented. In one district, the school board assumed district-wide responsibility for replenishing consumables. The adequacy of the teacher support materials that accompanied the curricula was also important to successful implementation. For example, a high school mathematics curriculum was complimented for including many teaching tools:

> It comes with very good examples—two or three examples and plenty of practice problems. Everything is clearly defined with lots of explanation. They provide us with a lot of extra teaching tools, which are handy—transparences for instructional purposes, a manual for testing, a solution manual, a practice book with additional problems for students to practice, and alternate workbook. *(Teacher Interview, non-IMD high school mathematics curriculum).*

On the other hand, implementation suffered when resources were not available:

> We don't have enough books, and therefore a set of books are shared between classes. The teachers have to juggle the books around when two teachers are teaching the same unit. There is no ownership of books since we don't have class sets so the kids trash them, tearing pages….The kids can't take the books home and study at night. *(Teacher Interview, middle school non-IMD science curriculum).*

Teacher Skills, Knowledge, and Attitude

The districts using non-IMD reform-oriented curricula reported more instances of implementation being affected by teacher skills, knowledge, and attitudes than did those using more traditional curricula. One district using an integrated mathematics curriculum in its high schools had pilot-tested another integrated curriculum, but found the mathematics teachers did not have a strong enough background to teach the alternative curricula. In another district, some teachers resisted a more reform-oriented elementary mathematics curriculum because of the tremendous change in pedagogy it required. A teacher using an integrated high school mathematics curricula commented that the main complaint she hears is "a reluctance to give up a certain amount of material, and the integrated curriculum is seen as almost requiring that you do a certain amount of that. And there is still an impression that when you go with the integrated curriculum, they don't give you as much of practice in drills and skills."

One teacher expressed her belief that teacher attitude can have both a positive and negative impact on student learning:

> I think it has to do with the attitude of the teachers, too. If the teacher is having a hard time with it (the curriculum) and being negative about it, it kind of reflects also on student learning. But if the teacher is really excited, motivated to do it, and feeling good about it, the students will, too. This new way of teaching...has

> allowed people to see math in a positive way—it's not so threatening.

Alignment Among the Materials, District Curriculum Standards, and Norm-referenced Tests

Teachers, even when they liked the more reform-oriented curricula, were critical of inconsistencies among district curriculum standards, the curriculum they use, and the standardized tests that their students are required to take:

> For many teachers, there continues to be a certain sense where the criteria of success is how many students can number crunch effectively. That is still a strong criterion by which they judge the success of a program. "In a sense, we want it both ways. We like to have higher order thinking. We like this idea of an integrated curriculum. We like all these things, but we are very hesitant to pursue that at the expense of students not maintaining the level of skill and effectiveness at working with equations…" "Teachers are going to tend to be pulled toward maintaining testable skills because that is the assessment tool that will determine whether they are doing their job correctly. And so it tends to be, 'How effective am I in being able to get the right answer.'" *(Summarized from Focus Group, non-IMD high school mathematics curriculum).*

This mismatch may drive many of the comments voiced by teachers about the non-IMD-funded projects (and some IMD-funded projects) when they complain that the materials pay insufficient attention to mastery of skills.

Summary

Overall, successful implementation relies less on the materials than on local factors, the existence of appropriate professional development and support, and strategies that gather support for the product from teachers and parents.

When teachers did not receive appropriate professional development, they implemented materials in ways resembling traditional practices. In other settings, where district- or school-level support was great, or where teacher enthusiasm had been developed through the process used to make adoption decisions, implementation was more faithful to developers' intent.

A similar problem exists in terms of community support. When parents are not persuaded of the value of reform-oriented approaches to curriculum and instruction, they present barriers to implementation. They do so by such actions as pressuring teachers and administrators for the type of homework that "looks like" mathematics or science as they knew it. In contrast, communities that work closely with parents experience fewer implementation problems stemming from their objections.

CHAPTER VII

Impact

The evaluation of the IMD materials addressed impact in three ways. First, we were interested in how those who were using the materials, either IMD-funded or non-IMD, assessed the impact. Second, to the extent possible, we sought information about how materials affected student learning. The study did not include testing of students; rather, we requested information during site visits about data collected at the classroom, school, or district level.

Finally, the study focused on how the use of materials affected classroom practice. Data related to classroom practice came from two sources: interviews or focus groups with users of the materials, both IMD and non-IMD; and observations conducted by WestEd and Abt Associates Inc. staff, using a structured instrument (see Appendix 3).

The interviews, focus groups, and observations that provided the information for this chapter were conducted in a variety of settings, including urban, rural, and suburban schools, and schools in which adoption was fairly new and those that had longer experience with the materials.

IMD Materials

Users of the IMD materials assessed their impact in multiple ways, including the extent to which:

- Teachers believed that the materials increased their own content knowledge;
- Teachers believed the products increased their use of reform-oriented pedagogy;
- Products increased student engagement; and
- Products increased student achievement.

Content Knowledge

Teachers of IMD-funded science products were more likely to report that using the materials increased their own knowledge of content than were those who used the mathematics materials, perhaps reflecting differences in how well they were originally prepared to teach the subject. Elementary school teachers appreciated the theoretical base that the NSF materials included, and high school teachers who used Project 5 believed their knowledge was extended through using the materials.

Teachers who used the science materials, particularly in elementary schools, reported that the IMD-funded materials increased their knowledge of science. Elementary school teachers often have little background in science, so schools often looked for strong teachers' manuals with clear concepts of what to cover. The teachers in the focus group for a comprehensive elementary school science project highlighted their appreciation for the clearly presented new content:

> For teachers who do not have a background in science, the materials give them a structure and a story line, since each concept and each grade builds upon the next. It provides a good introduction to certain meaningful science concepts for teachers. It becomes a base for teachers to use to teach science. The first-grade teacher in the group said that the curriculum gave her greater comfort with science: "It made me not dread science." *(Summarized from Focus Group, Project 21)*.

Similarly, teachers reported that the manual that accompanied Project 27 was clear and easy to follow, with a thorough overview and presentation of kits. Even supplemental materials, such as Project 20, were cited as improving understanding of science concepts and making it easier to teach science.

In contrast, teachers also reported that some IMD science materials required prior content knowledge. One teacher using a high school course commented:

> "I think the materials would scare the crap out of any teacher who is weak in science. You can't go to the text to educate yourself. You have to go to the research, which can be intimidating." *(Teacher Interview, Project 16).*

Reform-oriented Pedagogy: Teachers' Views

An explicit purpose of the IMD program is to encourage reform-oriented pedagogy by the nature of the products it supports. Teachers of the comprehensive IMD materials often remarked that the products stimulated them to use more student-led investigations and discovery activities for students, hands-on exercises, and exploration of mathematics and science concepts. When teachers of IMD materials remarked that their teaching had not changed, it was typically because they reported that they were already using an investigative, hands-on approach.

With the mathematics curricula, most teachers at each level believed they had changed the ways they taught, especially in moving away from teaching by rote.

> "The classroom is more active and student driven. The teacher's role is different. You are a member of the community and not just into exposition. You can't predict what's going to happen in the lesson because students often have questions that the teacher can't anticipate. It creates a learning community in the classroom. he content is so different that it drives changes in practice." *(Focus Group, Project 19).*

> "We're not teaching by rote but by solving problems, transmitting data, and working in teams." *(Focus Group, Project 8).*

> "It has changed the way I teach dramatically. It has changed how I teach, how I deliver information, how I engage students to be active participants in their education. It has also changed the physical appearance of the classroom (it's messier now), and how I assess student learning. It is exciting to watch kids share knowledge, and to share their excitement in the learning process." *(Focus Group, Project 5).*

With the comprehensive IMD science curricula, elementary teachers often remarked that although how they taught science had not changed, their attitudes about science were more positive and their enjoyment and excitement in teaching the subject had increased, reflecting a common research finding that teachers believe that they have "always done" what is required (Spillane & Zeuli, 1999). Middle and high school science teachers, on the other hand, saw changes in their pedagogy. As several teachers reported in focus groups:

> Prior to implementing [the product], his classes were two-thirds lecture and one-third activity based. During the activity-based portion, he might have an entire

> class devoted to computers or wet lab or a hands-on activity. Now his classes are more fluid, and a single class will incorporate two or more of these aspects at a time. *(Summarized from Teacher Interview, Project 16).*

> The materials forced a less passive approach to teaching (that is, less of the "lecture, read, answer lab questions" format). Teachers could not use "cruise control" to teach. The exploratory labs and student questions dramatically changed the teaching of one teacher because the program requires her to answer student questions when sometimes she doesn't know the answer. *(Summarized from Focus Group, Project 12).*

> The high school course is very student oriented rather than being teacher oriented. There is far more emphasis on students' sharing ideas in small groups and not on teacher lecture. The materials give guidelines for running the classes in this way. Changing the way of teaching was hard. As one teacher reported: "I had a rough time turning the room over to the kids. I have 23 years of being in total control with a lot of straight lecture. When I started [the course] that first year, turning the classroom over to the kids as a town meeting and saying, 'Ok you have two days to plot out your diet and figure out food values' — that was tough to do and maintain control." *(Summarized from Focus Group, Project 2).*

Some science teachers who did not change their pedagogy experienced changes in their attitudes toward science based on their students' and their own enjoyment of the materials:

> One teacher commented that [the product] has had an impact on her teaching in the sense that she had always found plant biology to be boring and really didn't like teaching it, but now she looks forward to teaching the unit because her students like it so much and because they get so much out of it. *(Summarized from Focus Group, Project 20).*

Comprehensive materials seem to be more likely than supplemental materials to have an impact on pedagogy, at least as the teachers reported it. The most common pedagogical changes noticed by teachers interviewed about IMD supplemental materials, was incorporating media, such as the Internet, videos, and special tools, into teaching. However, the teachers who used supplemental materials identified and selected them and were likely to characterize themselves as using reform-oriented pedagogy prior to implementing the IMD materials.

The new strategies make teaching more challenging for the teachers. The curriculum is no longer something they can simply pick up and implement, almost by rote. Instead, they need to study the materials in order to understand the concepts and strategies. Many teachers reported that far more preparation time was needed than was indicated by the publisher, including time to incorporate more group work into the day.

Reform-oriented Pedagogy: Classroom Observations

In addition to using focus group and interview data to collect teachers' views on the impact IMD materials made on their pedagogical practice, WestEd and Abt Associates Inc. staff observed in classrooms in which IMD-funded comprehensive materials were used, guided by a structured observation instrument. The instrument addressed the overall quality of instruction, mathematics or science content, classroom culture, and teacher behaviors. We found that both mathematics and science classes were interactive environments in which hands-on activities were notable, although there was more variety in the science classes.

Students in most mathematics classes we observed were engaged in problem solving and hands-on research. In elementary classrooms, we saw many student oral presentations. In contrast, there were few formal presentations by teachers. In fact, only at the middle school level did a majority of classes observed (70 percent) rely on formal teacher presentations.

Across all criteria included in the instrument, the overall quality of the mathematics lessons observed was high, especially in elementary school. The instrument rates scores of 4 as "accomplished, effective instruction" and 5 as "exemplary instruction," and the average ratings were 4.5 (elementary), 3.7 (middle school), and 2.7 (high school). The low high school rating is due to one class that was rated as exemplifying "ineffective" teaching.

Observers also rated the content of the mathematics lessons highly, with average ratings of 3.8 (elementary), 4.1 (middle school), and 4.2 (high school) on a five-point scale. The instrument addressed issues such as whether the content was appropriate, significant and worthwhile; accurate and relevant to the needs/interests of most students; and portrayed as a dynamic body of knowledge.

The observers gave high ratings to items related to the culture of the classroom, especially the extent to which teachers encouraged active participation and collaboration among students and showed respect for and collaborated with students. Average ratings ranged from 3.7 to 3.9 across the three school levels.

Teacher behaviors, such as the teacher's management style, pacing of the lesson, confidence in using the materials, and questioning strategies, were less highly rated. Averages ranged from 3.2 (high school) to 3.4 (elementary school) to 3.8 (middle school).

One observer described an exemplary lesson in numeration and place values among first graders:

> Students are organized in stations, with the teacher leading one station. Students work on a problem and share solutions with the group. The problems cover the different skills of the unit and allow the teacher to assess if there are students who are having difficulty with the material. Students are engaged in a variety of tasks that make them responsible for their own learning and the learning of their peers. Most students are eagerly participating in the activities and in sharing their ideas with each other. There are enough manipulatives so that all students have the opportunity to work with them. When students arrive at different answers, they discuss their work and come to an agreement. The activities are well structured to provide students with the opportunity to practice what they have been learning in the unit. It also allows students to teach each other if there are concepts that are still unclear to some.

Among the science classes observed, the major activities were hands-on science with some problem solving by students. Teachers made formal presentations in half or fewer of the classes. The elementary grade science classrooms received consistently high marks — 4.0 in overall quality, 3.8 each in content and in classroom culture, and 3.7 in teacher behaviors. Ratings for the middle and high school science classes were lower, with most average ratings at or near 3, the mid-point of the five-point scale. There was far more variability in ratings in science than in mathematics, with scores ranging from 1 ("activity for activity's sake") to 4 ("accomplished, effective instruction").

In a highly rated elementary science class, where first graders were focusing on the properties of balls of clay, one observer wrote:

> The teacher was completely confident with the subject lesson. She kept the students engaged, asked them questions and really tried to have them come up with answers, encouraged them to think, and to try out other questions. The teacher continually came around as kids were working in groups to ask them questions and listen to what they were finding. Kids were asked to draw and write about what they found (both individually and in groups). The teacher then asked what was found, wrote findings on the board and led a discussion comparing the properties of balls....It was an example of what can happen with a great curriculum and a wonderful teacher.

Among the lower scoring high school science classes, observers found that one teacher who had reportedly not bought into the IMD curriculum taught very traditionally, with emphasis on drill and practice. In another class, the observers wrote that the teaching was very "book-bound," with the teacher neither giving students sufficient time to develop their own ideas nor pushing them academically.

Student Engagement

Although we have no independent measures of student engagement, teachers interviewed consistently spoke of increases in student engagement using the IMD materials, across comprehensive and supplemental materials, grade levels, mathematics and science.

Teachers of comprehensive mathematics materials said:

> Students are no longer afraid of math. "Students actually look forward to doing math" one teacher remarked. Another teacher remarked that she had a student who would cry whenever they did math, yet since using [an elementary school math program], the student is very happy. *(Focus Group, Project 10).*

> There is a better level of student engagement. Students have much more conversation with peers about math. As the year goes on, students tackle more complicated problems with less teacher help. The questions students ask are thoughtful rather than procedural. There is greater diversity in responses to questions. Students are more willing to take risks. *(Focus Group, Project 19).*

> "I like the way it engages students in mathematics. Students learn to be in control of their own learning. It's not clear whether students are developing better math skills. What is clear is that students' belief in their ability to do math is increasing dramatically. In their writing, they seem to think they understand math. For the first time, all students are moving on in math and enrolling in courses beyond what is required. This is remarkable, particularly for those students who have always struggled with and disliked math." *(Focus Group, Project 5).*

Teachers reported increased student engagement with supplemental materials for mathematics as well. Videos provide a different angle for students that they can grasp right away and they were reported to be fun to watch. One tool was highly praised because it allowed students to explore spatial relations and geometric properties that would have been very tedious by hand. Teachers reported that students see the results immediately, which helps attract and hold their attention.

Science teachers also reported increases in student engagement:

> "The students do like using the materials....The subject holds their attention. They are solving problems and coming up with solutions, and they are having real discussions. The students come up with more questions, and even if they do not fully grasp the concept right away, the concept is on the way to being realized." *(Focus Group, Project 21).*

> "Learning is coming from within, not from without. The lessons make science real for kids. It builds a strong conceptual understanding of basic science principles. The lessons are fun and really hold kids' attention." *(Focus Group, Project 22).*

> "Subjectively, I think we're doing a better job getting students more interested in coming to school on a daily basis. I get testimonials from parents to this effect." *(Focus Group, Project 4).*

> "The students' reactions are very positive. They do not want to be absent when the program is in use and they appear to be eager to learn as much as they can about how the cars are working. The students apparently go home and talk endlessly with their families about what they are learning." *(Teacher Interview, Project 20).*

> Students become very attached to their [materials] and are extremely engaged in following the developmental process.... Two students with whom I was sitting had both named their materials, and according to them, almost all of their classmates had also done so. Both were very positive about the unit. One commented: "This is the best part of science, you know, where you get to do stuff in the labs." The other student agreed, saying: "It's better than if you watch a time lapse video because you're doing it yourself and it's yours and you can see everything happening." *(Summarized from Classroom Observation and Focus Group, Project 21).*

Across both mathematics and science materials, teachers often reported that IMD materials were suitable for a broad range of students. Several special education teachers spoke of the usefulness of hands-on materials for their students. In addition, two middle school programs that integrated technology were given high marks for increasing the representation of girls in technology. In one site, two years ago, the seventh grade technology education class had only two girls, but with the IMD-funded materials, girls are half the students and are full participants. One anecdote illustrates a girl's involvement in technology both within and outside the classroom:

> A student asked her father if she could have new bedroom furniture and her father replied that he didn't think that she was mature enough. [We're not sure why he thought that, but that's the way the story is told.] While he was away on a business trip, she took the dimensions of her room and designed and developed a scale

> model of the room, complete with what she had in mind — bed, dressers, study/computer area, etc.— and presented it to her father when he returned home. Her father, impressed with her initiative and the detailed manner in which she had thought through and presented the design, agreed to buy her new furniture. The furniture arrived while her father was away on another business trip and her mother told her: “Well, I guess we’ll have to wait until your father gets back from his business trip to set up your new room.” The daughter was not so easily daunted as the mother and headed down to the basement to get all the tools she needed and started assembling the room on her own and had everything in place before her father returned home. Her teacher believes that this anecdote demonstrates some of the types of problem-solving skills that students use in the… classrooms. Furthermore, she described the student as a “princess” who, prior to taking the technology portion of the course, would never have dreamed of picking up hammers, wrenches, and screwdrivers to assemble her new room. *(Summarized from Focus Group, Project 17).*

Student Academic Performance.

Most of our information about student achievement comes from teachers’ assessment of student progress, although some teachers reported results from norm- or criterion-referenced tests in mathematics, with some limited information about possible impact coming from the classroom observations. Formal achievement data comes primarily from sites in which the materials were adopted at the district or school levels.

Perhaps most strikingly, teachers said they assessed students differently from their previous practice. For example, teachers of an elementary-level mathematics curriculum noted:

> “[Before implementing this program] we probably assumed that students knew more than what they really did about certain concepts. Even though students (especially the high level students) were doing the problems and performing well, they often did not have a real understanding of what it was we were teaching. The explanation part of the materials made us take a closer look at the strengths and weaknesses of students.” *(Focus Group, Project 10).*

Teachers gave multiple examples of their assessments of student learning, often focused on students explaining the strategies they have employed in solving problems. Several teachers also observed that students were applying strategies they learned to situations outside class (Project 15).

Teachers using the IMD science materials also reported that students were more confident in themselves as learners, were now more independent and self-starting, and had built their social skills because of the need to gather information and make presentations as part of small groups. A middle school teacher echoed comments from other middle and high school teachers about what students learn from IMD science materials:

> These materials encourage students to develop and test their own hypotheses.....He finds that his students are now more willing to take these kinds of risks. He finds that girls, in particular, seem to talk more in class. He used the example of a girl in his class who collected data and believed that she had refuted a widely accepted scientific theory. She was confused and thought she had made

> a mistake, but wasn't sure where or how. She came to the teacher to talk through what she had done. As she explained what she had done, she figured out what she had done wrong. According to the teacher: "She thanked me for listening, but she solved the problem herself. Students get into the process enough to develop a gut instinct and say to themselves 'Okay, I need to redo this and this and this.' Stuff like that is good for kids. They're not so dependent on us for what they understand." *(Summarized from Focus Group, Project 16).*

Although teachers of the IMD-funded mathematics materials reported higher levels of sophistication in thinking mathematically, some worried that students' computational skills were inadequately addressed at several grade levels.

Several implementing sites assessed student achievement on the comprehensive IMD-funded mathematics products through state or district norm-referenced tests. These are cross-sectional designs (e.g., 8th grade students in one year compared with 8th grade students in the next) with no comparison group. Hence, attributing changes in achievement to the products and not to other factors is problematic.

For the two comprehensive elementary school mathematics programs for which users reported data (Projects 10 and 15), test scores have improved. One experienced an initial drop in standardized test scores and then gains. Teachers reported being a little surprised by the gains because they were on norm-referenced tests, and they decided to readopt the materials on the basis of the gains.

At the middle school level, all three comprehensive math programs had achievement data. The district adopting Project 19 looked at cross-sectional gains in sixth graders and eighth graders over several time points, and this year the district is beginning a longitudinal study to track the same students for five years. Increases in problem-solving skills among upper middle school students was attributed to Project 11, although some in the district think that increased mathematics scores could be related to the district's paying more attention to mathematics in general. In another district, advocates attributed increases in student achievement on the state assessment to the middle school math program (Project 1), although other teachers claimed that differences in the cohorts of middle school students could have been responsible. At the high school level, Project 5 showed improvements in test scores but as with other levels, attribution is difficult.

Once products were adopted by a district or school, cross-product comparisons of a product's relative impact on student learning were rarely made. Four of the seven comprehensive IMD math products were adopted either district- or school-wide, so no other products were available as comparisons. A fifth product was adopted as an alternative to the standard curriculum, but no achievement comparisons have been made. Another comprehensive high school math curriculum was also adopted as an alternative to the standard curriculum, with about 20 percent of students enrolled. The district visited is just beginning to assess the relative effectiveness of the two curricula through student grades, persistence in taking math courses, SAT/ACT results, and state test results. The final district in this group was cited in the case study of adoption, above.

Among the nine comprehensive IMD science products, none conducted formal student achievement assessments, nor was student achievement compared with other products. No student performance data were available about supplemental materials, either in math or science. This is not surprising because such assessments would have required considerable methodological sophistication.

Classroom observers were asked to rate the "likely effect" of the lesson observed on students' understanding and self-confidence. We found that observations supported the finding that better implemented materials were deemed to be likely to affect student outcomes more than poorly implemented materials.

Elementary mathematics classes received high ratings in such areas as student understanding of: mathematics using multiple approaches (4.3 on a five-point scale); science as a dynamic body enriched by investigation (4.0); and the importance of mathematics and science concepts (3.5). Observers also gave high marks to the likely effects of the lesson on student self-confidence in doing mathematics (4.2). At the elementary school level, the IMD products received higher ratings than did the non-IMD products.

The ratings of middle school mathematics classes were also very high (3.9 to 4.4) except in mathematics as a dynamic body of knowledge (3.2), but high school mathematics ratings were generally around 3, the mid-point on the five-point scale, and lower than elementary or middle school. However, the high school IMD mathematics ratings were higher than those given in classrooms using non-IMD materials, particularly with regard to likely effects on student understanding of important mathematics concepts (3.7 vs. 2.9); of mathematics as a dynamic body of knowledge enriched through investigation (3.0 vs. 1.5); and on students' self-confidence in doing mathematics (3 vs. 2.5).

The likely effects of the IMD science lessons were all above 3.5 at the elementary school level, around 3 at the middle school level, and between 2.5 and 3.2 at the high school level. These lower scores parallel the generally lower implementation ratings that science curricula received from the classroom observations.

Non-IMD Products

The information presented in this section must be interpreted with care. Few teachers of the non-IMD materials were as conscious of their own pedagogy as were many of the IMD teachers, and fewer of them reported changes in practice. We were intrigued by the difference in self-reflection between teachers of IMD products and those using non-IMD products, but the finding must be placed in the context of the fact that the teachers we observed and interviewed were "nominated" by developers or publishers. They may have been selected because of their reflective natures, reflective teachers may gravitate to reform, or the materials may stimulate reflection. Additional research is necessary to resolve the matter.

Further, although the observations illustrate that teachers of non-IMD materials tended to use more traditional instructional techniques, the difference may not be attributable to the products in use. Indeed, at least one teacher was observed using an IMD-funded and a non-IMD product, and her practice was the same with both. In short, far fewer teachers using non-IMD-funded curricula than IMD-funded curricula reported impacts on:

- Content knowledge
- Reform-oriented pedagogy
- Student engagement
- Student outcomes

Each of these issues will be discussed in the following section.

Content Knowledge

Only one teacher of non-IMD-funded materials reported any impact of the materials on content knowledge:

> The curriculum has made it much easier to teach science. Science is not my strength, so it was more difficult for me to get children excited about learning science. [The curriculum] has become the basis of how I teach.

This teacher's experience echoes that of elementary science teachers using several of the IMD-funded elementary science curricula, described above.

Reform-oriented Pedagogy

Far fewer teachers using non-IMD-funded curricula reported that the materials had an impact on their instructional approaches, which is not surprising because the materials are quite traditional, or only moderately reform-oriented. One teacher using one of the more reform-oriented curricula noted the following change in her instructional approach:

> The roles reversed. Before we would stand up in front and say "Okay, this is the program. This is the answer. This is how I got it—now you do the same thing." Now it's the reverse. "You have to come up with the answer and you have to explain it to me." *(Teacher Interview, elementary school non-IMD mathematics curriculum.)*

Another teacher using an integrated mathematics curriculum reported incorporating more activities and making better connections between mathematics and science than in her previous practice.

Other teachers believed the materials they were using supported appropriate classroom practice, but the real motivation for their pedagogy came from other factors. One chemistry teacher noted, for instance, that most of his students are not there for the fun of chemistry, so he has had to do everything that he can to draw them in and engage their interest. Although the variety of approaches in the curriculum helps, he believes it is really up to him to engage their interest. Teachers in another district saw new trends in education and the influence of a "change agent" teacher in their school as the forces behind their move to more concept-driven and hands-on approaches to learning rather than the materials they are using.

Classroom observations revealed two differences in the use of IMD and non-IMD materials. First, the classrooms using non-IMD materials were more likely to have formal teacher presentations than were those using IMD-funded materials. Observers indicated that 75 percent of all non-IMD classes included formal presentations as a major activity, although about half also had students engaged in hands-on research and problem-solving work. Second, non-IMD classes were less likely to use technology. Although few observers in either IMD or non-IMD classes rated technology use as a "major" activity, the non-IMD classes had less use than did the IMD classes.

Student Engagement

Teachers using non-IMD materials provided us with fairly few examples of impacts on student engagement, in contrast to the many testimonials offered by teachers using IMD-funded materials. The examples all come from teachers in schools implementing more reform-oriented curricula.

> They enjoy the math class more when we do it, and I will forever use it. *(Teacher Interview, reform-oriented non-IMD mathematics curriculum).*

> [The curriculum] does an excellent job in making students feel good about themselves and their ability to do math. *(Teacher Interview, reform-oriented non-IMD mathematics curriculum).*

One teacher, however, questioned whether increasing student enjoyment was an appropriate goal:

> With integrated mathematics, it's a way of making the kids enjoy it more, but I am not convinced that it helps them any more. I would like to see evidence that integrated works better than the traditional methods. Publishers need site studies showing their curriculum's effectiveness. *(Teacher Interview, non-IMD high school mathematics curriculum).*

Except in one school, where teachers reported students as "hating" their middle school science text, teachers using more traditional curricula gave fairly curt responses, indicated the curricula meet their students' needs, and students either liked the materials or at least thought that they were "okay."

Academic Performance

None of the districts we visited shared information about student achievement on either norm- or criterion-referenced tests. Two districts using integrated mathematics curricula reported that more students in their districts are taking mathematics. One district, in fact, had adopted the integrated mathematics because they wanted to increase the numbers of students taking advanced mathematics. Although pleased with increased enrollment, they will not consider the adoption a success until they have some evidence that test scores are also improving.

Conclusion

IMD-funded products are designed to change how teachers think about science and mathematics, as well as how the content and pedagogy they employ when working with students. Comprehensive materials are more likely to have an impact on teacher conceptions and practice than are supplementary materials.

When teachers do not implement the materials as designed, the impact on classroom practice and student engagement is decreased. In contrast, however, when the IMD materials surmount the many barriers to appropriate implementation, classrooms are places in which students are highly engaged in important learning activities. We saw a number of such examples in the study. Consequently, we believe that the gap between project intention and actual use and impact comes less from the materials themselves than from the contexts in which they are used.

The strength of the products is shown by the fact that almost all the IMD materials were well implemented in a few places, and all had positive results when they were.

CHAPTER VIII

Conclusions and Recommendations

The evaluation of the IMD program focused on questions related to the development, marketing, adoption, implementation, and impact of the materials supported by the program. The lenses through which we looked put the materials at the center of reform of mathematics, science, and technology education. As such, the study may have slighted alternative perspectives and the role of other NSF programs in reform. Indeed, we found that many sites with the strongest implementations were found in states that had participated in Statewide Systemic Initiative efforts.

Our findings, in brief, were that the materials were of high quality, but that marketing, adoption, and implementation were problematic. As a result, there was deviation between intention and actuality at every link in the chain between development and impact. Products were marketed by small publishers who had limited resources for aggressive dissemination, so they were unable to increase the market for reform-oriented materials through their efforts. Further, adoption process frequently involved single teachers so widespread use in a district was rare. Teachers became aware of the materials through their participation in pilot or field tests or by seeing them at subject-matter conferences. Although such teachers were able to use school and district funds to purchase the materials, in general, they were unable to influence other teachers to use them. Also, implementation encountered problems due to lack of sustained professional development; and impact was more limited than it could be. On the other hand, most products overcame the hurdles at each juncture and were successfully implemented in at least a few settings. The lessons from these successes and failures can guide future NSF programming.

This concluding chapter begins by summarizing the answers to the questions posed by the study, and then moves to recommendations for NSF action. The recommendations place the IMD program within a portfolio of activities NSF can support, whether directly through materials development or through other mechanisms.

Answers to the Evaluation Questions

The study was framed by six questions:

1. To what extent do instructional materials embody the national standards, including an emphasis on thinking skills and making connections across curriculum topics?

2. To what extent do they reflect what is currently known about good instructional practice?

3. How well have they been marketed?

4. To what extent do adopters and teachers use the materials?

5. What supports do teachers and other school-based professionals need to make the best use of the materials?

6. What is the impact of the materials on classroom practice?

The first two questions address issues over which NSF exerts direct influence by creating appropriate guidelines for funding, including reviewers who understand the intent of the program, and funding projects that hold promise of embracing the standards and reform-oriented pedagogy. The other questions are about the downstream issues, and the IMD program itself is more limited in the actions it can take about these matters, at least at the time of funding. In addition, the findings of the study related to these questions are more suggestive than definitive.

Each question will be answered in turn.

The Quality of the Materials

Both members of the Expert Panel and teachers who use the materials rate them highly. They believe that the materials embody the national standards. However, the quality of the materials is not sufficient to lead to widespread use. First, many teachers and parents do not embrace the reforms inherent in the products, and even in adopting districts, may resist their use or change their nature during implementation. For example, we conducted focus groups with teachers who "reorganized" the curriculum to make it more like what they were used to, ignoring the developers' intent. Second, state and local standards and tests are not always congruent with the national mathematics and science standards, and teacher success is judged by how well their students perform according to state and local expectations. Nonetheless, the IMD program goal of creating high quality materials has been realized.

Instructional Practice

IMD-supported materials are highly rated as supporting what is currently known about good instructional practice. Both the Expert Panel and teachers who are using the materials agree that the materials embrace reform-oriented pedagogy. Teachers reported that they encouraged student inquiry, problem solving, and making connections across curriculum topics as they used the materials.

However, despite the positive ratings related to instructional practice, the materials faced barriers in implementation. For example, users of IMD products reported that parents were concerned that student homework (if it existed) was not what they expected. Some teachers then "supplemented" the materials with drill and practice homework sheets. In other instances, comprehensive materials were used as supplementary, and reform-oriented pedagogy became marginalized in the classrooms.

However, the materials themselves are appropriate models that reflect current thinking about instruction.

Marketing

The first stumbling blocks to program success appear at the link between developers and marketers. When the relationship is positive, the two share a vision and work closely to market the materials, but both developers and publishers frequently cited misunderstandings or differences in perspectives. Further, both report being hampered by what they believe is a limited market for reform-oriented materials. As a result, major publishers are unlikely to publish the materials, and the smaller, reform-oriented publishers have fewer resources to use for marketing.

The marketing problem arises because of the limited market for the materials, but is exacerbated by the fact that the most effective marketing tool is professional development. Professional development helps sell products in two different ways. First, developers, marketers, and adopters agree that seeing the materials in a workshop setting is more likely to stimulate sales than any other approach. One person drew the analogy of the difference between reading a menu and eating a meal and other methods of dissemination and actual experience with the product. Second, and equally important, adopters cited the availability of professional development as an important factor in their decision to adopt. In the "ideal case" cited above, the key advocate said, "Service sold it," referencing both workshops and ongoing support to teachers.

Professional development is expensive, and publishers believe that their role is to provide support at the front end of use. They argue that others are responsible for ensuring that teachers have adequate knowledge of the content and are able to use a variety of instructional approaches. If teachers came to classrooms with strong preparation in content and pedagogy from their preservice education, there might be less need for the depth of professional development required by the materials. The professional development issue is exacerbated by the fact that most IMD publishers are small and do not have the resources for significant amounts of front-end support, nor should they be placed in a position that requires them to do more than help teachers use particular materials.

We found that marketing is most successful when it reaches those who are already interested in reform and acquainted with current instructional approaches. For this reason, teachers who were involved in pilot and field tests frequently became a major source of sales of the materials.

Use of the Materials

There was considerable slippage between marketing, adoption, and use of the materials. When the process worked well, teachers and community members were invested in the success of the product and used it as well as they could. Adoption processes that engendered such investment varied, depending on the setting. For example, some districts built support through adoption committees, but there were fewer of these than anticipated. In other sites, an individual teacher began using the product and her/his enthusiasm (and the enthusiasm of students) spread its use. Whatever the process, if it yielded understanding of and support for the approaches taken by the materials, successful use followed.

We found that barriers to implementation were the mirror image of the facilitators. For example, technology could support use if it were available but was a barrier if the product relied too heavily on the existence of large numbers of computers. However, if materials that use technology are not available, there will be little reason for schools and districts to invest in computers.

Perhaps the most important barrier to use lay in the fact that teachers sometimes resisted use or used the materials in ways that conflicted with the developers' intention when they lacked the skills and knowledge related to content and instructional practice. Such resistance and misuse arose less in sites in which there was strong support for appropriate implementation.

Required Support

As indicated throughout this report, sustained professional development is a necessary accompaniment to successful implementation of IMD products. The materials themselves require teachers to change their conceptions of mathematics, science, and technology as academic content areas, moving from an emphasis on passive knowledge of facts and algorithms to active construction of knowledge. In addition, the materials embody instructional approaches that focus on the student as problem solver and thinker. These changes place great demands on teachers, and professional development is an essential tool for their learning how best to use the materials.

The sustained professional development associated with successful implementation had a number of components. First, teachers were introduced to the materials through some kind of hands-on workshop. Second, extended institutes or workshops, most often held during the summer, gave teachers an opportunity to practice using the materials in instruction. Third, someone—either a developer, publisher representative, or teacher who was more experienced in the program—was available to provide support during the school year. And, finally, in the best circumstances, the developer received feedback and changed or supplemented the materials to meet teachers' needs.

In addition to formal professional development, successful implementers often had an advocate or champion. The champion was able to arrange events with parents so they were supportive of the curriculum change. Further, he/she solved logistical problems by such actions as developing a centralized location for laboratory materials or manipulatives and a system for their use that facilitated teacher access to the materials. Having a champion meant that the teachers using the materials believed they would get help, which increased their enthusiasm for the products.

Impact

When materials were well implemented, they had positive impacts on classrooms, as reported by teachers. For example, elementary school teachers reported increased knowledge of science, and, to a lesser extent, of mathematics as a result of using the materials. Elementary, middle, and high school teachers said that the materials helped them use more student-centered, problem solving instructional approaches. And teachers at every level reported increased student enthusiasm for science, mathematics, and technology.

Only sites implementing mathematics curricula had data related to student achievement, typically from state or district tests. The designs did not include comparison groups so attribution is problematic. However, those that had information about student learning indicated positive outcomes.

Recommendations

The recommendations arising from the evaluation of the IMD program fall into two broad categories. The first focuses specifically on actions IMD program staff can take that will improve product development and dissemination. The second group of recommendations concerns issues outside the direct influence of the IMD program, and focuses on creating the climate and support for reform that we found essential to successful implementation and positive impact.

IMD Program Recommendations

- IMD program guidelines should emphasize the importance of including teachers on development teams.

- IMD program staff should acknowledge the importance of individual teachers as adopters of IMD products and seek ways to increase their opportunities to influence other teachers, through support for networks and school- and district-reform efforts that build on teacher knowledge, skills, and interest.

- IMD program guidelines should increase the stress on evaluation as a component of the development process, and should also emphasize the importance of collecting data related to student learning of mathematics, science, and technology on tests not directly connected with the materials, but appropri-ate to them, such as the NAEP or TIMMS.

- IMD program staff should offer assistance to developers through such avenues sessions at Principal Investigator meetings and other venues as they begin to work with publishers and develop relationships with agents who work with publishers.

- IMD program staff and grant recipients should strengthen connections with other NSF and federal programs to increase opportunities to connect with professional networks and create awareness of the products. Such avenues as the NSF Implementation Centers and the various systemic change projects, the Eisenhower Regional Consortia, and the Eisenhower National Clearinghouse are potentially useful to dissemination.

- NSF should sponsor a study that proceeds from an alternative vision for the IMD program—that the purpose of the program is to demonstrate what types of materials are possible and influence professional practice, preservice education, and publishers through the example the materials present.

Supporting Reform More Broadly

- NSF should stimulate a public dialogue about reform of mathematics, science, and technology education and the role of materials in efforts to improve education.

- NSF should provide support to professional networks, including the Presidential awardees, in order to increase their effectiveness in stimulating attention to reform of mathematics, science, and technology education.

- NSF should work with professional associations outside the science and mathematics community to build support for reform. Such organizations as the American Association of School Administrators (AASA), the Association for Supervision and Curriculum Development (ASCD), and the American School Boards Association (ASBA) offer opportunities to work with a broad array of educators and policymakers to create the environment that will support the use of the materials.

- NSF should increase attention to support structures and approaches that provide sustained professional development related to reform-oriented curricula and pedagogy. Such professional development should include in-depth workshops and institutes and on-site support to teachers.

- NSF should increase attention to the role of materials in preservice education. Teachers play a major role in choosing instructional materials, and most current preservice courses do not include work on processes and criteria to use in making such choices. In addition, preservice teachers who are familiar with reform-oriented materials are likely to be supportive of their use when they begin their teaching careers.

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APPENDIX 1

Expert Panel

Sam Alessi (public school administrator, Buffalo, New York)

Sigmund Abeles (retired public school administrator, Connecticut)

Sarah Lee Armstrong (college biology, Millsaps College)

Ramesh Gangolli (university mathematics, University of Washington)

Barbara Janson (former publisher and independent consultant, Massachusetts)

Martin Johnson (mathematics educator, University of Maryland)

Charlotte Keith (middle school mathematics teacher, Olathe, Kansas)

Ramon Lopez (university science, University of Maryland)

Barry Rowe (public school technology, Champaign, Illinois)

Ernest Savage (university science, Bowling Green State University)

Ethel Schultz (retired science educator, Massachusetts)

APPENDIX 2

Instrument For Evaluating Materials

Framework for Review
Instructional Materials for Elementary School Science[1]

Title: ____
Author(s): ____
Publisher: ____________________________ ***Copyright date:*** __________
Reviewed by: __________________________ ***Date:*** ________________

I. Descriptors

a. Write a brief description of the components of the curriculum upon which this review is based (e.g., teachers guide, student books, hands-on materials, multimedia material). That is, what materials did you receive and include in your review?

b. Write a brief description of the purpose and broad goals of these materials. That is, what were the stated purposes and what were the actual purposes of the materials?

c. What grade levels do the materials serve?
____K ____1 ____2 ____3 ____4 ____5

d. Are the instructional materials designed to
___ provide a complete multi-year program for elementary school science.
___ provide a complete one-year course for elementary school science.
___ provide multiple modules or units that could be used to supplement other course materials for elementary school science.
___ provide a single module or collection of activities that could be used to supplement other course materials for elementary school science.
___ other (explain):

____

[1] *NOTE: This framework is adapted from an instrument developed by Inverness Research under contract to the National Science Foundation. The framework was refined as part of a panel review of NSF-supported materials for middle school science, which was limited to projects that provide at least a year-long course of study.*

e. What are the major domains/topics of content covered by these materials?

II. Quality of the Science

Directions: For each item, circle the number corresponding with your response to the question. Write an explanation for your rating of each item below the item.

a. Does the content in the instructional materials align well with all eight areas of the Content Standards as described in the National Science Education Standards (NSES)? (See attached guidelines)

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
Omits substantial content included in NSES and/or includes substantial content not recommended in NSES	Some misalignment of content with recommendations in NSES	The curriculum aligns well with content recommendations in NSES

b. Are the science concepts presented in the instructional materials accurate and correct? [Provide examples of major errors where they are evident. Attach extra page if necessary.]

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
Substantial, major errors	Mostly correct, with some minor errors	Scientifically accurate, and correct

c. Do the instructional materials adequately present the major concepts in the standards and adequately demonstrate and model the processes of science?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
Major concepts and processes not addressed	Major concepts and processes somewhat addressed	Major concepts and processes addressed well

d. Does the science presented in the instructional materials reflect current disciplinary knowledge?

1 . . . . .2. . . . . .3. . . . . .4. 5

The ideas are out of date | Somewhat current | Current

e. Do the instructional materials accurately represent views of science as inquiry as described in the National Science Education Standards?

1 . . . . .2. . . . . .3. . . . . .4. 5

Poor examples of inquiry	Mixed quality	Rich and accurate examples of inquiry

f. Do the instructional materials accurately present the history of science?

1 . . . . .2. . . . . .3. . . . . .4. 5

Poor portrayal of history of science	Mixed quality	Rich and accurate portrayal of history of science

g. Do the materials emphasize technology as an area of study?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no emphasis	Some emphasis	Rich and well designed emphasis

h. Do the materials emphasize the personal and societal dimensions of science?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no emphasis	Some emphasis	Rich and well designed emphasis

i. Do the materials emphasize the content of life science?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no emphasis	Some emphasis	Rich and well designed emphasis

j. Do the materials emphasize the content of earth science?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no emphasis	Some emphasis	Rich and well designed emphasis

k. Do the materials emphasize the content of physical science?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no emphasis	Some emphasis	Rich and well designed emphasis

l. Do the instructional materials provide sufficient activities for students to develop a good understanding of key science concepts?

1 . . . . .2. . . . . .3. . . . . .4. 5

Too few learning activities	Activities provide some opportunity for students to learn some important concepts	Activities provide many rich opportunities to learn key science concepts

m. Do the instructional materials provide sufficient opportunities for students to apply their understanding of the concepts (i.e., designing of solutions to problems or issues)?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
Very few application activities	Some application activities	Very rich in application activities

n. Do the instructional materials present an accurate picture of the nature of science as a dynamic endeavor?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
The image of science is out-of-date, inaccurate, or non-existent.	The image of science is of mixed quality.	The image of science is current and accurate.

o. Do the materials develop an appropriate breadth and depth of science content?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
Too narrow or too broad	Somewhat balanced	Good balance of breadth and depth

p. What is the overall quality of the science presented in the instructional materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
Low	Medium	High

III. The Pedagogical Design

a. Do the instructional materials provide a logical progression for developing conceptual understanding in science?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
No logical progression of ideas	Somewhat logical progression of ideas	Logical progression of ideas that builds conceptual understanding

b. Do the instructional materials provide students the opportunity to make conjectures, gather evidence, and develop arguments to support, reject, and revise their preconceptions and explanations for natural phenomena?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
No opportunity	Some opportunity	Rich and well designed opportunity

c. To what extent do the instructional materials engage students in doing science inquiry?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
Very few or very contrived activities for students to do science inquiry	Some good activities for students to do science inquiry	Many rich and authentic opportunities for students to do science inquiry

d. To what extent do the instructional materials engage students in doing technology problem solving?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
Very few or very contrived activities for students to do technology problem solving	Some good activities for students to do technology problem solving	Many rich and authentic opportunities for students to do technology problem solving

e. To what extent does the curriculum engage students in activities that help them connect science to everyday issues and events?

1 . . . . .2. . . . . .3. . . . . .4. 5

Very few or very contrived activities for students to make connections	Some good activities for students to make connections	Many rich and authentic opportunities for students to make connections

f. How would you rate the overall developmental appropriateness of the instructional materials, given its intended audience of ALL students at the targeted level(s)?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not developmentally appropriate	Somewhat developmentally appropriate	Developmentally appropriate

g. Do the materials reflect current knowledge about effective teaching and learning practices (e.g., active learning, inquiry, community of learners) based on research related to science education?

1 . . . . .2. . . . . .3. . . . . .4. 5

Do not reflect current knowledge about teaching and learning	Somewhat reflective of current knowledge about teaching and learning	Reflect well current knowledge about teaching and learning

h. Do the instructional materials provide students the opportunity to clarify, refine, and consolidate their ideas, and to communicate them through multiple modes?

1 . . . . .2. . . . . .3. . . . . .4. 5

No opportunity	Some opportunity	Rich and well designed opportunity

i. Do the instructional materials provide students the opportunity to think and communicate scientifically?

1 . . . . .2. . . . . .3. . . . . .4. 5

No opportunity	Some opportunity	Rich and well designed opportunity

j. Do the instructional materials provide students with activities connecting science with other subject areas?

1 . . . . .2. . . . . .3. . . . . .4. 5

No opportunity	Some opportunity	Rich and well designed opportunity

k. Are the instructional materials likely to be interesting, engaging, and effective for students?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not at all interesting	Somewhat interesting	Interesting and engaging

l. Are the instructional materials likely to be interesting, engaging, and effective for girls and boys?

1 . . . . .2. . . . . .3. . . . . .4. 5

No sensitivity to gender issues	Some sensitivity to gender issues	Sensitive to gender issues

m. Are the instructional materials likely to be interesting, engaging, and effective for underrepresented and underserved students (e.g., gender, ethnic, urban, rural, with disabilities)?

1 . . . . .2. . . . . .3. . . . . .4. 5

No sensitivity to underrepresented and underserved students	Some sensitivity to underrepresented and underserved students	Sensitive to underrepresented and underserved students

n. Does assessment have explicit purposes connected to decisions to be made by teachers (e.g., prior knowledge, conceptual understanding, grades)?

1 . . . . .2. . . . . .3. . . . . .4. 5

Unclear purposes	Somewhat clear purposes	Clear statement of purposes

o. Do assessments focus on the curriculum's important content and skills?

1 . . . . .2. . . . . .3. . . . . .4. 5

Poor correspondence	Fair correspondence	Full correspondence

p. Do the instructional materials include multiple kinds of assessments (e.g., performance, paper/pencil, portfolios, student interviews, embedded, projects)?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no student assessment provided	Some variety of student assessment	Complete student assessment package

q. Are the assessment practices fair to all students?

1 . . . . .2. . . . . .3. . . . . .4. 5

Fair for a few	Fair to most	Fair to all

r. Do the instructional materials include adequate and appropriate uses of a variety of educational technologies (e.g., video, computers, telecommunications)?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no educational technology included	Some appropriate educational technology included	Many appropriate applications of eductional technology included

s. What is the overall quality of the pedagogical design of these instructional materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

Low	Medium	High

t. To what extent are the purposes of the materials clear to students?

1 . . . . .2. . . . . .3. . . . . .4. 5

Purposes are unclear	Purposes are somewhat clear	Purposes are clear

IV. Implementation and System Support

a. Will the teachers find the materials interesting and engaging?

1 . . . . .2. . . . . .3. . . . . .4. 5

Dry and boring	Somewhat interesting and engaging	Interesting and engaging

b. Do the instructional materials include information and guidance to assist the teacher in implementing the lessons?

1 . . . . .2. . . . . .3. . . . . .4. 5

No teacher support	Some teacher support	Rich and useful teacher support

c. Do the instructional materials provide information about the kind of resources and support system required to facilitate the district implementation of the science materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

No materials support	Some materials support	Rich and useful materials support

d. Do the instructional materials provide information about how to establish a safe science learning environment?

1 . . . . .2. . . . . .3. . . . . .4. 5

No safety information	Some safety information	Rich and useful safety information

e. Do the instructional materials provide information about the kinds of professional development experiences needed by teachers to implement the materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no information provided	Partial information provided	Rich and useful information provided

f. Do the materials provide guidance in how to link the materials with the district and state assessment frameworks and programs?

1 . . . . .2. . . . . .3. . . . . .4. 5

No guidance	Some guidance	Rich and useful guidance

g. Do the materials provide guidance and assistance for involving administrators, parents, and the community at large actively in supporting school science?

1 . . . . .2. . . . . .3. . . . . .4. 5

No guidance	Some guidance	Rich and useful guidance

h. Overall, are the materials usable by, realistic in expectations of, and supportive of teachers?

1 . . . . .2. . . . . .3. . . . . .4. 5

Teacher unfriendly	Somewhat teacher friendly	Teacher friendly

V. Major Strengths and Weaknesses

a. In your opinion what are the three major strengths of this curriculum?

b. In your opinion, what are the three major weaknesses of this curriculum?

VI. Overall Quality, Value, and Contribution

a. In your opinion what is the overall quality of these materials relative to:

	low high
- turning students on to science?	1......2......3......4.......5
- making students think?	1......2......3......4.......5
- quality of science content?	1......2......3......4.......5
- quality of pedagogy?	1......2......3......4.......5
- quality of classroom assessments?	1......2......3......4.......5
- encouraging teachers to teach differently?	1......2......3......4.......5

b. In your opinion, what is the overall quality of these instructional materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

Low	Medium	High

c. To what extent would you encourage the dissemination, adoption, and implementation of this curriculum?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not worthy of dissemination, adoption, nor implementation	OK to disseminate, adopt, and implement **if revised**	OK to disseminate, adopt, and implement **as is**

Use this page for additional notations:

Guidelines for Section II.

The following is a brief outline of the National Science Education Standards. It should be used to guide your responses to Section II.

CONTENT STANDARD
A. Science as Inquiry
1. Abilities necessary to do science inquiry
2. Understandings about scientific inquiry
B. Physical Science
1. Properties of objects and materials
2. Position and motion of objects
3. Light, heat, electricity, and magnetism
C. Life Science
1. The characteristics of organisms
2. Life cycles of organisms
3. Organisms and environments
D. Earth and Space Science
1. Properties of Earth materials
2. Objects in the sky
E. Science and Technology
1. Abilities to distinguish between natural objects and objects made by humans
2. Abilities of technological design
3. Understandings about science and technology
F. Science in Personal and Social Perspectives
1. Personal health
2. Characteristics and changes in populations
3. Types of resources
4. Changes in environments
5. Science and technology in local challenges
G. History and Nature of Science
1. Science as a human endeavor
H. Unifying concepts and processes
1. Order and organization
2. Evidence, models, and explanation
3. Change, constancy, and measurement
4. Evolution and equilibrium
5. Form and function

Framework for Review

Instructional Materials for Middle School Science[1]

Title: ____
Author(s): ____
Publisher: ______________________ ***Copyright date:*** __________
Reviewed by: ______________________ ***Date:*** ______________

I. Descriptors

a. Write a brief description of the components of the curriculum upon which this review is based (e.g., teachers guide, student books, hands-on materials, multimedia material). That is, what materials did you receive and include in your review?

b. Write a brief description of the purpose and broad goals of these materials. That is, what were the stated purposes and what were the actual purposes of the materials?

c. What grade levels do the materials serve?
____5 ____6 ____7 ____8

d. Are the instructional materials designed to
___ provide a complete multi-year program for middle school science.
___ provide a complete one-year course for middle school science.
___ provide multiple modules or units that could be used to supplement other course materials for middle school science.
___ provide a single module or collection of activities that could be used to supplement other course materials for middle school science.
___ other (explain):

____

[1] *NOTE: This framework is adapted from an instrument developed by Inverness Research under contract to the National Science Foundation. The framework was refined as part of a panel review of NSF-supported materials for middle school science, which was limited to projects that provide at least a year-long course of study.*

e. What are the major domains/topics of content covered by these materials?

II. Quality of the Science

Directions: For each item, circle the number corresponding with your response to the question. ***Write an explanation for your rating of each item below the item.***

a. Does the content in the instructional materials align well with all eight areas of the Content Standards as described in the National Science Education Standards (NSES)?
(See attached guidelines)

1 . . . . .2. . . . . .3. . . . . .4. 5

Omits substantial content included in NSES and/or includes substantial content not recommended in NSES	Some misalignment of content with recommendations in NSES	The curriculum aligns well with content recommendations in NSES

b. Are the science concepts presented in the instructional materials accurate and correct? [Provide examples of major errors where they are evident. Attach extra page if necessary.]

1 . . . . .2. . . . . .3. . . . . .4. 5

Substantial, major errors	Mostly correct, with some minor errors	Scientifically accurate, and correct

c. Do the instructional materials adequately present the major concepts in the standards and adequately demonstrate and model the processes of science?

1 . . . . .2. . . . . .3. . . . . .4. 5

Major concepts and processes not addressed	Major concepts and processes somewhat addressed	Major concepts and processes addressed well

d. Does the science presented in the instructional materials reflect current disciplinary knowledge?

1 . . . . .2. . . . . .3. . . . . .4. 5

The ideas are out of date	Somewhat current	Current

e. Do the instructional materials accurately represent views of science as inquiry as described in the National Science Education Standards?

1 . . . . .2. . . . . .3. . . . . .4. 5

Poor examples of inquiry	Mixed quality	Rich and accurate examples of inquiry

f. Do the instructional materials accurately present the history of science?

1 . . . . .2. . . . . .3. . . . . .4. 5

Poor portrayal of history of science	Mixed quality	Rich and accurate portrayal of history of science

g. Do the materials emphasize technology as an area of study?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no emphasis	Some emphasis	Rich and well designed emphasis

h. Do the materials emphasize the content of earth science?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no emphasis	Some emphasis	Rich and well designed emphasis

i. Do the materials emphasize the content of physical science?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no emphasis	Some emphasis	Rich and well designed emphasis

j. Do the instructional materials provide sufficient activities for students to develop a good understanding of key science concepts?

1 . . . . .2. . . . . .3. . . . . .4. 5

Too few learning	Activities provide	Activities provide

k. Do the instructional materials provide sufficient opportunities for students to apply their understanding of the concepts (i.e., designing of solutions to problems or issues)?

1 . . . . .2. . . . . .3. . . . . .4. 5

Very few application activities	Some application activities	Very rich in application activities

l. Do the instructional materials present an accurate picture of the nature of science as a dynamic endeavor?

1 . . . . .2. . . . . .3. . . . . .4. 5

The image of science is out-of-date, inaccurate, or non-existent.	The image of science is of mixed quality.	The image of science is current and accurate.

m. Do the materials develop an appropriate breadth and depth of science content?

1 . . . . .2. . . . . .3. . . . . .4. 5

Too narrow or too broad	Somewhat balanced	Good balance of breadth and depth

n. What is the overall quality of the science presented in the instructional materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

Low	Medium	High

III. The Pedagogical Design

a. Do the instructional materials provide a logical progression for developing conceptual understanding in science?

1 . . . . .2. . . . . .3. . . . . .4. 5

No logical progression of ideas	Somewhat logical progression of ideas	Logical progression of ideas that builds conceptual understanding

b. Do the instructional materials provide students the opportunity to make conjectures, gather evidence, and develop arguments to support, reject, and revise their preconceptions and explanations for natural phenomena?

1 . . . . .2. . . . . .3. . . . . .4. 5

No opportunity	Some opportunity	Rich and well designed opportunity

c. To what extent do the instructional materials engage students in doing science inquiry?

1 . . . . .2. . . . . .3. . . . . .4. 5

Very few or very contrived activities for students to do science inquiry	Some good activities for students to do science inquiry	Many rich and authentic opportunities for students to do science inquiry

d. To what extent do the instructional materials engage students in doing technology problem solving?

1 . . . . .2. . . . . .3. . . . . .4. 5

Very few or very contrived activities for students to do technology problem solving	Some good activities for students to do technology problem solving	Many rich and authentic opportunities for students to do technology problem solving

e. To what extent does the curriculum engage students in activities that help them connect science to everyday issues and events?

1 . . . . .2. . . . . .3. . . . . .4. 5

Very few or very contrived activities for students to make connections	Some good activities for students to make connections	Many rich and authentic opportunities for students to make connections

f. How would you rate the overall developmental appropriateness of the instructional materials, given its intended audience of ALL students at the targeted level(s)?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not developmentally appropriate	Somewhat developmentally appropriate	Developmentally appropriate

g. Do the materials reflect current knowledge about effective teaching and learning practices (e.g., active learning, inquiry, community of learners) based on research related to science education?

1 . . . . .2. . . . . .3. . . . . .4. 5

Do not reflect current knowledge about teaching and learning	Somewhat reflective of current knowledge about teaching and learning	Reflect well current knowledge about teaching and learning

h. Do the instructional materials provide students the opportunity to clarify, refine, and consolidate their ideas, and to communicate them through multiple modes?

1 . . . . .2. . . . . .3. . . . . .4. 5

No opportunity	Some opportunity	Rich and well designed opportunity

i. Do the instructional materials provide students the opportunity to think and communicate scientifically?

1 . . . . .2. . . . . .3. . . . . .4. 5

No opportunity	Some opportunity	Rich and well designed opportunity

j. Do the instructional materials provide students with activities connecting science with other subject areas?

1 . . . . .2. . . . . .3. . . . . .4. 5

No opportunity	Some opportunity	Rich and well designed opportunity

k. Are the instructional materials likely to be interesting, engaging, and effective for students?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not at all interesting	Somewhat interesting	Interesting and engaging

l. Are the instructional materials likely to be interesting, engaging, and effective for girls and boys?

1 . . . . .2. . . . . .3. . . . . .4. 5

No sensitivity to gender issues	Some sensitivity to gender issues	Sensitive to gender issues

m. Are the instructional materials likely to be interesting, engaging, and effective for underrepresented and underserved students (e.g., gender, ethnic, urban, rural, with disabilities)?

1 . . . . .2. . . . . .3. . . . . .4. 5

No sensitivity to underrepresented and underserved students	Some sensitivity to underrepresented and underserved students	Sensitive to underrepresented and underserved students

n. Does assessment have explicit purposes connected to decisions to be made by teachers (e.g., prior knowledge, conceptual understanding, grades)?

1 . . . . .2. . . . . .3. . . . . .4. 5

Unclear purposes	Somewhat clear purposes	Clear statement of purposes

o. Do assessments focus on the curriculum's important content and skills?

1 . . . . .2. . . . . .3. . . . . .4. 5

Poor correspondence	Fair correspondence	Full correspondence

p. Do the instructional materials include multiple kinds of assessments (e.g., performance, paper/pencil, portfolios, student interviews, embedded, projects)?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no student assessment provided	Some variety of student assessment	Complete student assessment package

q. Are the assessment practices fair to all students?

1 . . . . .2. . . . . .3. . . . . .4. 5

Fair for a few	Fair to most	Fair to all

r. Do the instructional materials include adequate and appropriate uses of a variety of educational technologies (e.g., calculators, video, computers, telecommunications)?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no educational technology included	Some appropriate educational technology included	Many appropriate applications of educational technology included

s. What is the overall quality of the pedagogical design of these instructional materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

Low	Medium	High

t. To what extent are the purposes of the materials clear to students?

1 . . . . .2. . . . . .3. . . . . .4. 5

Purposes are unclear	Purposes are somewhat clear	Purposes are clear

IV. Implementation and System Support

a. Will the teachers find the materials interesting and engaging?

1 . . . . .2. . . . . .3. . . . . .4. 5

Dry and boring	Somewhat interesting and engaging	Interesting and engaging

b. Do the instructional materials include information and guidance to assist the teacher in implementing the lessons?

1 . . . . .2. . . . . .3. . . . . .4. 5

No teacher support	Some teacher support	Rich and useful teacher support

c. Do the instructional materials provide information about the kind of resources and support system required to facilitate the district implementation of the science materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

No materials support	Some materials support	Rich and useful materials support

d. Do the instructional materials provide information about how to establish a safe science learning environment?

1 . . . . .2. . . . . .3. . . . . .4. 5

No safety information	Some safety information	Rich and useful safety information

e. Do the instructional materials provide information about the kinds of professional development experiences needed by teachers to implement the materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no information provided	Partial information provided	Rich and useful information provided

f. Do the materials provide guidance in how to link the materials with the district and state assessment frameworks and programs?

1 . . . . .2. . . . . .3. . . . . .4. 5

No guidance	Some guidance	Rich and useful guidance

g. Do the materials provide guidance and assistance for involving administrators, parents, and the community at large actively in supporting school science?

1 . . . . .2. . . . . .3. . . . . .4. 5

No guidance	Some guidance	Rich and useful guidance

h. Overall, are the materials usable by, realistic in expectations of, and supportive of teachers?

1 . . . . .2. . . . . .3. . . . . .4. 5

Teacher unfriendly	Somewhat teacher friendly	Teacher friendly

V. Major Strengths and Weaknesses

a. In your opinion, what are the three major strengths of this curriculum?

b. In your opinion, what are the three major weaknesses of this curriculum?

VI. Overall Quality, Value, and Contribution

a. In your opinion, what is the overall quality of these materials relative to:

	low	**high**
- turning students on to science?	1......2......3......4.......5	
- making students think?	1......2......3......4.......5	
- quality of science content?	1......2......3......4.......5	
- quality of pedagogy?	1......2......3......4.......5	
- quality of classroom assessments?	1......2......3......4.......5	
- encouraging teachers to teach differently?	1......2......3......4.......5	

b. In your opinion, what is the overall quality of these instructional materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

Low	Medium	High

c. To what extent would you encourage the dissemination, adoption, and implementation of this curriculum?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not worthy of dissemination, adoption, nor implementation	OK to disseminate, adopt, and implement **if revised**	OK to disseminate, adopt, and implement **as is**

Use this page for additional notations:

Guidelines for Section II.

The following is a brief outline of the National Science Education Standards. It should be used to guide your responses to Section II.

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3. Light, heat, electricity, and magnetism
C. Life Science
1. The characteristics of organisms
2. Life cycles of organisms
3. Organisms and environments
D. Earth and Space Science
1. Properties of Earth materials
2. Objects in the sky
E. Science and Technology
1. Abilities to distinguish between natural objects and objects made by humans
2. Abilities of technological design
3. Understandings about science and technology
F. Science in Personal and Social Perspectives
1. Personal health
2. Characteristics and changes in populations
3. Types of resources
4. Changes in environments
5. Science and technology in local challenges
G. History and Nature of Science
1. Science as a human endeavor
H. Unifying concepts and processes
1. Order and organization
2. Evidence, models, and explanation
3. Change, constancy, and measurement
4. Evolution and equilibrium
5. Form and function

Framework for Review
Instructional Materials for High School Science[1]

Title: ____

Author(s): ____

Publisher: ___________________________________ ***Copyright date:*** __________

Reviewed by: ______________________________ ***Date:*** ___________________

I. Descriptors

a. Write a brief description of the components of the curriculum upon which this review is based (e.g., teachers guide, student books, hands-on materials, multimedia material). That is, what materials did you receive and include in your review?

b. Write a brief description of the purpose and broad goals of these materials. That is, what were the stated purposes and what were the actual purposes of the materials?

c. What grade levels do the materials serve?

____9 ____10 ____11 ____12

d. Are the instructional materials designed to

___ provide a complete multi-year program for high school science.

___ provide a complete one-year course for high school science.

___ provide multiple modules or units that could be used to supplement other course materials for high school science.

___ provide a single module or collection of activities that could be used to supplement other course materials for high school science.

___ other (explain):

[1] *NOTE: This framework is adapted from an instrument developed by Inverness Research under contract to the National Science Foundation. The framework was refined as part of a panel review of NSF-supported materials for middle school science, which was limited to projects that provide at least a year-long course of study.*

e. What are the major domains/topics of content covered by these materials?

II. Quality of the Science

Directions: For each item, circle the number corresponding with your response to the question. ***Write an explanation for your rating of each item below the item.***

a. Does the content in the instructional materials align well with all eight areas of the Content Standards as described in the National Science Education Standards (NSES)?
(See attached guidelines)

1 . . . . .2. . . . . .3. . . . . .4. 5

Omits substantial content included in NSES and/or includes substantial content not recommended in NSES	Some misalignment of content with recommendations in NSES	The curriculum aligns well with content recommendations in NSES

b. Are the science concepts presented in the instructional materials accurate and correct?
[Provide examples of major errors where they are evident. Attach extra page if necessary.]

1 . . . . .2. . . . . .3. . . . . .4. 5

Substantial, major errors	Mostly correct, with some minor errors	Scientifically accurate, and correct

c. Do the instructional materials adequately present the major concepts in the standards and adequately demonstrate and model the processes of science?

1 . . . . .2. . . . . .3. . . . . .4. 5

Major concepts and processes not addressed	Major concepts and processes somewhat addressed	Major concepts and processes addressed well

d. Does the science presented in the instructional materials reflect current disciplinary knowledge?

1 . . . . .2. . . . . .3. . . . . .4. 5

The ideas are out of date	Somewhat current	Current

e. Do the instructional materials accurately represent views of science as inquiry as described in the National Science Education Standards?

1 . . . . .2. . . . . .3. . . . . .4. 5

Poor implies of inquiry	Mixed quality	Rich and accurate examples of inquiry

f. Do the instructional materials accurately present the history of science?

1 . . . . .2. . . . . .3. . . . . .4. 5

Poor portrayal of history of science	Mixed quality	Rich and accurate portrayal of history of science

g. Do the materials emphasize technology as an area of study?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no emphasis	Some emphasis	Rich and well designed emphasis

h. Do the materials emphasize the personal and societal dimensions of science?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no emphasis	Some emphasis	Rich and well designed emphasis

i. Do the materials emphasize the content of life science?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no emphasis	Some emphasis	Rich and well designed emphasis

j. Do the materials emphasize the content of earth science?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no emphasis	Some emphasis	Rich and well designed emphasis

k. Do the materials emphasize the content of physical science?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no emphasis	Some emphasis	Rich and well designed emphasis

l. Do the instructional materials provide sufficient activities for students to develop a good understanding of key science concepts?

1 . . . . .2. . . . . .3. . . . . .4. 5

Too few learning activities	Activities provide some opportunity for students to learn some important concepts	Activities provide many rich oppotunities to learn key science concepts

m. Do the instructional materials provide sufficient opportunities for students to apply their understanding of the concepts (i.e., designing of solutions to problems or issues)?

1 . . . . .2. . . . . .3. . . . . .4. 5

Very few application activities	Some application activities	Very rich in application activities

n. Do the instructional materials present an accurate picture of the nature of science as a dynamic endeavor?

1 . . . . .2. . . . . .3. . . . . .4. 5

The image of science is out-of-date, inaccurate, or non-existent	The image of science is of mixed quality	The image of science is current and accurate

o. Do the materials develop an appropriate breadth and depth of science content?

1 . . . . .2. . . . . .3. . . . . .4. 5

Too narrow or too broad	Somewhat balanced	Good balance of breadth and depth

p. What is the overall quality of the science presented in the instructional materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

Low	Medium	High

III. The Pedagogical Design

a. Do the instructional materials provide a logical progression for developing conceptual understanding in science?

1 . . . . .2. . . . . .3. . . . . .4. 5

No logical progression of ideas	Somewhat logical progression of ideas	Logical progression of ideas that builds conceptual understanding

b. Do the instructional materials provide students the opportunity to make conjectures, gather evidence, and develop arguments to support, reject, and revise their preconceptions and explanations for natural phenomena?

1 . . . . .2. . . . . .3. . . . . .4. 5

No opportunity	Some opportunity	Rich and well designed opportunity

c. To what extent do the instructional materials engage students in doing science inquiry?

1 . . . . .2. . . . . .3. . . . . .4. 5

Very few or very contrived activities for students to do science inquiry	Some good activities for students to do science inquiry	Many rich and authentic opportunities for students to do science inquiry

d. To what extent do the instructional materials engage students in doing technology problem solving?

1 . . . . .2. . . . . .3. . . . . .4. 5

Very few or very contrived activities for students to do technology problem solving	Some good activities for students to do technology problem solving	Many rich and authentic opportunities for students to do technology problem solving

e. To what extent does the curriculum engage students in activities that help them connect science to everyday issues and events?

1 . . . . .2. . . . . .3. . . . . .4. 5

Very few or very contrived activities for students to make connections	Some good activities for students to make connections	Many rich and authentic opportunities for students to make connections

f. How would you rate the overall developmental appropriateness of the instructional materials, given its intended audience of ALL students at the targeted level(s)?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not developmentally appropriate	Somewhat developmentally appropriate	Developmentally appropriate

g. Do the materials reflect current knowledge about effective teaching and learning practices (e.g., active learning, inquiry, community of learners) based on research related to science education?

1 . . . . .2. . . . . .3. . . . . .4. 5

Do not reflect current knowledge about teaching and learning	Somewhat reflective of current knowledge about teaching and learning	Reflect well current knowledge about teaching and learning

h. Do the instructional materials provide students the opportunity to clarify, refine, and consolidate their ideas, and to communicate them through multiple modes?

1 . . . . .2. . . . . .3. . . . . .4. 5

No opportunity	Some opportunity	Rich and well designed opportunity

i. Do the instructional materials provide students the opportunity to think and communicate scientifically?

1 . . . . .2. . . . . .3. . . . . .4. 5

No opportunity	Some opportunity	Rich and well designed opportunity

j. Do the instructional materials provide students with activities connecting science with other subject areas?

1 . . . . .2. . . . . .3. . . . . .4. 5

No opportunity	Some opportunity	Rich and well designed opportunity

k. Are the instructional materials likely to be interesting, engaging, and effective for students?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not at all interesting	Somewhat interesting	Interesting and engaging

l. Are the instructional materials likely to be interesting, engaging, and effective for girls and boys?

1 . . . . .2. . . . . .3. . . . . .4. 5

No sensitivity to gender issues	Some sensitivity to gender issues	Sensitive to gender issues

m. Are the instructional materials likely to be interesting, engaging, and effective for underrepresented and underserved students (e.g., gender, ethnic, urban, rural, with disabilities)?

1 . . . . .2. . . . . .3. . . . . .4. 5

No sensitivity to underrepresented and underserved students	Some sensitivity to underrepresented and underserved students	Sensitive to underrepresented and underserved students

n. Does assessment have explicit purposes connected to decisions to be made by teachers (e.g., prior knowledge, conceptual understanding, grades)?

1 . . . . .2. . . . . .3. . . . . .4. 5

Unclear purposes	Somewhat clear purposes	Clear statement of purposes

o. Do assessments focus on the curriculum's important content and skills?

1 . . . . .2. . . . . .3. . . . . .4. 5

Poor correspondence	Fair correspondence	Full correspondence

p. Do the instructional materials include multiple kinds of assessments (e.g., performance, paper/pencil, portfolios, student interviews, embedded, projects)?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no student assessment provided	Some variety of student assessment	Complete student assessment package

q. Are the assessment practices fair to all students?

1 . . . . .2. . . . . .3. . . . . .4. 5

Fair for a few	Fair to most	Fair to all

r. Do the instructional materials include adequate and appropriate uses of a variety of educational technologies (e.g., calculators, video, computers, telecommunications)?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no educational technology included	Some appropriate educational technology included	Many appropriate applications of educational technology included

s. What is the overall quality of the pedagogical design of these instructional materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

Low	Medium	High

t. To what extent are the purposes of the materials clear to students?

1 . . . . .2. . . . . .3. . . . . .4. 5

Purposes are unclear	Purposes are somewhat clear	Purposes are clear

IV. Implementation and System Support

a. Will the teachers find the materials interesting and engaging?

1 . . . . .2. . . . . .3. . . . . .4. 5

Dry and boring	Somewhat interesting and engaging	Interesting and engaging

b. Do the instructional materials include information and guidance to assist the teacher in implementing the lessons?

1 . . . . .2. . . . . .3. . . . . .4. 5

No teacher support	Some teacher support	Rich and useful teacher support

c. Do the instructional materials provide information about the kind of resources and support system required to facilitate the district implementation of the science materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

No materials support	Some materials support	Rich and useful materials support

d. Do the instructional materials provide information about how to establish a safe science learning environment?

1 . . . . .2. . . . . .3. . . . . .4. 5

No safety information	Some safety information	Rich and useful safety information

e. Do the instructional materials provide information about the kinds of professional development experiences needed by teachers to implement the materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no information provided	Partial information provided	Rich and useful information provided

f. Do the materials provide guidance in how to link the materials with the district and state assessment frameworks and programs?

1 . . . . .2. . . . . .3. . . . . .4. 5

No guidance	Some guidance	Rich and useful guidance

g. Do the materials provide guidance and assistance for involving administrators, parents, and the community at large actively in supporting school science?

1 . . . . .2. . . . . .3. . . . . .4. 5

No guidance	Some guidance	Rich and useful guidance

h. Overall, are the materials usable by, realistic in expectations of, and supportive of teachers?

1 . . . . .2. . . . . .3. . . . . .4. 5

Teacher unfriendly	Somewhat teacher friendly	Teacher friendly

V. Major Strengths and Weaknesses

a. In your opinion what are the three major strengths of this curriculum?

b. In your opinion, what are the three major weaknesses of this curriculum?

VI. Overall Quality, Value, and Contribution

a. In your opinion what is the overall quality of these materials relative to:

	low				high
- turning students on to science?	1	2	3	4	5
- making students think?	1	2	3	4	5
- quality of science content?	1	2	3	4	5
- quality of pedagogy?	1	2	3	4	5
- quality of classroom assessments?	1	2	3	4	5
- encouraging teachers to teach differently?	1	2	3	4	5

b. In your opinion, what is the overall quality of these instructional materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

Low — Medium — High

c. To what extent would you encourage the dissemination, adoption, and implementation of this curriculum?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
Not worthy of dissemination, adoption, nor implementation	OK to disseminate adopt, and implement **if revised**	OK to disseminate, adopt, and implement **as is**

Use this page for additional notations:

Guidelines for Section II.

The following is a brief outline of the National Science Education Standards. It should be used to guide your responses to Section II.

CONTENT STANDARD
A. Science as Inquiry
1. Abilities necessary to do science inquiry
2. Understandings about scientific inquiry
B. Physical Science
1. Structure of the atom
2. Structure and properties of matter
3. Chemical reactions
4. Forces and motions
5. Conservation of energy and increase in disorder
6. Interactions of energy and matter
C. Life Science
1. The cell
2. The molecular basis of heredity
3. Biological evolution
4. The interdependence of organisms
5. Matter, energy, and organization in living systems
6. The nervous system and behavior of organisms
D. Earth and Space Science
1. Energy in the Earth system
2. Geochemical cycles
3. Origin and evolution of the Earth
4. Origin and evolution of the universe
E. Science and Technology
1. Abilities of technological design
2. Understandings about science and technology
F. Science in Personal and Social Perspectives
1. Personal and community health
2. Population growth
3. Natural resources
4. Environmental quality
5. Natural and human-induced hazards
6. Science and technology in local, national, and global challenges
G. History and Nature of Science
1. Science as a human endeavor
2. Nature of scientific knowledge
3. Historical perspectives

H. Unifying concepts and processes
1. Order and organization
2. Evidence, models, and explanation
3. Change, constancy, and measurement
4. Evolution and equilibrium
5. Form and function

Framework for Review
Instructional Materials for Elementary School Mathematics[1]

Title: ____
Author(s): ____
Publisher: __________________________ ***Copyright date:*** __________
Reviewed by: _______________________ ***Date:*** _______________

I. Descriptors
a. Write a brief description of the components of the curriculum upon which this review is based (e.g., teachers guide, student books, hands-on materials, multimedia material). That is, what materials did you receive and include in your review?

b. Write a brief description of the purpose and broad goals of these materials. That is, what were the stated purposes and what were the actual purposes of the materials?

c. What grade levels do the materials serve?
____K ____1 ____2 ____3 ____4 ____5

d. Are the instructional materials designed to
___ provide a complete multi-year program for elementary school mathematics.
___ provide a complete one-year course for elementary school mathematics.
___ provide multiple modules or units that could be used to supplement other course materials for elementary school mathematics.
___ provide a single module or collection of activities that could be used to supplement other course materials for elementary school mathematics.
___ other (explain):

---

1 *NOTE: This framework is adapted from an instrument developed by Inverness Research under contract to the National Science Foundation. The framework was refined as part of a panel review of NSF-supported materials for middle school science, which was limited to projects that provide at least a year-long course of study.*

e. What are the major domains/topics of content covered by these materials?

II. Quality of the Mathematics

Directions: For each item, circle the number corresponding with your response to the question. Write an explanation for your rating of each item below the item.

a. Does the content in the instructional materials align well with all thirteen areas of the Curriculum Standards as described in the National Council of Teachers of Mathematics Curriculum and Evaluation Standards for School Mathematics (NCTM)?
(See attached guidelines)

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
Omits substantial content included in NCTM and/or includes substantial content not recommended in NCTM	Some misalignment of content with recommendations in NCTM	The curriculum aligns well with content recommendations in NCTM

b. Are the mathematics concepts presented in the instructional materials accurate and correct? [Provide examples of major errors where they are evident. Attach extra page if necessary.]

1 . . . . .2. . . . . .3. . . . . .4. 5

1	2–3	5
Substantial, major errors	Mostly correct, with some minor errors	Mathematically accurate, and correct

c. Do the instructional materials adequately present the major concepts and adequately demonstrate and model the processes of mathematics?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
Major concepts and processes not addressed	Major concepts and processes somewhat addressed	Major concepts and processes addressed well

d. Do the instructional materials accurately represent views of mathematical problem solving as described in the NCTM Curriculum and Evaluation Standards for School Mathematics?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
Poor portrayal of problem solving	Mixed quality	Rich and accurate portrayal of problem solving

e. Do the materials use technology as a tool for learning mathematics?

1 . . . . .2. . . . . .3. . . . . .4. 5		
Little or no use	Some emphasis	Rich and well designed use

f. Do the materials emphasize communication about mathematics through a variety of modalities?

1 . . . . .2. . . . . .3. . . . . .4. 5		
Little or no emphasis, few modalities	Some emphasis, some modalities	Rich and well designed emphasis, varied modalities

g. Do the materials appropriately address mathematical reasoning?

1 . . . . .2. . . . . .3. . . . . .4. 5		
Not appropriately addressed	Somewhat appropriately addressed	Appropriately addressed

h. Do the materials appropriately address computation?

1 . . . . .2. . . . . .3. . . . . .4. 5		
Not appropriately addressed	Somewhat appropriately addressed	Appropriately addressed

i. Do the materials appropriately address estimation?

1 . . . . .2. . . . . .3. . . . . .4. 5		
Not appropriately addressed	Somewhat appropriately addressed	Appropriately addressed

j. Do the materials appropriately address number sense and numeration?

1 . . . . .2. . . . . .3. . . . . .4. 5
Not appropriately addressed Somewhat appropriately addressed Appropriately addressed

k. Do the materials appropriately address concepts of whole number operation?

1 . . . . .2. . . . . .3. . . . . .4. 5
Not appropriately addressed Somewhat appropriately addressed Appropriately addressed

l. Do the materials appropriately address whole number computation?

1 . . . . .2. . . . . .3. . . . . .4. 5
Not appropriately addressed Somewhat appropriately addressed Appropriately addressed

m. Do the materials appropriately address geometry and spatial sense?

1 . . . . .2. . . . . .3. . . . . .4. 5
Not appropriately addressed Somewhat appropriately addressed Appropriately addressed

n. Do the materials appropriately address measurement?

1 . . . . .2. . . . . .3. . . . . .4. 5
Not appropriately addressed Somewhat appropriately addressed Appropriately addressed

o. Do the materials appropriately address statistics and probability?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not appropriately addressed	Somewhat appropriately addressed	Appropriately addressed

p. Do the materials emphasize fractions and decimals?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no emphasis	Some emphasis	Rich and well designed emphasis

q. Do the instructional materials provide sufficient activities for students to develop a good understanding of key mathematics concepts?

1 . . . . .2. . . . . .3. . . . . .4. 5

Too few learning activities	Activities provide some opportunity for students to learn some important concepts	Activities provide many rich opportunities to learn key mathematics concepts

r. Do the instructional materials provide sufficient opportunities for students to apply their understanding of the concepts (i.e., designing of solutions to problems or issues)?

1 . . . . .2. . . . . .3. . . . . .4. 5

Very few application activities	Some application activities	Very rich in application activities

s. Do the materials develop an appropriate breadth and depth of mathematics content?

1 . . . . .2. . . . . .3. . . . . .4. 5

Too narrow or too broad	Somewhat balanced	Good balance of breadth and depth

t. What is the overall quality of the mathematics presented in the instructional materials?

1 . . . . .2. . . . . .3. . . . . .4. 5
Low Medium High

III. The Pedagogical Design

a. Do the instructional materials provide a logical progression for developing conceptual understanding in mathematics?

1 . . . . .2. . . . . .3. . . . . .4. 5

No logical progression of ideas	Somewhat logical progression of ideas	Logical progression of ideas that builds conceptual understanding

b. Do the instructional materials provide students the opportunity to formulate, solve, and reflect critically on problems?

1 . . . . .2. . . . . .3. . . . . .4. 5

No opportunity	Some opportunity	Rich and well designed opportunity

c. To what extent are the mathematical concepts embedded in learner-appropriate contexts?

1 . . . . .2. . . . . .3. . . . . .4. 5

Very few or very contrived activities for students to do mathematical problem solving	Some good activities for students to do mathematical problem solving	Many rich and authentic opportunities for students to do mathematical problem solving

d. How would you rate the overall developmental appropriateness of the instructional materials, given its intended audience of ALL students at the targeted level(s)?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not developmentally appropriate	Somewhat developmentally appropriate	Developmentally appropriate

e. Do the materials reflect current (that is, within the last 5 years) knowledge about effective teaching and learning practices (e.g., active learning, inquiry, community of learners) based on research related to mathematics education?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
Do not reflect current knowledge about teaching and learning	Somewhat reflective of current knowledge about teaching and learning	Reflect well current knowledge about teaching and learning

f. Do the instructional materials provide students the opportunity to clarify, refine, and consolidate their ideas?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
No opportunity	Some opportunity	Rich and well designed opportunity

g. Do the instructional materials provide students with activities connecting mathematics with other subject areas?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
No opportunity	Some opportunity	Rich and well designed opportunity

h. Are the instructional materials likely to be interesting, engaging, and effective for girls and boys?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
No sensitivity to gender issues	Some sensitivity to gender issues	Sensitive to gender issues

i. Are the instructional materials likely to be interesting, engaging, and effective for underrepresented and underserved students (e.g., ethnic, urban, rural, with disabilities)?

1 . . . . .2. . . . . .3. . . . . .4. 5

No sensitivity to underrepresented and underserved students	Some sensitivity to underrepresented and underserved students	Sensitive to underrepresented and underserved students

j. Does assessment have explicit purposes connected to decisions to be made by teachers (e.g., prior knowledge, conceptual understanding, grades)?

1 . . . . .2. . . . . .3. . . . . .4. 5

Unclear purposes	Somewhat clear purposes	Clear statement of purposes

k. Do assessments focus on the curriculum's important content and skills?

1 . . . . .2. . . . . .3. . . . . .4. 5

Poor correspondence	Fair correspondence	Full correspondence

l. Do the instructional materials include multiple kinds of assessments (e.g., performance, paper/pencil, portfolios, student interviews, embedded, projects)?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no student assessment provided	Some variety of student assessment	Complete student assessment package

m. Are the assessment practices fair to all students?

1 . . . . .2. . . . . .3. . . . . .4. 5

Fair for a few	Fair to most	Fair to all

n. Do the instructional materials include adequate and appropriate uses of a variety of educational technologies (e.g., calculators, video, computers, telecommunications)?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no educational technology included	Some appropriate educational technology included	Many appropriate applications of educational technology included

o. What is the overall quality of the pedagogical design of these instructional materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

Low	Medium	High

IV. Implementation and System Support

a. Will the teachers find the materials interesting and engaging?

1 . . . . .2. . . . . .3. . . . . .4. 5

Dry and boring	Somewhat interesting and engaging	Interesting and engaging

b. Do the instructional materials include information and guidance to assist the teacher in implementing the lessons?

1 . . . . .2. . . . . .3. . . . . .4. 5

No teacher support	Some teacher support	Rich and useful teacher support

c. Do the instructional materials provide information about the kind of resources and support system required to facilitate the district implementation of the required mathematics materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

No materials support	Some materials support	Rich and useful materials support

d. Do the instructional materials provide information about the kinds of professional development experiences needed by teachers to implement the materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no information provided	Partial information provided	Rich and useful information provided

e. Do the materials provide guidance in how to link the materials with the district and state assessment frameworks and programs?

1 . . . . .2. . . . . .3. . . . . .4. 5
No guidance | Some guidance | Rich and useful guidance

f. Do the materials provide guidance and assistance for involving administrators, parents, and the community at large actively in supporting school mathematics?

1 . . . . .2. . . . . .3. . . . . .4. 5
No guidance | Some guidance | Rich and useful guidance

g. Overall, are the materials usable by, realistic in expectations of, and supportive of teachers?

1 . . . . .2. . . . . .3. . . . . .4. 5
Teacher unfriendly | Somewhat teacher friendly | Teacher friendly

V. Major Strengths and Weaknesses

a. In your opinion, what are the three major strengths of this curriculum?

b. In your opinion, what are the three major weaknesses of this curriculum?

VI. Overall Quality, Value, and Contribution

a. In your opinion, what is the overall quality of these materials relative to:

	low **high**
- turning students on to mathematics?	1........2.......3.......4........5
- making students think?	1........2.......3.......4........5
- quality of mathematics content?	1........2.......3.......4........5
- quality of pedagogy?	1........2.......3.......4........5
- quality of classroom assessments?	1........2.......3.......4........5
- encouraging teachers to teach differently?	1........2.......3.......4........5

b. In your opinion, what is the overall quality of these instructional materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

Low	Medium	High

c. To what extent would you encourage the dissemination, adoption, and implementation of this curriculum?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not worthy of dissemination, adoption, nor implementation	OK to disseminate, adopt, and implement **if revised**	OK to disseminate, adopt, and implement **as is**

Use this page for additional notations:

Guidelines for Section II.

The following is a brief outline of the National Council of Teachers of Mathematics Curriculum and Evaluation Standards for School Mathematics. It should be used to guide your responses to Section II.

CONTENT STANDARD
A. Mathematics as Problem Solving
1. Use problem solving approaches to investigate and understand mathematical content
2. Formulate problems from everyday and mathematical situations
3. Develop and apply strategies to solve a wide variety of problems
4. Verify and interpret results with respect to the original problem
5. Acquire confidence in using mathematics meaningfully
B. Mathematics as Communication
1. Relate physical materials, pictures, and diagrams to mathematical ideas
2. Reflect on and clarify their thinking about mathematical ideas and situations
3. Relate their everyday language to mathematical language and symbols
4. Realize that representing, discussing, reading, writing, and listening to mathematics are a vital part of learning and using mathematics
C. Mathematics as Reasoning
1. Draw logical conclusions about mathematics
2. Use models, known facts, properties, and relationships to explain their thinking
3. Justify their answers and solution processes
4. Use patterns and relationships to analyze mathematical situations
5. Believe that mathematics makes sense
D. Mathematical Connections
1. Link conceptual and procedural knowledge
2. Relate various representations of concepts or procedures to one another
3. Recognize relationships among different topics in mathematics
4. Use mathematics in other curriculum areas
5. Use mathematics in their daily lives
E. Estimation
1. Explore estimation strategies
2. Recognize when an estimate is appropriate
3. Determine the reasonableness of results
4. Apply estimation in working with quantities, measurement, computation, and problem solving
F. Number Sense and Numeration
1. Construct number meanings through real-world experiences and the use of physical materials
2. Understand our numeration system by relating counting, grouping, and place-value concepts
3. Develop number sense
4. Interpret the multiple uses of numbers encountered in the real world

CONTENT STANDARD *(Continued)*
G. Concepts of Whole Number Operations
1. Develop meaning for the operations by modeling and discussing a rich variety of problem situations
2. Relate the mathematical language and symbolism of operations to problem situations and informal language
3. Recognize that a wide variety of problem structures can be represented by a single operation
4. Develop operation sense
H. Whole Number Computation
1. Model, explain, and develop reasonable proficiency with basic facts and algorithms
2. Use a variety of mental computation and estimation techniques
3. Use calculators in appropriate computational situations
4. Select and use computation techniques appropriate to specific problems and determine whether the results are reasonable
I. Geometry and Spatial Sense
1. Describe, model, draw, and classify shapes
2. Investigate and predict the results of combining, subdividing, and changing shapes
3. Develop spatial sense
4. Relate geometric ideas to number and measurement ideas
5. Recognize and appreciate geometry in their world
J. Measurement
1. Understand the attributes of length, capacity, weight, mass, area, volume, time, temperature, and angle
2. Develop the process of measuring and concepts related to units of measurement
3. Make and use estimates of measurement
4. Make and use measurements in problem and everyday situations
K. Statistics and Probability
1. Collect, organize, and describe data
2. Construct, read, and interpret displays of data
3. Formulate and solve problems that involve collecting and analyzing data
4. Explore concepts of chance
L. Fractions and Decimals
1. Develop concepts of fractions, mixed numbers, and decimals
2. Develop number sense for fractions and decimals
3. Use models to relate fractions to decimals and to find equivalent fractions
4. Use models to explore operations on fractions and decimals
5. Apply fractions and decimals to problem situations
M. Patterns and Relationships
1. Recognize, describe, extend, and create a wide variety of patterns
2. Represent and describe mathematical relationships
3. Explore the use of variables and open sentences to express relationships

Framework for Review
Instructional Materials for Middle School Mathematics[1]

Title: ____
Author(s): ____
Publisher: __________________________ ***Copyright date:*** __________
Reviewed by: _______________________ ***Date:*** ______________

I. Descriptors

a. Write a brief description of the components of the curriculum upon which this review is based (e.g., teachers guide, student books, hands-on materials, multimedia material). That is, what materials did you receive and include in your review?

b. Write a brief description of the purpose and broad goals of these materials. That is, what were the stated purposes and what were the actual purposes of the materials?

c. What grade levels do the materials serve?
____5 ____6 ____7 ____8

d. Are the instructional materials designed to
___ provide a complete multi-year program for middle school mathematics.
___ provide a complete one-year course for middle school mathematics.
___ provide multiple modules or units that could be used to supplement other course materials for middle school mathematics.
___ provide a single module or collection of activities that could be used to supplement other course materials for middle school mathematics.
___ other (explain):

[1] *NOTE: This framework is adapted from an instrument developed by Inverness Research under contract to the National Science Foundation. The framework was refined as part of a panel review of NSF-supported materials for middle school science, which was limited to projects that provide at least a year-long course of study.*

e. What are the major domains/topics of content covered by these materials?

II. Quality of the Mathematics

Directions: For each item, circle the number corresponding with your response to the question.
Write an explanation for your rating of each item below the item.

a. Does the content in the instructional materials align well with all thirteen areas of the Curriculum Standards as described in the National Council of Teachers of Mathematics Curriculum and Evaluation Standards for School Mathematics (NCTM)?
(See attached guidelines)

1 . . . . .2. . . . . .3. . . . . .4. 5

Omits substantial content included in NCTM and/or includes substantial content not recommended in NCTM	Some misalignment of content with recommendations in NCTM	The curriculum aligns well with content recomendations in NCTM

b. Are the mathematics concepts presented in the instructional materials accurate and correct?
[Provide examples of major errors where they are evident. Attach extra page if necessary]

1 . . . . .2. . . . . .3. . . . . .4. 5

Substantial, major errors	Mostly correct, with some minor errors	Mathematically accurate, and correct

c. Do the instructional materials adequately present the major concepts and adequately demonstrate and model the processes of mathematics?

1 . . . . .2. . . . . .3. . . . . .4. 5

Major concepts and processes not addressed	Major concepts and processes somewhat addressed	Major concepts and processes addressed well

d. Do the instructional materials accurately represent views of mathematical problem solving as described in the NCTM Curriculum and Evaluation Standards for School Mathematics?

1 . . . . .2. . . . . .3. . . . . .4. 5

Poor portrayal of problem solving	Mixed quality	Rich and accurate portrayal of problem solving

e. Do the materials use technology as a tool for learning mathematics?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no use	Some emphasis	Rich and well designed use

f. Do the materials emphasize communication about mathematics through a variety of modalities?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no emphasis, few modalities	Some emphasis, some modalities	Rich and well designed emphasis, varied modalities

g. Do the materials appropriately address mathematical reasoning?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not appropriately addressed	Somewhat appropriately addressed	Appropriately addressed

h. Do the materials appropriately address computation?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not appropriately addressed | Somewhat appropriately addressed | Appropriately addressed

i. Do the materials appropriately address estimation?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not appropriately addressed | Somewhat appropriately addressed | Appropriately addressed

j. Do the materials appropriately address number and number relationships?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not appropriately addressed | Somewhat appropriately addressed | Appropriately addressed

k. Do the materials appropriately address number systems and number theory?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not appropriately addressed | Somewhat appropriately addressed | Appropriately addressed

l. Do the materials appropriately address patterns?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not appropriately addressed Somewhat appropriately addressed Appropriately addressed

m. Do the materials appropriately address functions?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not appropriately addressed Somewhat appropriately addressed Appropriately addressed

n. Do the materials appropriately address algebra?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not appropriately addressed Somewhat appropriately addressed Appropriately addressed

o. Do the materials appropriately address geometry?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not appropriately addressed Somewhat appropriately addressed Appropriately addressed

p. Do the materials appropriately address measurement?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not appropriately addressed	Somewhat appropriately addressed	Appropriately addressed

q. Do the materials appropriately address statistics?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not appropriately addressed	Somewhat appropriately addressed	Appropriately addressed

r. Do the materials appropriately address probability?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not appropriately addressed	Somewhat appropriately addressed	Appropriately addressed

s. Do the instructional materials provide sufficient activities for students to develop a good understanding of key mathematics concepts?

1 . . . . .2. . . . . .3. . . . . .4. 5

Too few learning activities	Activities provide some opportunity for students to learn some important concepts	Activities provide many rich opportunities to learn key mathematics concepts

t. Do the instructional materials provide sufficient opportunities for students to apply their understanding of the concepts (i.e., designing of solutions to problems or issues)?

1 . . . . .2. . . . . .3. . . . . .4. 5

Very few application activities	Some application activities	Very rich in application activities

u. Do the materials develop an appropriate breadth **and** depth of mathematics content?

1 . . . . .2. . . . . .3. . . . . .4. 5

Too narrow or too broad	Somewhat balanced	Good balance of breadth and depth

v. What is the overall quality of the mathematics presented in the instructional materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

Low	Medium	High

III. The Pedagogical Design

a. Do the instructional materials provide a logical progression for developing conceptual understanding in mathematics?

1 . . . . .2. . . . . .3.	. . . . .4. 5	
No logical progression of ideas	Somewhat logical progression of ideas	Logical progression of ideas that builds conceptual understanding

b. Do the instructional materials provide students the opportunity to formulate, solve, and reflect critically on problems?

1 . . . . .2. . . . . .3.	. . . . .4. 5	
No opportunity	Some opportunity	Rich and well designed opportunity

c. To what extent are the mathematical concepts embedded in learner-appropriate contexts?

1 . . . . .2. . . . . .3.	. . . . .4. 5	
Very few or very contrived activities for students to do mathematical problem solving	Some good activities for students to do mathematical problem solving	Many rich and authentic opportunities for students to do mathematical problem solving

d. How would you rate the overall developmental appropriateness of the instructional materials, given its intended audience of ALL students at the targeted level(s)?

1 . . . . .2. . . . . .3.	. . . . .4. 5	
Not developmentally appropriate	Somewhat developmentally appropriate	Developmentally appropriate

e. Do the materials reflect current (that is, within the last 5 years) knowledge about effective teaching and learning practices (e.g., active learning, inquiry, community of learners) based on research related to mathematics education?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
Do not reflect current knowledge about teaching and learning	Somewhat reflective of current knowledge about teaching and learning	Reflect well current knowledge about teaching and learning

f. Do the instructional materials provide students the opportunity to clarify, refine, and consolidate their ideas?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
No opportunity	Some opportunity	Rich and well designed opportunity

g. Do the instructional materials provide students with activities connecting mathematics with other subject areas?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
No opportunity	Some opportunity	Rich and well designed opportunity

h. Are the instructional materials likely to be interesting, engaging, and effective for girls and boys?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
No sensitivity to gender issues	Some sensitivity to gender issues	Sensitive to gender issues

i. Are the instructional materials likely to be interesting, engaging, and effective for underrepresented and underserved students (e.g., ethnic, urban, rural, with disabilities)?

1 . . . . .2. . . . . .3. . . . . .4. 5		
No sensitivity to underrepresented and served students	Some sensitivity to underrepresented and underserved students	Sensitive to underrepresented under- and underserved students

j. Does assessment have explicit purposes connected to decisions to be made by teachers (e.g., prior knowledge, conceptual understanding, grades)?

1 . . . . .2. . . . . .3. . . . . .4. 5		
Unclear purposes	Somewhat clear purposes	Clear statement of purposes

k. Do assessments focus on the curriculum's important content and skills?

1 . . . . .2. . . . . .3. . . . . .4. 5		
Poor correspondence	Fair correspondence	Full correspondence

l. Do the instructional materials include multiple kinds of assessments (e.g., performance, paper/pencil, portfolios, student interviews, embedded, projects)?

1 . . . . .2. . . . . .3. . . . . .4. 5		
Little or no student assessment provided	Some variety of student assessment	Complete student assessment package

m. Are the assessment practices fair to all students?

1 . . . . .2. . . . . .3. . . . . .4. 5

Fair for a few	Fair to most	Fair to all

n. Do the instructional materials include adequate and appropriate uses of a variety of educational technologies (e.g., calculators, video, computers, telecommunications)?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no educational technology included	Some appropriate educational technology included	Many appropriate applications of educational technology included

o. What is the overall quality of the pedagogical design of these instructional materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

Low	Medium	High

IV. Implementation and System Support

a. Will the teachers find the materials interesting and engaging?

1 . . . . .2. . . . . .3. . . . . .4. 5

Dry and boring	Somewhat interesting and engaging	Interesting and engaging

b. Do the instructional materials include information and guidance to assist the teacher in implementing the lessons?

1 . . . . .2. . . . . .3. . . . . .4. 5

No teacher support	Some teacher support	Rich and useful teacher support

c. Do the instructional materials provide information about the kind of resources and support system required to facilitate the district implementation of the required mathematics materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

No materials support	Some materials support	Rich and useful materials support

d. Do the instructional materials provide information about the kinds of professional development experiences needed by teachers to implement the materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no information provided	Partial information provided	Rich and useful information provided

e. Do the materials provide guidance in how to link the materials with the district and state assessment frameworks and programs?

1 . . . . .2. . . . . .3. . . . . .4. 5

No guidance	Some guidance	Rich and useful guidance

f. Do the materials provide guidance and assistance for involving administrators, parents, and the community at large actively in supporting school mathematics?

1 . . . . .2. . . . . .3. . . . . .4. 5

No guidance | Some guidance | Rich and useful guidance

g. Overall, are the materials usable by, realistic in expectations of, and supportive of teachers?

1 . . . . .2. . . . . .3. . . . . .4. 5

Teacher unfriendly | Somewhat teacher friendly | Teacher friendly

V. Major Strengths and Weaknesses

a. In your opinion, what are the three major strengths of this curriculum?

b. In your opinion, what are the three major weaknesses of this curriculum?

VI. Overall Quality, Value, and Contribution

a. In your opinion, what is the overall quality of these materials relative to:

	low ... high
- turning students on to mathematics?	1........2.......3.......4........5
- making students think?	1........2.......3.......4........5
- quality of mathematics content?	1........2.......3.......4........5
- quality of pedagogy?	1........2.......3.......4........5
- quality of classroom assessments?	1........2.......3.......4........5
- encouraging teachers to teach differently?	1........2.......3.......4........5

b. In your opinion, what is the overall quality of these instructional materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
Low	Medium	High

c. To what extent would you encourage the dissemination, adoption, and implementation of this curriculum?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
Not worthy of dissemination, adoption, nor implementation	OK to disseminate, adopt, and implement **if revised**	OK to disseminate, adopt, and implement **as is**

Use this page for additional notations:

Guidelines for Section II.

The following is a brief outline of the National Council of Teachers of Mathematics Curriculum and Evaluation Standards for School Mathematics. It should be used to guide your responses to Section II.

CONTENT STANDARD
A. Mathematics as Problem Solving
1. Use problem solving approaches to investigate and understand mathematical content
2. Formulate problems from within and outside mathematics
3. Develop and apply a variety of strategies to solve problems, with emphasis on multistep and nonroutine problems
4. Verify and interpret results with respect to the original problem situation
5. Generalize solutions and strategies to new problem situations
6. Acquire confidence in using mathematics meaningfully
B. Mathematics as Communication
1. Model situations using oral, written, concrete, pictorial, graphical, and algebraic methods
2. Reflect on and clarify their own thinking about mathematical ideas and situations
3. Develop common understandings of mathematical ideas, including the role of definitions
4. Use the skills of reading, listening, and viewing to interpret and evaluate mathematical ideas
5. Discuss mathematical ideas and make conjectures and convincing arguments
6. Appreciate the value of mathematical notation and its role in the development of mathematical ideas
C. Mathematics as Reasoning
1. Recognize and apply deductive and inductive reasoning
2. Understand and apply reasoning processes, with special attention to spatial reasoning and reasoning with proportions and graphs
3. Make and evaluate mathematical conjectures and arguments
4. Validate their own thinking
5. Appreciate the pervasive use and power of reasoning as a part of mathematics
D. Mathematical Connections
1. See mathematics as an integrated whole
2. Explore problems and describe results using graphical, numerical, physical, algebraic, and verbal mathematical models or representations
3. Use a mathematical idea to further their understanding of other mathematical ideas
4. Apply mathematical thinking and modeling to solve problems that arise in other disciplines, such as art, music, psychology, science, and business
5. Value the role of mathematics in our culture and society
E. Number and Number Relationships
1. Understand, represent, and use numbers in a variety of equivalent forms (integer, fraction, decimal, percent, exponential, and scientific notation) in real-world and mathematical problem situations
2. Develop number sense for whole numbers, fractions, decimals, integers, and rational numbers
3. Understand and apply ratios, proportions, and percents in a wide variety of situations
4. Investigate relationships among fractions, decimals, and percents
5. Represent numerical relationships in one- and two-dimensional graphs

CONTENT STANDARD *(Continued)*
F. Number Systems and Number Theory
1. Understand and appreciate the need for numbers beyond the whole numbers
2. Develop and use order relations for whole numbers, fractions, decimals, integers, and rational numbers
3. Extend their understanding of whole number operations to fractions, decimals, integers, and rational numbers
4. Understand how the basic arithmetic operations are related to one another
5. Develop and apply number theory concepts (e.g., primes, factors, and multiples) in real-world and mathematical problem situations
G. Computation and Estimation
1. Compute with whole numbers, fractions, decimals, integers, and rational numbers
2. Develop, analyze, and explain procedures for computation and techniques for estimation
3. Develop, analyze, and explain methods for solving proportions
4. Select and use an appropriate method for computing from among mental arithmetic, paper-and-pencil, calculator, and computer methods
5. Use computation, estimation, and proportions to solve problems
6. Use estimation to check the reasonableness of results
H. Patterns and Functions
1. Describe, extend, analyze, and create a wide variety of patterns
2. Describe and represent relationships with tables, graphs, and rules
3. Analyze functional relationships to explain how a change in one quantity results in a change in another
4. Use patterns and functions to represent and solve problems
I. Algebra
1. Understand the concepts of variable, expression, and equation
2. Represent situations and number patterns with tables, graphs, verbal rules, and equations and explore the interrelationships of these representations
3. Analyze tables and graphs to identify properties and relationships
4. Develop confidence in solving linear equations using concrete, informal, and formal methods
5. Investigate inequalities and nonlinear equations informally
6. Apply algebraic methods to solve a variety of real-world and mathematical problems
J. Statistics
1. Systematically collect, organize, and describe data
2. Construct, read, and interpret tables, charts, and graphs
3. Make inferences and convincing arguments that are based on data analysis
4. Evaluate arguments that are based on data analysis
5. Develop an appreciation for statistical methods as powerful means for decision making
K. Probability
1. Model situations by devising and carrying out experiments or simulations to determine probabilities
2. Model situations by constructing a sample space to determine probabilities
3. Appreciate the power of using a probability model by comparing experimental results with mathematical expectations

CONTENT STANDARD *(Continued)*
L. Geometry
1. Identify, describe, compare, and classify geometric figures
2. Visualize and represent geometric figures with special attention to developing spatial sense
3. Explore transformations of geometric figures
4. Represent and solve problems using geometric models
5. Understand and apply geometric properties and relationships
6. Develop an appreciation of geometry as a means of describing the physical world
M. Measurement
1. Extend their understanding of the process of measurement
2. Estimate, make, and use measurements to describe and compare phenomena
3. Select appropriate units and tools to measure to the degree of accuracy required in a particular situations
4. Understand the structure and use of systems of measurement
5. Extend their understanding of the concepts of perimeter, area, volume, angle measure, capacity, and weight and mass
6. Develop the concepts of rates and other derived and indirect measurements
7. Develop formulas and procedures for determining measures to solve problems

Framework for Review
Instructional Materials for High School Mathematics[1]

Title: ____
Author(s): ____
Publisher: __________________________________ ***Copyright date:*** __________
Reviewed by: ______________________________ ***Date:*** __________________

I. Descriptors

a. Write a brief description of the components of the curriculum upon which this review is based (e.g., teachers guide, student books, hands-on materials, multimedia material). That is, what materials did you receive and include in your review?

b. Write a brief description of the purpose and broad goals of these materials. That is, what were the stated purposes and what were the actual purposes of the materials?

c. What grade levels do the materials serve?

____9 ____10 ____11 ____12

d. Are the instructional materials designed to

___ provide a complete multi-year program for high school mathematics.
___ provide a complete one-year course for high school mathematics.
___ provide multiple modules or units that could be used to supplement other course materials for high school mathematics.
___ provide a single module or collection of activities that could be used to supplement other course materials for high school mathematics.
___ other (explain):

[1] *NOTE: This framework is adapted from an instrument developed by Inverness Research under contract to the National Science Foundation. The framework was refined as part of a panel review of NSF-supported materials for middle school science, which was limited to projects that provide at least a year-long course of study.*

e. What are the major domains/topics of content covered by these materials?

II. Quality of the Mathematics

Directions: For each item, circle the number corresponding with your response to the question. ***Write an explanation for your rating of each item below the item.***

a. Does the content in the instructional materials align well with all thirteen areas of the Curriculum Standards as described in the National Council of Teachers of Mathematics Curriculum and Evaluation Standards for School Mathematics (NCTM)?
(See attached guidelines)

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
Omits substantial content included in NCTM and/or includes substantial content not recommended in NCTM	Some misalignment of content with recommendations in NCTM	The curriculum aligns well with content recommendations in NCTM

b. Are the mathematics concepts presented in the instructional materials accurate and correct? [Provide examples of major errors where they are evident. Attach extra page if necessary]

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
Substantial, major errors	Mostly correct, with some minor errors	Mathematically accurate, and correct

c. Do the instructional materials adequately present the major concepts and adequately demonstrate and model the processes of mathematics?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
Major concepts and processes not addressed	Major concepts and processes somewhat addressed	Major concepts and processes addressed well

d. Do the instructional materials accurately represent views of mathematical problem solving as described in the NCTM Curriculum and Evaluation Standards for School Mathematics?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
Poor portrayal of problem solving	Mixed quality	Rich and accurate portrayal of problem solving

e. Do the materials use technology as a tool for learning mathematics?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
Little or no use	Some emphasis	Rich and well designed use

f. Do the materials emphasize communication about mathematics through a variety of modalities?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
Little or no emphasis, few modalities	Some emphasis, some modalities	Rich and well designed emphasis, varied modalities

g. Do the materials appropriately address mathematical reasoning?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
Not appropriately addressed	Somewhat appropriately addressed	Appropriately addressed

h. Do the materials appropriately address computation?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not appropriately addressed | Somewhat appropriately addressed | Appropriately addressed

i. Do the materials appropriately address estimation?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not appropriately addressed | Somewhat appropriately addressed | Appropriately addressed

j. Do the materials appropriately address number systems?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not appropriately addressed | Somewhat appropriately addressed | Appropriately addressed

k. Do the materials appropriately address patterns?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not appropriately addressed | Somewhat appropriately addressed | Appropriately addressed

l. Do the materials appropriately address functions?

1 . . . . .2. . . . . .3. . . . . .4. 5
Not appropriately addressed Somewhat appropriately addressed Appropriately addressed

m. Do the materials appropriately address algebra?

1 . . . . .2. . . . . .3. . . . . .4. 5
Not appropriately addressed Somewhat appropriately addressed Appropriately addressed

n. Do the materials appropriately address geometry?

1 . . . . .2. . . . . .3. . . . . .4. 5
Not appropriately addressed Somewhat appropriately addressed Appropriately addressed

o. Do the materials appropriately address measurement?

1 . . . . .2. . . . . .3. . . . . .4. 5
Not appropriately addressed Somewhat appropriately addressed Appropriately addressed

p. Do the materials appropriately address statistics?

1 . . . . .2. . . . . .3. . . . . .4. 5
Not appropriately addressed Somewhat appropriately addressed Appropriately addressed

q. Do the materials appropriately address probability?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not appropriately addressed | Somewhat appropriately addressed | Appropriately addressed

r. Do the instructional materials provide sufficient activities for students to develop a good understanding of key mathematics concepts?

1 . . . . .2. . . . . .3. . . . . .4. 5

Too few learning activities | Activities provide some opportunity for students to learn some important concepts | Activities provide many rich opportunities to learn key mathematics concepts

s. Do the instructional materials provide sufficient opportunities for students to apply their understanding of the concepts (i.e., designing of solutions to problems or issues)?

1 . . . . .2. . . . . .3. . . . . .4. 5

Very few application activities | Some application activities | Very rich in application activities

t. Do the materials develop an appropriate breadth **and** depth of mathematics content?

1 . . . . .2. . . . . .3. . . . . .4. 5

Too narrow or too broad | Somewhat balanced | Good balance of breadth and depth

u. What is the overall quality of the mathematics presented in the instructional materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

Low | Medium | High

III. The Pedagogical Design

a. Do the instructional materials provide a logical progression for developing conceptual understanding in mathematics?

1 . . . . .2. . . . . .3. . . . . .4. 5

No logical progression of ideas	Somewhat logical progression of ideas	Logical progression of ideas that builds conceptual understanding

b. Do the instructional materials provide students the opportunity to formulate, solve, and reflect critically on problems?

1 . . . . .2. . . . . .3. . . . . .4. 5

No opportunity	Some opportunity	Rich and well designed opportunity

c. To what extent are the mathematical concepts embedded in learner-appropriate contexts?

1 . . . . .2. . . . . .3. . . . . .4. 5

Very few or very contrived activities for students to do mathematical problem solving	Some good activities for students to do mathematical problem solving	Many rich and authentic opportunities for students to do mathematical problem solving

d. How would you rate the overall developmental appropriateness of the instructional materials, given its intended audience of ALL students at the targeted level(s)?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not developmentally appropriate	Somewhat developmentally appropriate	Developmentally appropriate

e. Do the materials reflect current (that is, within the last 5 years) knowledge about effective teaching and learning practices (e.g., active learning, inquiry, community of learners) based on research related to mathematics education?

1 . . . . .2. . . . . .3. . . . . .4. 5

Do not reflect current knowledge about teaching and learning	Somewhat reflective of current knowledge about teaching and learning	Reflect well current knowledge about teaching and learning

f. Do the instructional materials provide students the opportunity to clarify, refine, and consolidate their ideas?

1 . . . . .2. . . . . .3. . . . . .4. 5

No opportunity	Some opportunity	Rich and well designed opportunity

g. Do the instructional materials provide students with activities connecting mathematics with other subject areas?

1 . . . . .2. . . . . .3. . . . . .4. 5

No opportunity	Some opportunity	Rich and well designed opportunity

h. Are the instructional materials likely to be interesting, engaging, and effective for girls and boys?

1 . . . . .2. . . . . .3. . . . . .4. 5

No sensitivity to gender issues	Some sensitivity to gender issues	Sensitive to gender issues

i. Are the instructional materials likely to be interesting, engaging, and effective for underrepresented and underserved students (e.g., ethnic, urban, rural, with disabilities)?

1 . . . . .2. . . . . .3. . . . . .4. 5

No sensitivity to underrepresented and served students	Some sensitivity to underrepresented and underserved students	Sensitive to underrepresented and under- and underserved students

j. Does assessment have explicit purposes connected to decisions to be made by teachers (e.g., prior knowledge, conceptual understanding, grades)?

1 . . . . .2. . . . . .3. . . . . .4. 5

Unclear purposes	Somewhat clear purposes	Clear statement of purposes

k. Do assessments focus on the curriculum's important content and skills?

1 . . . . .2. . . . . .3. . . . . .4. 5

Poor correspondence	Fair correspondence	Full correspondence

l. Do the instructional materials include multiple kinds of assessments (e.g., performance, paper/pencil, portfolios, student interviews, embedded, projects)?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no student assessment provided	Some variety of student assessment	Complete student assessment package

m. Are the assessment practices fair to all students?

1 . . . . .2. . . . . .3. . . . . .4. 5

Fair for a few | Fair to most | Fair to all

n. Do the instructional materials include adequate and appropriate uses of a variety of educational technologies (e.g., calculators, video, computers, telecommunications)?

1 . . . . .2. . . . . .3. . . . . .4. 5

Little or no educational technology included | Some appropriate educational technology included | Many appropriate applications of educational technology included

o. What is the overall quality of the pedagogical design of these instructional materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

Low | Medium | High

IV. Implementation and System Support

a. Will the teachers find the materials interesting and engaging?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
Dry and boring	Somewhat interesting and engaging	Interesting and engaging

b. Do the instructional materials include information and guidance to assist the teacher in implementing the lessons?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
No teacher support	Some teacher support	Rich and useful teacher support

c. Do the instructional materials provide information about the kind of resources and support system required to facilitate the district implementation of the required mathematics materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
No materials support	Some materials support	Rich and useful materials support

d. Do the instructional materials provide information about the kinds of professional development experiences needed by teachers to implement the materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

1	3	5
Little or no information provided	Partial information provided	Rich and useful information provided

e. Do the materials provide guidance in how to link the materials with the district and state assessment frameworks and programs?

1 . . . . .2. . . . . .3. . . . . .4. 5

No guidance Some guidance Rich and useful guidance

f. Do the materials provide guidance and assistance for involving administrators, parents, and the community at large actively in supporting school mathematics?

1 . . . . .2. . . . . .3. . . . . .4. 5

No guidance Some guidance Rich and useful guidance

g. Overall, are the materials usable by, realistic in expectations of, and supportive of teachers?

1 . . . . .2. . . . . .3. . . . . .4. 5

Teacher unfriendly Somewhat teacher friendly Teacher friendly

V. Major Strengths and Weaknesses

a. In your opinion, what are the three major strengths of this curriculum?

b. In your opinion, what are the three major weaknesses of this curriculum?

VI. Overall Quality, Value, and Contribution

a. In your opinion, what is the overall quality of these materials relative to:

	low	**high**
- turning students on to mathematics?	1........2.......3.......4........5	
- making students think?	1........2.......3.......4........5	
- quality of mathematics content?	1........2.......3.......4........5	
- quality of pedagogy?	1........2.......3.......4........5	
- quality of classroom assessments?	1........2.......3.......4........5	
- encouraging teachers to teach differently?	1........2.......3.......4........5	

b. In your opinion, what is the overall quality of these instructional materials?

1 . . . . .2. . . . . .3. . . . . .4. 5

Low	Medium	High

c. To what extent would you encourage the dissemination, adoption, and implementation of this curriculum?

1 . . . . .2. . . . . .3. . . . . .4. 5

Not worthy of dissemination, adoption, nor implementation	OK to disseminate, adopt, and implement if revised	OK to disseminate, adopt, and implement as is

Use this page for additional notations:

Guidelines for Section II.

The following is a brief outline of the National Council of Teachers of Mathematics Curriculum and Evaluation Standards for School Mathematics. It should be used to guide your responses to Section II.

CONTENT STANDARD
A. Mathematics as Problem Solving
1. Use, with increasing confidence, problem solving approaches to investigate and understand mathematical content
2. Apply integrated mathematical problem-solving strategies to solve problems from within and outside mathematics
3. Recognize and formulate problems from situations within and outside mathematics
4. Apply the process of mathematical modeling to real-world problem situations
B. Mathematics as Communication
1. Reflect upon and clarify their thinking about mathematical ideas and relationships
2. Formulate mathematical definitions and express generalizations discovered through investigations
3. Express mathematical ideas orally and in writing
4. Read written presentations of mathematics with understanding
5. Ask clarifying and extending questions related to mathematics they have read or heard about
6. Appreciate the economy, power, and elegance of mathematical notation and its role in the development of mathematical ideas
C. Mathematics as Reasoning
1. Make and test conjectures
2. Formulate counterexamples
3. Follow logical arguments
4. Judge the validity of arguments
5. Construct simple valid arguments
If college-intending,
6. Construct proofs for mathematical assertions, including indirect proofs and proofs by mathematical induction
D. Mathematical Connections
1. Recognize equivalent representations of the same concept
2. Relate procedures in one representation to procedures in an equivalent representation
3. Use and value the connections among mathematical topics
4. Use and value the connections between mathematics and other disciplines
E. Algebra
1. Represent situations that involve variable quantities with expressions, equations, inequalities, and matrices
2. Use tables and graphs as tool to interpret expressions, equations, and inequalities
3. Operate on expressions and matrices, and solve equations and inequalities
4. Appreciate the power of mathematical abstraction and symbolism
If college-intending,
5. Use matrices to solve linear systems
6. Demonstrate technical facility with algebraic transformations, including techniques based on the theory of equations

CONTENT STANDARD *(Continued)*
F. Functions
1. Model real-world phenomena with a variety of functions
2. Represent and analyze relationships using tables, verbal rules, equations, and graphs
3. Translate among tabular, symbolic, and graphical representations of functions
4. Recognize that a variety of problem situations can be modeled by the same type of function
5. Analyze the effects of parameter changes on the graphs of functions
If college-intending,
6. Understand operations on, and the general properties and behavior of, classes of functions
G. Geometry from a Synthetic Perspective
1. Interpret and draw three-dimensional objects
2. Represent problem situations with geometric models and apply properties of figures
3. Classify figures in terms of congruence and similarity and apply these relationships
4. Deduce properties of, and relationships between, figures from given assumptions
If college-intending,
5. Develop an understanding of an axiomatic system through investigating and comparing various geometrics
H. Geometry From an Algebraic Perspective
1. Translate between synthetic and coordinate representations
2. Deduce properties of figures using transformations and using coordinates
3. Identify congruent and similar figures using transformations
4. Analyze properties of Euclidean transformations and relate translations to vectors
If college-intending,
5. Deduce properties of figures using vectors
6. Apply transformations, coordinates, and vectors in problem solving
I. Trigonometry
1. Apply trigonometry to problem situations involving triangles
2. Explore periodic real-world phenomena using the sine and cosine functions
If college-intending,
3. Understand the connection between trigonometric and circular functions
4. Use circular functions to model periodic real-world phenomena
5. Apply general graphing techniques to trigonometric functions
6. Solve trigonometric equations and verify trigonometric identities
7. Understand the connections between trigonometric functions and polar coordinates, complex numbers, and series
J. Statistics
1. Construct and draw inferences from charts, tables, and graphs that summarize data from real-world situations
2. Use curve fitting to predict from data
3. Understand and apply measures of central tendency, variability, and correlation
4. Understand sampling and recognize its role in statistical claims
5. Design a statistical experiment to study a problem, conduct the experiment, and interpret and communicate the outcomes
6. Analyze the effects of data transformations on measures of central tendency and variability
If college-intending,

CONTENT STANDARD   ***(Continued)***
K. Probability
1. Use experimental or theoretical probability, as appropriate, to represent and solve problems involving uncertainty
2. Use simulations to estimate probabilities
3. Understand the concept of a random variable
4. Create and interpret discrete probability distributions
5. Describe, in general terms, the normal curve and use its properties to answer questions about sets of data that are assumed to be normally distributed
If college-intending,
6. Apply the concept of a random variable to generate and interpret probability distributions including binomial, uniform, normal, and chi square
L. Discrete Mathematics
1. Represent problem situations using discrete structures such as finite graphs, matrices, sequences, and recurrence relations
2. Represent and analyze finite graphs using matrices
3. Develop and analyze algorithms
4. Solve enumeration and finite probability problems
If college-intending,
5. Represent and solve problems using linear programming and difference equations
6. Investigate problem situations that arise in connection with computer validation and the application of algorithms
M. Conceptual Underpinnings of Calculus
1. Determine maximum and minimum points of a graph and interpret the results in problem situations
2. Investigate limiting processes by examining infinite sequences and series and areas under curves
If college-intending,
3. Understand the conceptual foundations of limit, the area under a curve, the rate of change, and the slope of a tangent line, and their applications in other disciplines
4. Analyze the graphs of polynomial, rational, radical, and transcendental functions
N. Mathematical Structure
1. Compare and contrast the real number system and its various subsystems with regard to their structural characteristics
2. Understand the logic of algebraic procedures
3. Appreciate that seemingly different mathematical systems may be essentially the same
If college-intending,
4. Develop the complex number system and demonstrate facility with its operation
5. Prove elementary theorems within various mathematical structures, such as groups and fields
6. Develop an understanding of the nature and purpose of axiomatic systems

APPENDIX 3

Classroom Observation Instrument

IMD Product
Classroom Observation Protocol

Background Information

IMD Product:

Site:________________________ Date of Observation:________________________

Subject/Grade Level:________________________ Time of Observation:________________________

Observer:________________________ Start:__________ End:__________

Section One: Contextual Background and Activities

In this section, please fill in the circles that best describe the class. For each item, be sure to fill in all responses that apply.

I. Classroom Demographics

A. What is the total number of students in the class at the time of the observation?

- ○ 15 or fewer
- ○ 16-20
- ○ 21-25
- ○ 26-30
- ○ 31 or more

B. What is the approximate percentage of white (not Hispanic origin) students in the class?

- ○ 0–10 percent
- ○ 11-25 percent
- ○ 26-50 percent
- ○ 51-75 percent
- ○ 76-100 percent

C. Indicate the gender and race/ethnicity of the *teacher*?

○ Male ○ Female

- ○ African-American (not Hispanic origin)
- ○ American Indian or Alaskan Native
- ○ Asian or Pacific Islander
- ○ Hispanic
- ○ White (not Hispanic origin)
- ○ Other

D. Indicate the gender and race/ethnicity of the *teacher's aide*?

○ Male ○ Female

- ○ African-American (not Hispanic origin)
- ○ American Indian or Alaskan Native
- ○ Asian or Pacific Islander
- ○ Hispanic
- ○ White (not Hispanic origin)
- ○ Other

II. Classroom Context

A. Rate the adequacy of the physical environment.

1. Classroom resources:

○	○	○	○	○
1	2	3	4	5
Sparsely equipped				Rich in resources

2. Classroom space:

○	○	○	○	○
1	2	3	4	5
Crowded				Adequate space

3. Room arrangement:

○	○	○	○	○
1	2	3	4	5
Inhibited interactions among students				Facilitated interactions among students

B. In a few sentences, describe the lesson you observed. Include where this lesson fits in the overall unit of study, if you know this.

III. Lesson Focus

A. Indicate the *major*[*] *content area(s)* of this lesson or activity.

- ○ Numeration and number theory
- ○ Computation
- ○ Estimation
- ○ Measurement
- ○ Pre-algebra
- ○ Algebra
- ○ Patterns and relationships
- ○ Geometry and spatial sense
- ○ Functions (including trigonometric functions) and pre-calculus concepts
- ○ Data collection and analysis
- ○ Probability
- ○ Statistics (e.g., hypothesis tests, curve fitting, and regression)
- ○ Topics from discrete mathematics (e.g., combinatorics, graph theory. recursion)
- ○ Mathematical structures (e.g.. vector spaces; groups, rings, fields)
- ○ Calculus

[*]"Major" means, was used, or addressed for a substantial portion of the lesson; if you were describing the lesson to someone, this feature would help characterize it.

- ○ Life science
- ○ Physical science
- ○ Earth and space science
- ○ Environmental science

- ○ Engineering and design principles
- ○ Technology (calculators, computers) in support of science/mathematics

- ○ History of science/mathematics
- ○ Other disciplines (please specify:)

____

____

IV. Classroom Instruction

A. Indicate the *major instructional resource(s)* used in this lesson. Please specify the names of any published teacher guides,. textbooks, or kits used in this lesson.

- ○ Print Materials:
  - ○ Published teacher guide/manual for hands-on unit:
    ____
  - ○ Published textbook(s):
    ____
  - ○ Teacher-created print materials
  - ○ Other published materials (e.g., trade books, magazines)
- ○ Hands-on/Manipulative Materials/ Models:
  - ○ Tools and instruments
  - ○ Objects specimens, or models
  - ○ Commercially-produced manipulatives
  - ○ Commercially-produced kits:
    ____
  - ○ Other hands-on/laboratory supplies
- ○ Outdoor Resources
  - ○ Garden
  - ○ Nature trail
  - ○ Other outdoor area
- ○ Technology/Audio-visual Resources:
  - ○ Computers
  - ○ Calculators
  - ○ Videotape/film/filmstrip/TV program
  - ○ Multimedia
  - ○ Telecommunications
- ○ Other Resources
  - ○ Chalkboard
  - ○ Overhead Projector
  - ○ Charts
  - ○ Maps

B. Indicate the *major way(s)* in which student activities were structured.

- ○ As a whole group
- ○ As small groups
- ○ As pairs
- ○ As individuals

____

*“Major” means, was used, or addressed for a substantial portion of the lesson if you were describing the lesson to someone, this feature would help characterize it.

C. Indicate the *major *way(s)* in which students engaged in class activities.**

- ○ Entire class was engaged in the same activities at the same time.
- ○ Groups of students were engaged indifferent activities at the same time (e.g.. centers).

V. Use of Material

A. Indicate the *major *activities* of teachers and students in this lesson. When choosing an "umbrella" category, be sure to indicate subcategories that apply as well. (For example, if you mark "formal presentations by teacher," indicate what kind).**

○ Formal Presentations by Teacher:

- ○ Disciplinary content/process information
- ○ Demonstration of a principle or phenomenon
- ○ Procedural instructions
- ○ Other (please specify)

____

○ Students Presenting and/or Defending Work Orally

○ Guest Speaker/"Expert" Serving as a Resource

○ Discussions/Seminars:

- ○ Whole group led by teacher
- ○ Whole group led by student(s)
- ○ Small groups/pairs

○ Students Engaged in Hands-on/Investigative/Research/Field Activities:

- ○ Followed prescribed steps in a science/mathematics activity or investigation
- ○ Designed or implemented their *own* investigation in science/mathematics
- ○ Worked on an extended investigation/project (a week or more in duration)
- ○ Recorded, represented, and/or analyzed data
- ○ Interpreted data to draw conclusions
- ○ Worked on a model or simulation
- ○ Designed objects within constraints (e.g., egg drop, toothpick bridges. aluminum boats)
- ○ Participated in fieldwork
- ○ Engaged in role play or debate
- ○ Played a game to build or review knowledge/skills

○ Students Engaged in Problem-Solving Activities:

- ○ Practiced routine computations/algorithums
- ○ Determined if a problem was well defined
- ○ Reflected on examples of problems and their solutions
- ○ Recognized patterns, cycles, or trends
- ○ Worked on solving a real-world or abstract problem
- ○ Applied scientific/mathematical principles or strategies in solving new problems
- ○ Formulated conjectures to generalize problems

○ Students Focused on Proof and Evidence:

- ○ Reflected on methods of proof in science/mathematics
- ○ Evaluated the validity of arguments or claims
- ○ Tested a hypothesis or conjecture
- ○ Developed a formal argument or proof

○ Students Engaged in Reading/Reflection/Written Communication:

- ○ Read (or listened to a story) about science/mathematics
- ○ Answered textbook/worksheet questions
- ○ Reflected on readings, activities, or problems individually or in groups

*"Major" means, was used, or addressed for a substantial portion of the lesson; if you were describing the lesson to someone, this feature would help characterize it.

- ○ Wrote a description of a plan, procedure, or problem solving process
- ○ Wrote a reflections in a notebook or journal
- ○ Prepared a written product (e.g., report. story, poem)

○ Students and/or Teacher Used Technology/Audio visual Resources:

- ○ To develop conceptual understanding
- ○ To learn or practice a skill
- ○ To collect data (e.g., probeware)
- ○ As an analytic tool (e.g., spreadsheets or data analysis)
- ○ As a presentation tool
- ○ For word processing
- ○ As a communication tool (e.g., e-mail, Internet, Web)

○ Other activities (please specify):

____
____
____
____
____

○ Students participated in assessment:

- ○ Homework/worksheet review
- ○ Informal assessment (e.g., questioning for understanding)
- ○ Short-answer tests (e.g., multiple choice, true/false, fill-in-the-blank)
- ○ Tests requiring open-ended responses (e.g., explanations, descriptions, or justifications of solutions)
- ○ Performance-based assessment
- ○ Embedded assessment (using class activities/projects for assessment purposes)
- ○ Portfolios

E. Comments

Please provide any additional information you consider necessary to capture the activities or context of this lesson. Include comments on any feature of the class that is so salient that you need to get it “on the table” right away to help explain your ratings; for example, the class was interrupted by a fire drill, the kids were excited about an upcoming school event, or the teacher’s tone was so warm (or so hostile) that it was an overwhelmingly important feature of the lesson.

Section Two: Ratings

In Section One of this form, you documented what occurred in the lesson. In this section, you are asked to rate each of a number of key indicators from 1 (not at all) to 5 (to a great extent) in four different categories by circling the appropriate response. You may list any additional indicators you consider important in capturing the essence of this session and rate these as well. Use your "Ratings of Key Indicators" (Part A) to inform your 'Synthesis Ratings' (Part B) and indicate in "Supporting Evidence for Synthesis Ratings" (Part C) what factors were most influential in determining your synthesis ratings. Note that any one lesson is not likely to provide evidence for every single indictor: use 6, "Don't Know" when there is not enough evidence for you to make a judgment. Use 7, "N/A" (Not Applicable) when you consider the indicator inappropriate given the purpose and context of the session. Section Two concludes with ratings of the likely impact of instruction, and a capsule description of the lesson.

I. Implementation of Key Strategies Embedded in the Curriculum Product

A. Ratings of Key Indicators

	Not at all				To a great extent	Don't Know	N/A
1. The implementation of instructional strategies was consistent with investigative science/ mathematics.	1	2	3	4	5	6	7
2. The teacher appeared confident in his/her ability to use the materials.	1	2	3	4	5	6	7
3. The teacher's classroom management style/strategies enhanced the quality of the lesson.	1	2	3	4	5	6	7
4. The pace of the lesson was appropriate for the developmental levels/needs of the students and the purposes of the lesson, as embedded in the materials.	1	2	3	4	5	6	7
5. The teacher was cognizant of prior knowledge of students	1	2	3	4	5	6	7
6. The teacher's questioning strategies were likely to enhance the development of student conceptual understanding (e.g., emphasized higher order questions, appropriately used "wait time").	1	2	3	4	5	6	7
7. Teacher used assessment strategies appropriate to the lesson and materials.	1	2	3	4	5	6	7
8. ____	1	2	3	4	5	6	7

B. Synthesis Rating

1	2	3	4	5
Implementation of lesson not at all reflective of best practice				Implementation of lesson extremely reflective of best practice

C. Supporting evidence for Synthesis Rating

II. Content

A. Ratings of Key Indicators

	Not at all				To a great extent	Don't Know	N/A
1. The content was appropriate for the purposes of the lesson and developmental level of the class.	1	2	3	4	5	6	7
2. The science/mathematics content was significant and worthwhile.	1	2	3	4	5	6	7
3. Teacher-presented information was accurate.	1	2	3	4	5	6	7
4. The teacher was familiar with the materials and their intentions.	1	2	3	4	5	6	7
5. The content was relevant for the needs/interests of most students.	1	2	3	4	5	6	7
6. Science/mathematics was portrayed as a dynamic body of knowledge that involves conjecture, investigation, analysis, and proof/justification.	1	2	3	4	5	6	7
7. Appropriate connections were made to other areas of science/mathematics, to other disciplines, and/or to real-world contexts.	1	2	3	4	5	6	7
8. The degree of closure or resolution of conceptual understanding was appropriate for the developmental levels/needs of the students and the purposes of the lesson.	1	2	3	4	5	6	7
9. The materials were used in the lesson.	1	2	3	4	5	6	7
10. ______________________________	1	2	3	4	5	6	7

B. Synthesis Rating

1	2	3	4	5
Content of lesson not at all reflective of current standards for science/ mathematics education				Content of lesson extremely reflective of current standards for science/ mathematics education

C. Supporting evidence for Synthesis Rating

III. Classroom Culture/Equity

A. Ratings of Key Indicators

	Not at all				To a great extent	Don't Know	N/A
1. Active participation of all was encouraged and valued.	1	2	3	4	5	6	7
2. There was a climate of respect for students' ideas, questions, and contributions.	1	2	3	4	5	6	7
3. Interactions reflected collaborative working relationships among students (e.g., students worked together, talked with each other about the lesson).	1	2	3	4	5	6	7
4. Interactions reflected collaborative working relationships between teacher and students.	1	2	3	4	5	6	7
5. The teacher's language and behavior demonstrated sensitivity to issues of gender, race/ethnicity, special needs, limited English proficiency, culture, and socio-economic status.	1	2	3	4	5	6	7
	1	2	3	4	5	6	7
6. Opportunities were taken to recognize and challenge stereotypes and biases that became evident during the lesson.	1	2	3	4	5	6	7
7. Students were intellectually engaged with important ideas relevant to the focus of the lesson.	1	2	3	4	5	6	7
8. Students were encouraged to generate ideas, questions, conjectures, or propositions.	1	2	3	4	5	6	7
9. Intellectual rigor, constructive criticism, and the challenging of ideas were valued.	1	2	3	4	5	6	7
10. ____	1	2	3	4	5	6	7

B. Synthesis Rating

1	2	3	4	5
The classroom culture interferes with student learning				The classroom culture facilitates the learning of all students

C. Supporting evidence for Synthesis Rating

IV. Overall Ratings of the Lesson

A. Likely Impact of Instruction on Students' Understanding of Science/Mathematics

While the impact of a single lesson may well be limited in scope, it is important to judge whether it is helping move students in the desired direction. For this series of ratings, consider all available information (i.e., your previous ratings of design, implementation, content, and culture/equity and the pre-and post-observation interviews with the teacher) as you assess the probable impact of this lesson. Feel free to elaborate on ratings with comments in the space provided.

Circle the response that best describes your overall assessment of the *likely effect* of this lesson in each of the following areas.

	Negative effect		Neutral effect		Positive effect	Don't Know	N/A
1. Students' understanding of science as a dynamic body of knowledge generated and enriched by investigation.	1	2	3	4	5	6	7
2. Students' understanding of mathematics by the use of multiple approaches.	1	2	3	4	5	6	7
3. Students' understanding of important science/mathematics concepts.	1	2	3	4	5	6	7
4. Students' capacity to carry out their own inquiries.	1	2	3	4	5	6	7
5. Students' ability to apply or generalize skills and concepts to other areas of science/mathematics, other disciplines, and/or real-life situations.	1	2	3	4	5	6	7
6. Students' self-confidence in doing science/mathematics.	1	2	3	4	5	6	7
7. Students' interest in and/or appreciation for the discipline	1	2	3	4	5	6	7

Comments (optional):

B. Capsule Description of the Quality of the Lesson

In this final rating of the lesson, consider all available information about the lesson, its context and purpose and your own judgment of the relative importance of the ratings you have made. Select the capsule description that best characterizes the lesson you observed. Keep in mind that this rating is not intended to be an average of all the previous ratings, but should encapsulate your overall assessment of the quality and likely impact of the lesson. Feel free to comment on or modify the capsule description in the space provided for comments.

○ Level 1: Ineffective Instruction
There is little or no evidence of student thinking or engagement with important ideas of science/mathematics. Instruction is unlikely to enhance students' understanding of the discipline or to develop their capacity to successfully "do" science/mathematics. Lesson was characterized by either (mark one below):

○ Passive Learning
Instruction is pedantic and uninspiring. Students are passive recipients of information from the teacher or textbook; material is presented in a way that is inaccessible to many students.

○ Activity for Activity's Sake
Students are involved in hands-on activities or other individual or group work, but it appears to be activity for activity's sake. Lesson lacks a clear sense of purpose and/or a clear link to conceptual development.

○ Level 2: Elements of Effective Instruction
Instruction contains some elements of effective practice, but there are *substantial problems* in the design, implementation, content, and/or appropriateness for many students in the class. For example, the content may lack importance and/or appropriateness; instruction may not successfully address the difficulties that many students are experiencing, etc. Overall, the lesson is *quite limited* in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully 'do" science/mathematics.

○ Level 3: Beginning Stages of Effective Instruction
Instruction is purposeful and characterized by quite a few elements of effective practice. Students are, at times, engaged in meaningful work, but there are *some weaknesses* in the design, implementation, or content of instruction. For example, the teacher may short-circuit a planned exploration by telling students what they "should have found," instruction may not adequately address the needs of a number of students, or the classroom culture may limit the accessibility or effectiveness of the lesson. Overall, the lesson is somewhat limited in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully "do" scicnce/mathematics.

○ Level 4: Accomplished. Effective Instruction
Instruction is purposeful and engaging for most students. Students actively participate in meaningful work (e.g., investigations, teacher presentations, discussions with each other or teacher, reading). The lesson is well-designed and the teacher implements it well, but adaptation of content or pedagogy in response to student needs and interests is limited. Instruction is *quite likely* to enhance most students' understanding of the discipline and to develop their capacity to successfully "do" science/mathematics.

○ Level 5: Exemplary Instruction
Instruction is purposeful and all students arc highly engaged most or all of the time in meaningful work (e.g., investigations, teacher presentations, discussions with each other or teacher, reading). The lesson is well-designed and artfully implemented, with flexibility and responsiveness to student needs and interests. Instruction is highly likely to enhance most students' understanding of the discipline and to develop their capacity to successfully "do" science/mathematics.

Comments (optional):

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