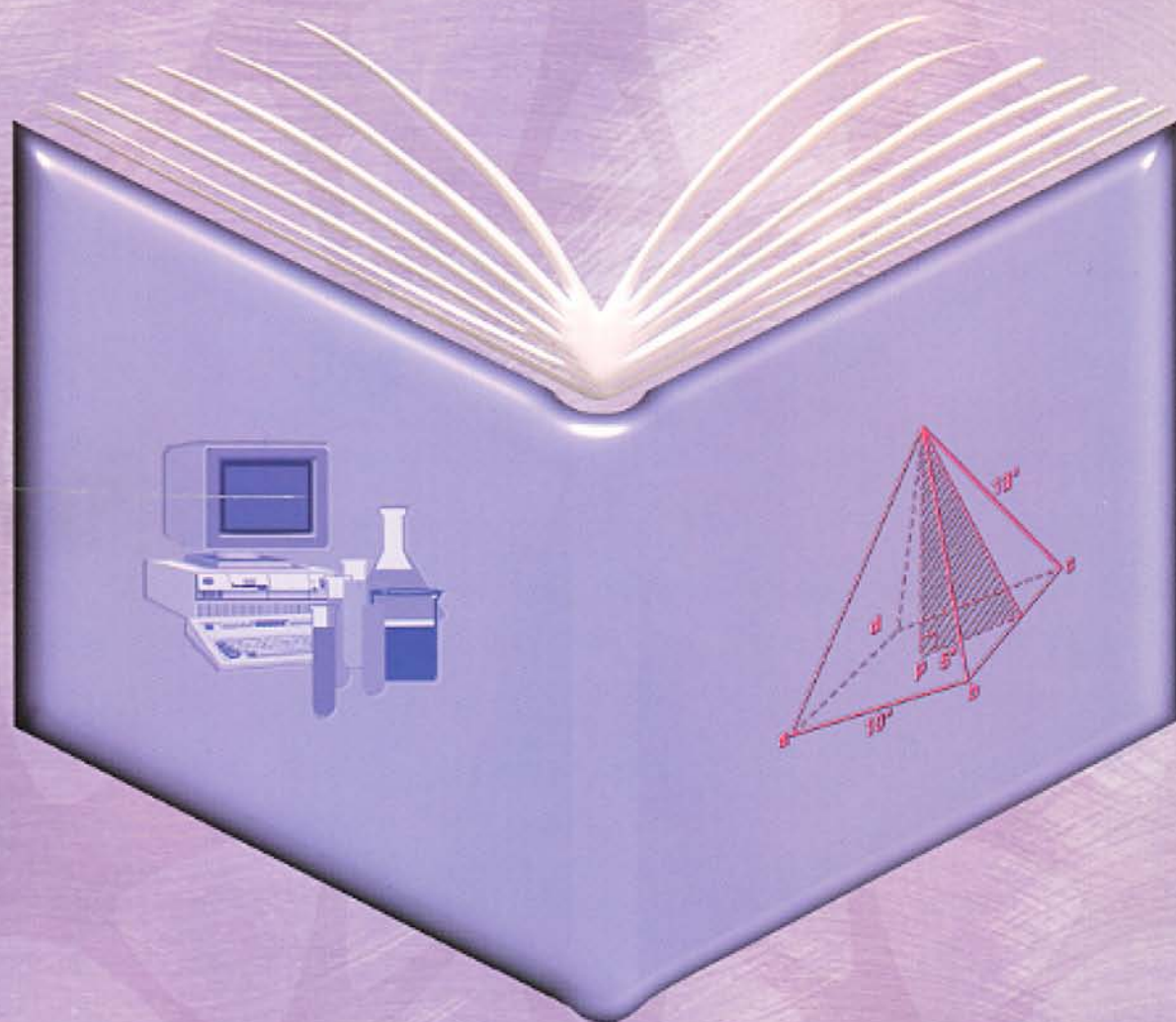


Final Report on the Evaluation of the National Science Foundation's Instructional Materials Development Program



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

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Naida C. Tushnet, Mary Ann Millsap, Noraini Abdullah-Welsh, Nancy Brigham, Elizabeth Cooley, Jeanne Elliott, Karen Johnston, Alina Martinez, Marla Nierenberg, Sheila Rosenblum

James Dietz
Conrad Katzenmeyer
Contracting Officers Technical Representatives
Division of Research, Evaluation, and Communication

Any opinions, findings, and conclusions or recommendations expressed in this report are those of the participants and do not necessarily represent the official view, opinions, or policy of the National Science Foundation.

National Science Foundation
Directorate for Education and Human Resources
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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 publishers 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.

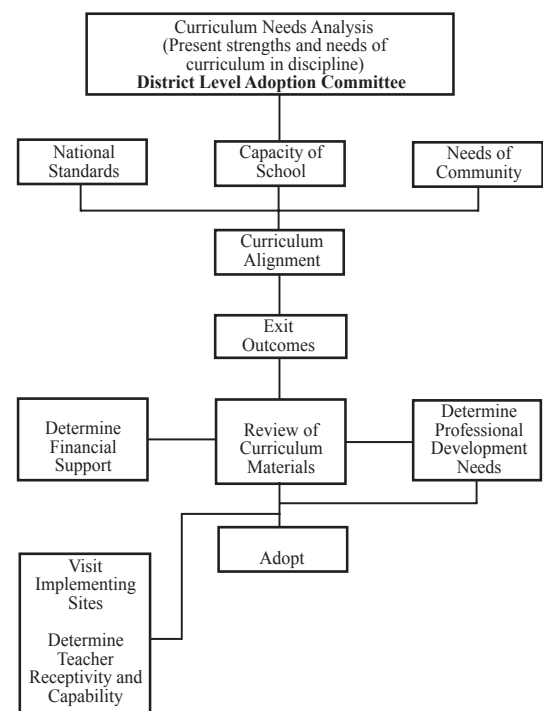
ADOPTION

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.

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?

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 represent-

ing 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.

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