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.