National Science Foundation
Directorate for Education and Human Resources

Staff Response
Instructional Materials Development Program
Committee of Visitors Report

September 2005

Division of Elementary, Secondary, and Informal Education

The Committee of Visitors (COV) for the Instructional Materials Development (IMD) program met on April 21-22, 2005 at NSF Headquarters. Before the meeting, the Committee was sent extensive materials including the Strategic Plans for NSF, EHR, and ESIE along with Program Solicitations for the three years under review (FY 2002, 2003, and 2004). Also included were demographic information about reviewers and awards, as well as lists of proposals declined and awarded.

At the meeting, Committee members received instructions from the NSF administration about their duties. A COV Report template guided their actions. The COV reviewed 10 awards, 20 declines, and four (4) other proposal actions all chosen randomly. In addition, Program Officers (POs) from the IMD program chose eight (8) awards considered exemplary to compare as a standard of performance.

The Committee thought that IMD has a strong vision for changing the way instructional materials can change classroom teaching and that it is working to make that change happen. It found that the review processes "work well to identify important significant work" and that documentation in the jackets is thorough, complete, fair, and substantive. The COV stated that "the range and types of IMD funded projects in science, technology, engineering, and mathematics (STEM) education demonstrate a thoughtful, strategic vision regarding the educational materials needed to prepare a diverse, competitive workforce and citizenry for the new global economy."

When the COV submitted its report for factual review, staff noted that the report had many suggestions, but none stated as recommendations. Staff then suggested that the COV highlight suggestions rising to the level of recommendations. That list was appended to the report when the final version was submitted. In this response, some recommendations have been reordered so that related topics can be addressed as a single issue. The parentheses refer directly to labeled sections from the COV Committee report.

Program Solicitation

1. Clarity in language in the Program Solicitation regarding ‘should’ and ‘must’ would enhance consistency in submitted proposals (A.2).

Response: In response to this recommendation, IMD program staff have already clarified this distinction in the FY 2006 Program Solicitation (NSF 05-612).

Reviewer Guidance

2. The use of a template and/or a checklist that is correlated to the Program Solicitation for reviewers and Program Officers would increase consistency in reviews and summaries (A.3).

Response: The Program Solicitation does describe important issues to be addressed by proposers and therefore by reviewers. Reviewers are presently instructed to use those criteria and provide comments as they apply to proposals under consideration. Within a panel, however, reviewers are selected for their range of expertise and ratings can vary because of the weights being assigned across various issues by panel members. Only some of these differences are reconciled during panel discussion. Although a checklist may provide the consistency, our experience is that reviewers may then only address those issues in a rather routine way rather than provide a holistic review of the proposal.

3. Program Officers are encouraged to provide clear and explicit guidance to reviewers about the criteria for intellectual merit and its implications for a particular solicitation. The review process would be better served if reviewers were provided exemplars of broad impact and intellectual merit reviews (A.2,4).

Response: In response to the recommendation made by this COV, the revised IMD Program Solicitation (NSF 05-612) describes which additional program-related review criteria should be considered under each National Science Board criteria. Specifically, … "Under the criterion of ***intellectual merit,*** reviewers will address goals and objectives, project evaluation, anticipated products, rationale, work plan, content and pedagogical strategies, assessment, and personnel. Under the criterion of ***broader impacts***, reviewers will address strategies for increased participation of underrepresented groups, professional development, caregiver and community involvement, and dissemination and implementation. Some of the goals and products may be addressed under *broader impacts*, as well."

In addition, at the start of each panel meeting, reviewers are reminded of these special criteria and are encouraged to address requests for clarification to the POs.

4. Prioritization of comments and issues of concern in the summaries for Principal Investigator(s) would improve the quality of the feedback (A.5).

Response: Instructions for writing panel summaries already include statements about emphasizing important issues that have resulted in the panel ratings. During panel orientation, reviewers are reminded of the importance of their comments in supporting the work of NSF (for making funding decisions and negotiating awards) and of the field (for refining the design/implementation of projects or developing a subsequent resubmission).

5. Greater emphasis on the delineation of a rationale for the proposed work and how it relates to other previous or current work in the field would enhance the quality and coherence of the proposal reviews and analysis (A.3).

Response. NSF requires that all proposals describe findings from related work that they completed with NSF support during the preceding five years. Several years ago, however, EHR developed a strong focus on the "cycle of innovation," requiring that proposals explicitly address relevant research and work in the field to demonstrate the potential impact of proposed projects for contributing to a growing knowledge base. This requirement plays out in the current IMD Program Solicitation in several ways. Those submitting "Learning

Progressions" proposals, for example, must outline "the theoretical basis for the proposed process and content strands and explain how the learning progressions, instructional materials modules for students, assessments, professional development models, and professional development materials are consistent with relevant theories of learning and appropriate for the selected grade bands." Those submitting instructional materials development proposals are required to "describe how the proposed work relates to, and builds upon, previous and ongoing efforts in the field and reference relevant literature to indicate knowledge of disciplinary and pedagogical issues."

Panelist Selection

6. The COV would like IMD to pay attention to the following areas of concern (A.3,5):

a. It was noted that none of the reviewers on 2002 and 2003 panels were from industry. Given that a secondary effect of the IMD is to foster the next generation of scientists, mathematicians, and engineers that enter the industrial workforce, industry representatives should provide input to the K-12 education of their future employees.

b. A balance between university professors and practicing K-12 teachers on panels should be ensured.

c. Engineers and technology professionals should be adequately represented on future panels, including science and mathematics panels. And,

d. Consideration needs to be given to a selection of panelists representing divergent points of view about mathematics and science education.

Response: Panels generally include eight-to-ten reviewers who are chosen for their experience and expertise relevant to the proposals being considered and who represent, to the best of our ability, a balanced point of view about STEM education as aligned with standards developed by national professional organizations. Each proposal in a panel receives comments from about five reviewers. Although we expect reviewers to read all proposals assigned to their panel so they can contribute to the discussion.

Program staff will be mindful of the COV's suggestions to increase the number of people from industry and engineering professionals, and will be especially vigilant to ensure that panels include K-12 teachers to be sure that projects are grounded in practice.

Response to Proposals

7. Shorten the response time when it is known that a proposal will not be funded (A.7).

Response: NSF's goal is to process more than 70 percent of its proposal actions within six-months. IMD's dwell-time performance has improved consistently from 79 percent in 2002 to 92 percent in 2005. In 2005, this compares to 91 percent for the Division; 82 percent for the EHR Directorate; and 75 percent for NSF overall.

While this recommendation looks acceptable on the surface, it would be difficult to improve performance significantly from the current level. Moreover, for FY 2006, IMD has moved its full proposal submission date forward in order to alleviate workload pressure on POs who work across major Division programs. The IMD merit review panel meeting will be held in May 2006. Since awards must be made by mid-August to meet fiscal year processing requirements and negotiations take time, POs will have to begin work on awards first and interweave declines as appropriate.

Programmatic Concerns

8. Making a recommendation for new directions in programming, the COV noted the need for more materials focused on secondary physics, technology, and elements of mathematics that are necessary for success in science. A greater emphasis on projects that integrate mathematics and science would be welcome (A.4,14).

Response: Within the last few years, IMD has funded a number of comprehensive curricula in physics including --

Active Physics
Hands-On Physics
PRISMS
Minds-On Physics
Physics That Works
Constructing Ideas in Physical Science

In addition, two comprehensive, three-year science curricula have been funded for high schools in which physics either is taught in two single-semester courses or taught in part, in each of the three years. These curricula include:

Foundation Science - EDC
BSCS Science: An Inquiry Approach

An important innovation involving physics curriculum supported by IMD is the revision of *Active Physics* for improved implementation in the 9th grade and its use as the first year of a "Physics-Chemistry-Biology" curriculum sequence. This latter sequence responds to a growing perception that modern high school biology must move from the macroscopic to microscopic world. Understanding biology at the molecular level requires understanding the properties and structures of atoms and molecules (i.e., chemistry). Physics then becomes the study of macroscopic processes and the use of physical laws to reason about the world. This sequencing innovation allows physical principles to be taught with algebra, thus motivating students to learn mathematics because they see its utility and requiring students to wrestle in greater depth with fewer physics principles. In fact, the revision of *Active Physics* includes an option for a more mathematically intense version.

In view of other important issues facing the program, we think that the portfolio for secondary physics is sufficient at this time.

Some IMD Program Officers have been involved in discussions with various groups to consider courses that emphasize engineering design and other concepts. In the most recent Program Solicitation (NSF 05-612), knowing how to do engineering design is one of three areas of emphasis under a new "Learning Progressions" initiative that will be joint supported by the IMD and TPC programs. The integration of mathematics and science has little support in the disciplinary professional educator community because of the perception that mathematics would become the handmaiden of science and vice versa. Considerable experimentation with special attention to professional development issues is needed before moving far in the direction of integrating mathematics and science in the K-12 school curriculum. Examples are, however, found within the IMD portfolio. For example, IMD recently funded a Small Grant for Exploratory Research (ESI-0421887) to identify topics at the interface of biology, computational modeling, and mathematics that are suitable for introduction to the high school curriculum.

In subsequent solicitations, IMD will continue its practice of emphasizing that science materials should use the mathematics being learned within mathematics curricula, and that mathematics curricula should use content in science and technology as a context for learning mathematics.

9. The IMD program should continue to support development of technology education instructional materials in order to increase technological literacy for all, as well as to catalyze the development of the next generation of engineers and technologists. Instructional materials in technology education should be aligned with the *Standards for Technological Literacy: Content Standards for the Study of Technology* (A.4,14).

Response: Some IMD Program Officers agree strongly with this request. In the current solicitation, "Learning Progressions" for becoming competent in engineering design is one of three areas of emphases. Through the IMD program, NSF provided support for development of the *Standards for Technological Literacy: Content for the Study of Technology* by the International Technology Education Association. These standards provide a strong foundation for developing instructional materials and teacher education efforts.

10. The IMD program should also support the development of instructional materials in the area of education technology (sometimes called information technology). Students should be literate in the use of information technologies such as home computers, handheld computers, Internet, and e-mail (A.4,14).

Response: The COV is correct in calling out the importance of promoting effective use of educational technologies within K-12 education. The IMD portfolio does contain some thoughtful uses of education technologies. In the last year, for example, IMD supported an award to the National Research Council to update its monograph, *Being Fluent With Information Technology* (ESI-0437462), which addresses issues related to what all students should know and be able to do in information and communications technology by the time they leave high school. This award was co-funded by the Information Technology Experiences for Students and Teachers (ITEST) program, which is supported out of H1-B Visa Fees. *Being Fluent* recommends that all courses contain contemporary skills, fundamental concepts, and intellectual capabilities. We think that the education technologies used in STEM courses ought to engage students in developing competencies in technologies that will continue to be useful to them. Among the issues that students need to understand is how to assess the quality and accuracy of materials on the Internet and how to operate information systems in a secure manner.

Other innovative projects, awarded during the period under consideration by this COV also have potential for broad impact. These projects include:

- *Foundational Tools for Data Literacy* (ESI-0242626) is developing age-appropriate data tools to help children build sustainable knowledge about measurements and statistics.
- *Molecular Logic: Bringing the Power of Molecular Models to High School Biology* (ESI-0242701) uses powerful tools that build on molecular physics to help students reexamine chemical and biological phenomena.
- *CENSNet: An Architecture for Authentic Web-based Science Inquiry in Middle and High School* (ESI-0352572) builds on a $20 million NSF Science and Technology Center that has created an extensive, ecosystem monitoring network allowing remote investigations of the James Reserve in California. CENSNet adds a developmentally appropriate educational interface and supporting materials to this major research effort that will eventually allow school children and their teachers to conduct investigations and inquiry in the same way and in the same environment as scientists.

Impact

11. The COV made a number of recommendations that stressed the importance of impact studies on assessment of the effectiveness of supported materials across a variety of dimensions, including market penetration.

a. The COV noted the need for more impact studies so the result of the funding on the goals of impact and excellence are clear (A.4.14) and that the focus of IMD should move toward impact and concern itself less with the launching of new materials. The COV recommends the leveraging of existing materials by initiating more impact studies and implementing the findings from those studies (A.5.4).

b. Relatedly, the COV recommended that IMD undertake studies that provide evidence of the impact of funded programs that have had sufficient time to penetrate the field. The range of studies could include both quantitative data that consider total number of books sold, number of programs, teachers, and districts, as well as student achievement indicators and data, whenever possible. The COV stated that there is also a need for implementation studies capable of providing deep analysis of the fidelity of implementation, effectiveness of materials in diverse contexts, and of contextual issues (e.g., variance in state standards and frameworks, funding, teacher content knowledge and experience) (C.4,1).

Response: There is no argument about the importance to NSF of studies on the implementation and impact of instructional materials developed with its support. With respect to quantitative data on student performance, it should be noted that developers must obtain data on student learning in pilot tests (to engage assistance of master teachers in refining design for classroom use) and field tests (to determine the effectiveness of materials in a variety of contexts [urban versus rural, resource rich versus resource poor schools], with students of varying learning styles, and teachers of varying disciplinary and instructional preparation). Pilot and field tests are equivalent to *Phase 1* and *Phase 2* trials in medical studies. A *Phase 3* trial can only be conducted when materials are used on a wide scale and after teachers have a reasonable amount of experience in using them.

The COV may be unaware of some of the third-party studies that have been conducted around IMD-supported materials. Notable examples are:

- **Tri-State Achievement Study**, conducted by the Consortium for Mathematics and its Applications (ESI-0306474, ESI-9729328), examined performance of three NSF-supported elementary mathematics curricula (*Math Trailblazers; Investigations in Number, Data, and Space; and Everyday Mathematics)* using state-mandated, standardized tests in Massachusetts, Illinois, and Washington. Tests were administered in Spring 2000 to just over 100,000 students, about one-half of whom had studied with the curricula for at least two years and the other one-half (from matched comparison schools) who had not used the curricula. Results showed that elementary students taught with these curricula had higher mean scores (with statistical significance) than peers in control classrooms on the overall test, as well as on computation, measurement, geometry, probability and statistics, and algebra subcomponents. Results held for all racial and income subgroups, and across different state-mandated tests, including the Iowa Test of Basic Skills. Of 34 state-grade comparisons made—28 favored students using the NSF-funded materials, 6 showed no statistically significant difference, and none favored comparison students.

- **Has Inquiry Made a Difference? A Synthesis of Research on the Impact of Inquiry** (ESI-0101766), conducted by the Educational Development Center, is researching the impact of inquiry science on student outcomes as compared with that of other instructional strategies and approaches. The project identified 850 studies (many more than anticipated); reviewed and organized the studies into clusters; and coded and analyzed studies within and across clusters. Complicating factors for a meta-analysis of this scale stems from the variability in descriptions of interventions, outcomes, and research methodology, as well as ensuring that all included studies are represented in a fair and unbiased way. The project report is expected within the next few months and will be broadly disseminated.

- **Improving Mathematics Teacher Practice and Student Learning through Professional Development** (REC-0129398) is an Interagency Education Research Initiative (IERI) project awarded to the American Association for the Advancement of Science (AAAS). This project is studying four NSF-supported curricula (*Mathematics Applications and Connections*, *Mathematics in Context*, *Connected Mathematics*, and *MathThematics*) that earned high ratings on instructional criteria found to demonstrate explicit and high quality support for effective teaching toward the learning goals examined by Project 2061 (AAAS, 2000). The IERI project is investigating the extent to which these materials contribute to teacher knowledge and influence teacher practice, as well as how teachers' use of the support provided in the materials relates to student learning. Models of professional development and student learning are being analyzed in selected school districts in Texas and Delaware.

- From 1994-2002, NSF's Teacher Enhancement program supported a Local Systemic Change (LSC) initiative intended to assist school districts and their partners in reforming science and mathematics education, grades K-12, through professional development of entire instructional workforces. Over the years, LSC projects have expanded collection and analysis of student achievement data. One large-scale study, a doctoral dissertation in Philadelphia and its suburbs, investigated mathematics learning at a high school near in the Philadelphia suburbs that simultaneously adopted a block schedule and implemented the *Interactive Mathematics Program (IMP)*, an NSF-supported curriculum. A number of prior research studies at sites where block schedules were adopted without changes to mathematics curriculum and instruction have shown declining mathematics achievement. By contrast, this study showed that joint implementation of a block schedule and the *IMP* curriculum, with extra time allocated to planning and staff development, resulted in improvements in student mathematics achievement. In 2005, a supplement to an LSC project in Minneapolis, led to a Small Grant for Exploratory Research, jointly funded by IMD and the TPC programs, to compare performance in college-level mathematics courses of students who studied with NSF-supported materials, as compared with those who had not. This study is still underway.

- In 2005, IMD funded a study through its relatively new applied research focus. *A Longitudinal Comparison of the Effects of the Connected Mathematics Program and Other Curricula on Middle School Students' Learning of Algebra* (ESI-0454739) is a controlled, randomized study researching similarities and differences between the intended treatment of algebra in *Connected Math (CMP)* curriculum and non-*CMP* curricula; key features of *CMP* and non-*CMP* experiences for students and teachers; and similarities and differences in performance on a broad spectrum of mathematical thinking and reasoning skills, with a focus on algebra. The skills and concepts to be assessed are conceptual understanding and problem solving; algebraic manipulative skills; as well as solution strategies, representations and mathematical justifications.

Several years ago, in order to get a handle on the extent, quality, and future need of impact studies, IMD funded the report, *On Evaluating Curricular Effectiveness: Judging the Quality of K-12 Mathematics Evaluations* (2004), which was prepared by the National Research Council's Mathematical Sciences Education Board and published by the National Academy Press (see http://www.nap.edu/catalog/11025.html). The study reports on the quality of evaluations of 19 mathematics curricula (13 supported by NSF's IMD program, six (6) commercially generated). The NRC Committee reviewed a total of 698 studies, categorizing them as historical (225), content analyses (36), comparative studies (95), case studies (45), and syntheses (16). A total of 147 met criteria set for consideration – 75 percent of which were NSF-supported. The report states that limitation on the number of studies and arrays of methods, as well as their uneven quality leads to inconclusive findings of effectiveness of any one individual curriculum. Important to the field is that the NRC identified elements and arrays of evaluation approaches that should be used to judge curricula effectiveness, as well as standards of evidence. For example, the three major components of evaluation are: (1) program materials and design principles; (2) quality, extent, and means of curricular implementation; and (3) quality, breadth, type, and distribution of student learning outcomes over time. The NRC notes that curriculum effectiveness needs to be ascertained through multiple methods of evaluation, each of which is a scientifically valid study, and that periodic syntheses of results across evaluation studies should be conducted. The NRC stated that responsibility for curricula evaluation should be shared by three primary bodies -- federal agencies developing curricula, publishers, and state/local agencies.

It should also be noted that IMD's Program Solicitation for FY 2006 identifies research related to adoption and implementation of existing sets of instructional materials as a priority area under the "Applied Research" component.

The COV also recommended support of data collection on the adoption of curricula, specifically through information on the number of books sold. Such data are very difficult to obtain because most publishers consider the information proprietary, fearing that their competitors will use it to advantage. Even in cases where our PIs, as authors, are provided sales data from publishers, the data may not be indicative of impact because no one can be certain that materials are being used as opposed to being stored or left wrapped in classrooms. In spite of these difficulties, the Dissemination and Implementation Sites funded by IMD in the late 1990s used a variety of approaches to collect related data and devoted considerable effort in developing reasonable estimates on market penetration for materials developed with NSF support. Program staff think it unfortunate that these projects cannot be renewed. The lapse of these projects has resulted from a combination of reasons ranging from budget reductions in the IMD program itself, to a concern over the distinction between building awareness of our materials and appearances that NSF might be taking an active role in their "marketing**."**

It should also be noted that there are other avenues for exploring the impact of NSF-supported materials, including doctoral dissertations and studies that are part of other, large research agendas. The US Department of Education (DoED), for example, supports such work. At the University of Missouri-Columbia, where the NSF-supported CLT Center is studying mathematics curricula, DoED has funded Drs. Barbara Reys (CLT PI), Robert Reys, and James Tarr to conduct a six-state, longitudinal study of students, grades 6-8, some of whom are in schools using NSF-supported materials and others in schools using commercially generated materials. This research focuses on the extent to which teachers are using their district-adopted mathematics texts; the instructional methods these teachers are employing; and the resulting impact on student learning. Data have been collected and analyzed; reports should be released in late 2005. IMD is encouraging researchers to avail themselves of opportunities within DoED research programs.

For the IMD program, the tension between support for development, implementation, and impact studies does, however, remain a major issue. IMD staff, however, strongly believe that the program cannot abandon its support of the development of materials. A not inconsequential by-product of which is maintaining and strengthening the national cadre of experts (in curriculum design, content, pedagogy, cognitive science, assessment, education research, education technologies, etc.) capable of creating high quality materials. The level of resources (intellectual and financial) required for such development is well beyond that available to most states and certainly to local districts. These materials—created in collaboration with disciplinary and education experts, rigorously tested, and designed to align with standards developed by national professional organizations and states—are explicitly created for adoption and subsequent adaptation by school districts nationally.

For the foreseeable future, however, budgetary constraints will limit efforts in all areas. To the extent possible, IMD will look for opportunities to develop synergistic efforts with other NSF programs (e.g., TPC) and make every effort to accumulate knowledge about impact and studies that speak to the effectiveness of the materials, as well as to disseminate these results to the field.

12. The COV recommends that a series of studies be undertaken that draw from the knowledge and experience of teachers' use of the NSF materials. The various studies could focus on the effectiveness of the teacher support materials and teacher content knowledge; professional development structures and mechanisms required or absent for successful implementation; fundamental assertions about knowledge and

cognition that frame the materials; and connections/disconnections with respect to both teacher practice and student understandings of how and what to know (C.3,1).

Response. The COV raises an issue of importance to both the IMD and TPC programs, highlighting the need to inform both development of teacher guides that accompany curriculum and professional development strategies that would prepare teachers for implementing curriculum. Within IMD, the former Teacher Enhancement, and the current Teacher Professional Continuum program portfolios, a number of examples exist and more work needs to be done.

A special IMD initiative, Intermediate Grades Science Instructional Materials, supported three comprehensive materials development projects, grades 6-11, that address several of the issues raised here. One project, *Foundation Science: A Comprehensive High School Curriculum* (ESI-0439443), was recently awarded a supplement from the TPC program to develop an assessment of teacher knowledge requisite to the content of the curriculum and to provide on-line professional development to help teachers learn that content. An important article deriving from work supported by NSF is, *Designing Educative Curriculum to Promote Teacher Learning,* by Elizabeth A. Davis and Joseph S. Krajcik (see *Educational Researcher*, Volume 34, No. 3). Educative curriculum materials, grades K-12, are those that promote both teacher and student learning. This article sets forth a set of heuristics meant to further principled design of these materials that build on ideas about teacher learning and are organized around important aspects of teachers' knowledge base (i.e., subject matter knowledge, pedagogical content knowledge for topics, pedagogical content knowledge for disciplinary practices). The heuristics serve as cognitive tools situated in teachers' practice and are informing development of teacher guides for some of the newer curricula under development.

The FY 2006 IMD Program Solicitation contains the IMD-TPC supported initiative on "Learning Progressions" that includes not only development of instructional materials, but also professional development strategies for educating teachers to think in terms of progressions of learning that take place over several school years as students become more proficient in processes and more sophisticated about the content.

13. It is recommended that NSF support a series of forums or mechanisms that focus on the teaching and learning of science. Such an endeavor can bring to the public forum key issues and concerns about science education, state standards and policies, and standards based instructional materials, including inquiry-based materials. Proceedings and findings could be made available to the field and disseminated to a broader public audience. (C.3,2)

Response. All formal education programs within ESIE support conferences, special studies, and meetings of Principal Investigators that share ideas and findings important to the IMD program. Over the past year, the Division re-energized its efforts for disseminating research to practice to a variety of audiences (e.g., practitioners, administrators, policy makers, education researchers). Some efforts that relate directly to this recommendation have been implemented through support provided to the National Research Council. The NRC Board on Science Education, for example, has conducted a study on *Science Learning, Kindergarten through Eighth Grade* (ESI-0348841). In another recently completed study, *America's Lab Report: Investigations in High School Science* (ESI-0102582), the NRC examined the current status of science laboratories and developed a vision for their future role in high school science education. Yet another report, *Designing Quality Science Assessment Systems,* was prepared by the NRC Board on Testing and Assessment to set guidelines for developing science assessments that meet requirements of *No Child Left Behind*, and provide measurement of student understanding of how science is done. This report recommended the “Learning Progressions” initiative highlighted earlier.

The Centers for Learning and Teaching (CLT) program also supports development of learning communities and serve as vehicles for disseminating issues important to IMD. One of the major goals of the CLT program is to research critical issues facing science, mathematics, and technology education, grades K-12. Within the program portfolio, two Centers focus directly on development, implementation, and evaluation of instructional materials: The *Center for the Study of Mathematics Curriculum* (ESI-0333879) at the University of Missouri-Columbia and the *Center for Learning and Teaching with a Focus on Research for Developing Instructional Materials in Science* (ESI-0227557) at the AAAS. A third Center, the *Center for Assessment and Evaluation of Student Learning* (ESI-0119790), at WestEd addresses the need for increasing assessment capacity across the K-12 science education enterprise. Thus, research from these CLTs will also inform future development of IMD program efforts.

14. The COV recommends that IMD develop statistics about impact for completed funded programs and that these statistics be summarized for future COV panels. For example, how many copies of curricula have been sold, how many schools/teachers/ students/districts use these materials? How many hits does major IMD-supported Web sites get every year? What is the evidence for improved learning with these materials, especially compared to previously used materials? (C.4,1)

Response. As noted earlier in this report, IMD staff believe that impact data on instructional materials is important, but serious impediments exist to obtaining them (e.g., cost of studies, proprietary information of publishers). Previously funded "Dissemination and Implementation Sites" had been collecting these data, as well as relevant research studies. All IMD-supported materials development projects are required to conduct field tests and develop data for evidence of improved student learning. These data are used by the projects for revising materials, as well as publishers in marketing them. The limitations of these data, however, are that they are collected by PIs to inform development and thus lack the objectivity and robust research design needed as verifiable and valid studies. Discussion in the Program has focused on whether each project should be required to maintain a Web site that contains data on evidence for student learning. They could also post, at least, anecdotal evidence of use. The program will, however, be sensitive to the need to synthesize and present the information that is available (on adoption and implementation, research studies, Web site hits, etc.) and present it to future COVs

Suggested Improvements to the COV Process

15. Include all funded abstracts for all 3 years (C.5,1).

Response. The program appreciates that a list of abstracts would provide relevant information to the COV on the most recent additions to the program portfolio and provide signals as to programmatic directions being taken. Given electronic systems now available, this can easily be done. The program will provide abstracts for the three-year period being reviewed by future COVs.

16. The COV made several comments related to making its job easier. It requested that: (1) all pages in a tab be given sequential numbers to facilitate discussion of particular documents (C.5,2) and (2) relevant information (e.g., awards to new investigators (A.4,7) for completing the COV review be made easier to find by correlating it in an index or table of contents. While backup material did provide much relevant information, references and indexing would have been helpful (C.5,3). And, (3) COVs should be given written explanation of all non-obvious abbreviations as part of the reviewer package (C.5,5).

Response. The work required of a COV is daunting given the finite time available to conduct the review. The COV should expect that care be given to alignment of data to the COV Template; to the organization of those data to facilitate their use; and explanations of acronyms. The Division will ensure that particular attention is paid to this by IMD and all programs for future COVs and will critically look to developing standardization of procedures across programs for accomplishing this goal.

17. Provide relevant information for all three years, not just two of the three. For example, IMD provided tables of panel distributions by gender, race, geographic diversity, and type of institution for 2002 and 2003, but not 2004 (C.5,4).

Response. Assessing diversity and representativeness of review panels is an important responsibility that NSF entrusts to COVs. Data should have been provided to the COV for reviewers used during the October 2001 panels; panel information was not provided for 2004 because proposals processed from that panel will fall under the program's next COV.

18. In the NSF response to the COV, clearly delineate (by bolding, quotation marks, or other means) COV comments from NSF staff responses. In the NSF staff response to the 2002 COV, it was sometimes difficult to determine if comments were those of the COV or the NSF response. For example, on page 6 of the staff response, the last full paragraph is a COV comment, but appears in the response to be due to NSF staff. (C.5,7)

Response: This suggestion is incorporated in this response by bolding and numbering each recommendation and labeling the response.

IN CONCLUSION: The IMD program staff thank the COV for their careful work. We appreciate their praise and their thoughtful recommendations. The recommendations have been carefully considered and will form the basis for future decisions. As indicated earlier in this document, the program believes that top priority should be on developing new instructional materials and related teacher professional development approaches that investigate how best to incorporate recent advances in cognitive science. Our intent is to create curriculum that helps students obtain a coherent and comprehensive understanding of STEM disciplines and how they are studied. Projects will continue to collect data on student learning and changes in teacher practice. Third-party studies on impact and implementation will continue to be funded, but budgetary restraints will limit these inherently costly and complex efforts.