MEMORANDUM

DATE: December 21, 2005
TO: Bernice Anderson**,** Senior Advisor on Evaluation
Directorate for Education and Human Resources
FROM: Larry Suter
Division of Research, Evaluation and Communication
SUBJECT: COV for [enter program name]
COI and Diversity Memo

The Committee of Visitors report for the __ROLE Program was approved at the EHR Advisory Committee meeting held at NSF on November 2, 2005. The COV consisted of seven members selected for their expertise related to the goals of the program. They provided a balance with respect to the type of institutions supported through the program, gender, and representation from underrepresented groups. The following table shows the main features of the COV's diversity.

Category of COV Membership	**No. of COV Members in Category**
Member of EHR Advisory Committee……..	……..
Institution Type:	
❑ University……	…5…….
❑ Four-year College……	…1…….
❑ Two-year College……	……..
❑ K-12 School or LEA……	……..
❑ Industry……..	……1…….
❑ Federal Agency……	……..
Location	
❑ East……..	……2……
❑ Midwest/North ……	……2……
❑ West……	……2……
❑ South……	……1……
Gender	
❑ Female……	…3…….
❑ Male……	…4…….
Race/Ethnicity	
❑ White……	……5……
❑ Black……	……2……
❑ Hispanic……..	……..
❑ Asian……	……..
❑ Pacific Islander……..	……..

The COV was briefed on Conflict of Interest issues and each COV member completed a COI form. COV members had no conflicts with any of the proposals or files. (or, if they did, use 'Proposals and files were not available to COV members in those cases where the member had a COI and members were not allowed to participate in discussions of actions with which they had conflicts.')

Executive Summary

The U.S. faces a crisis in science and mathematics literacy. This crisis is as great as the nation faced when Sputnik was launched. However, now it is not just a race to the moon, but rather a race to continue to excel in the fields of science, mathematics and technology and to maintain the economic preeminence of the United States in a time of unprecedented intellectual competition from around the world. Other countries are succeeding in developing science and mathematics literacy in their children, youth and adults in ways that far exceed those of the United States. The critical need to improve science and mathematics literacy in the United States should transcend any methodological debates, political wrangling, and territorial fights among government agencies.

The Committee of Visitors (COV) believes that the Research on Learning and Education program (ROLE) is uniquely positioned to play a key part in funding research on science, technology, engineering, and mathematics (STEM) learning that will address the challenge that the U.S. faces to improve science and mathematics literacy in our country. However, ROLE needs to do a better job of synthesizing what has been learned from the research on STEM learning, teaching and assessment that has been funded (within NSF and elsewhere) and then figuring out how to get this message out to relevant audiences. In short, ROLE needs to communicate its mission and findings more clearly and it needs to present and market more clearly its research findings throughout the NSF and to the scientific community broadly defined.

The COV applauds what ROLE has accomplished in the short period of time it has been in existence. To date, ROLE has an impressive portfolio of funded projects. The COV salutes the program for funding a group of excellent and diverse researchers at various stages of their careers. In addition, ROLE does a good job of seeking out and forming partnerships with other groups within NSF. The COV urges ROLE to continue to develop such partnerships.

The COV appreciates ROLE's accomplishments and its choice to cast a broad net initially in looking at STEM learning and teaching. Given the nature of learning in mathematics and science, the COV recognizes the inclination for ROLE to include a wide range of issues and factors to be investigated. However, such an approach has resulted in a potpourri of projects funded by ROLE. These projects cover many topics at many different levels making it difficult to see how such disparate projects will yield a strong cumulative impact.

The COV sees a clear need for funding research on learning in the STEM disciplines and thus, ROLE has an important mission in this regard. ROLE should continue to focus on learning in the STEM disciplines. This program on STEM learning should be located in the National Science Foundation because the Foundation has unique access to disciplinary experts in mathematics, science and technology and because the scientific methods employed fit clearly with those of the National Science Foundation. ROLE is in a unique position to cultivate a group of scientists who, as result of their participation on panels, will develop and maintain an interest in research on learning in their disciplines.

ROLE needs to develop an infrastructure to enable clear and effective communication to various audiences: 1) other Directorates within NSF; 2) the Department of Education and NIH; 3) practitioners in the field; and 4) policymakers and other appropriate audiences. ROLE has not effectively communicated to others in a direct and strategic manner. It might be wise to acquire expertise in public relations to craft an effective message to the various audiences noted above.

Given limited resources, the COV concludes that ROLE will have the greatest impact if it narrows its focus in strategic ways. ROLE has a comparative programmatic advantage within the National Science Foundation as well within all federal agencies that fund education research. But ROLE

needs to position its portfolio so that it is distinctive from education research funded by the Department of Education and the National Institutes of Health. This is quite feasible given the distinctive nature of STEM learning research that should be done under the NSF umbrella.

In summary, the COV recognizes that ROLE has accomplished much in a short period. However, now is the time for ROLE to focus strategically. ROLE needs to initiate and sustain both external and internal conversations to discuss its mission, goals and strategies. Toward this end, ROLE might begin by convening an advisory panel of external experts to discuss where ROLE should target its efforts. ROLE staff should also initiate a series of internal conversations in which they seek to clarify, focus, and narrow the mission of ROLE. They also need to develop strategies for integrating the findings from the program's funded research and for effectively communicating and disseminating these results to audiences where they will have the greatest impact. ROLE has an important story to tell—we urge you to tell it as broadly as possible both in NSF and in the scientific community.

CORE QUESTIONS and REPORT TEMPLATE
for
FY 2005 NSF COMMITTEE OF VISITOR (COV) REVIEWS

Guidance to NSF Staff: This document includes the FY 2005 set of Core Questions and the COV Report Template for use by NSF staff when preparing and conducting COVs during FY 2005. Specific guidance for NSF staff describing the COV review process is described in Subchapter 300-Committee of Visitors Reviews (NSF Manual 1, Section VIII) that can be obtained at http://www.inside.nsf.gov/od/gpra/.

NSF relies on the judgment of external experts to maintain high standards of program management, to provide advice for continuous improvement of NSF performance, and to ensure openness to the research and education community served by the Foundation. Committee of Visitor (COV) reviews provide NSF with external expert judgments in two areas: (1) assessments of the quality and integrity of program operations and program-level technical and managerial matters pertaining to proposal decisions; and (2) comments on how the outputs and outcomes generated by awardees have contributed to the attainment of NSF's mission and strategic outcome goals.

Many of the Core Questions are derived from NSF performance goals and apply to the portfolio of activities represented in the program(s) under review. The program(s) under review may include several subactivities as well as NSF-wide activities. The directorate or division may instruct the COV to provide answers addressing a cluster or group of programs – a portfolio of activities integrated as a whole – or to provide answers specific to the subactivities of the program, with the latter requiring more time but providing more detailed information.

The Division or Directorate may choose to add questions relevant to the activities under review. NSF staff should work with the COV members in advance of the meeting to provide them with the report template, organized background materials, and to identify questions/goals that apply to the program(s) under review.

Guidance to the COV: The COV report should provide a balanced assessment of NSF's performance in two primary areas: (A) the integrity and efficiency of the ***processes*** related to proposal review; and (B) the quality of the ***results*** of NSF's investments in the form of outputs and outcomes that appear over time. The COV also explores the relationships between award decisions and program/NSF-wide goals in order to determine the likelihood that the portfolio will lead to the desired results in the future. Discussions leading to answers for Part A of the Core Questions will require study of confidential material such as declined proposals and reviewer comments. *COV reports should not contain confidential material or specific information about declined proposals.* Discussions leading to answers for Part B of the Core Questions will involve study of non-confidential material such as results of NSF-funded projects. It is important to recognize that the reports generated by COVs are used in assessing agency progress in order to meet government-wide performance reporting requirements, and are made available to the public. Since material from COV reports is used in NSF performance reports, the COV report may be subject to an audit.

We encourage COV members to provide comments to NSF on how to improve in all areas, as well as suggestions for the COV process, format, and questions.

FY 2005 REPORT TEMPLATE FOR
NSF COMMITTEES OF VISITORS (COVs)

Date of COV May 26-27 2005
Program/Cluster: ROLE
Division:
Directorate: Education and Human Resources
Number of actions reviewed by COV[1]: Awards: 35 Declinations: 14 Other:
Total number of actions within Program/Cluster/Division during period being reviewed by COV[2]: Awards: Declinations: Other:
Manner in which reviewed actions were selected: **Random selection by Program Officer**

PART A. INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

Briefly discuss and provide comments for *each* relevant aspect of the program's review process and management. Comments should be based on a review of proposal actions (awards, declinations, and withdrawals) that were *completed within the past three fiscal years*. Provide comments for *each* program being reviewed and for those questions that are relevant to the program under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

A.1 Questions about the quality and effectiveness of the program's use of merit review procedures.

Provide comments in the space below the question**.** Discuss areas of concern in the space provided.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCEDURES	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE[3]

[1] To be provided by NSF staff.
[2] To be provided by NSF staff.
[3] If "Not Applicable" please explain why in the "Comments" section.

1. Is the review mechanism appropriate? (panels, ad hoc reviews, site visits) Comments: There was some unevenness in the sample of individual reviews examined by the COV. Members of the COV stressed the need for preparation of reviewers and wondered if the ROLE leadership would want to establish online training for first time reviewers that would include expectations and models of good reviews. The COV suggests that ROLE continue to explore this.	Yes, in principle
2. Is the review process efficient and effective? Comments: The review process is efficient. Outcome data are not yet available for many of the funded projects, therefore effectiveness is difficult to assess.	Yes
3. Are reviews consistent with priorities and criteria stated in the program's solicitations, announcements, and guidelines? Comments: The scope of ROLE is extraordinarily broad and allows for the inclusion of a wide variety of proposals that vary in quality.	Yes
4. Do the individual reviews (either mail or panel) provide sufficient information for the principal investigator(s) to understand the basis for the reviewer's recommendation? Comments: Our experience with the sample we reviewed indicates that individual reviews were uneven. In some cases they were very detailed and helpful, and in other cases they were cursory and less helpful.	Yes
5. Do the panel summaries provide sufficient information for the principal investigator(s) to understand the basis for the panel recommendation? Comments: From the sample of proposals we reviewed, there is enough information.	Yes

6. Is the documentation for recommendations complete, and does the program officer provide sufficient information and justification for her/his recommendation? Comments: In many cases, there was extensive and useful email between PI and program officer. The comments of the program officers were informed and extensive, and in many cases focused proposals and improved their quality.	Yes
7. Is the time to decision appropriate? Comments: Excellent; turn around time has always been expeditious and has even improved.	Yes

8. Discuss any issues identified by the COV concerning the quality and effectiveness of the program's use of merit review procedures:

See item 1. Several copies of excellent and inadequate reviews should be provided to potential reviewers as guidelines. The COV endorsed continuing the practice of combining new and experienced ROLE reviewers on each panel.

While the majority of the COV favors the current practice of utilizing rotating membership on review panels, we concluded that there would be value in providing panel members with more guidance about the type of review that is most helpful.

A.2 Questions concerning the implementation of the NSF Merit Review Criteria (intellectual merit and broader impacts) by reviewers and program officers.

Provide comments in the space below the question. Discuss issues or concerns in the space provided.

IMPLEMENTATION OF NSF MERIT REVIEW CRITERIA	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE[4]
1. Have the individual reviews (either mail or panel) addressed both merit review criteria? Comments: Individual reviews usually address the criteria, but not always effectively, especially in the area of broader impact. Over the years in which ROLE has existed, there has been improvement in broader impact statements in the proposals.	Yes
2. Have the panel summaries addressed both merit review criteria? Comments: The panel summaries have been of high quality throughout the ROLE funding period, and they address both criteria.	Yes
3. Have the *review analyses* (Form 7s) addressed both merit review criteria? Comments: In many cases, the program officers provided helpful additional information beyond that provided by the panel summary. In other cases, however, the analysis was a repetition of the panel review summary. Often these repetitions were all that were needed given the quality of the summary.	Yes

[4] In "Not Applicable" please explain why in the "Comments" section.

4. Discuss any issues the COV has identified with respect to implementation of NSF's merit review criteria.

See 3 above. Both PI's and reviewers tend to address both criteria although discussions of broader impact pose considerable challenges for some PI's.

The COV suggests that ROLE devote more attention to describing the broader impacts it seeks. It could then use these descriptions to guide PI's and reviewers. This additional attention to broader impacts by ROLE might also help address questions raised below about the focus of the program.

A.3 Questions concerning the selection of reviewers. Provide comments in the space below the question. Discuss areas of concern in the space provided.

SELECTION OF REVIEWERS	YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE[5]
1. Did the program make use of an adequate number of reviewers? Comments: There were an adequate number of reviewers for each proposal.	Yes
2. Did the program make use of reviewers having appropriate expertise and/or qualifications? Comments: Based on information provided by the program officers, the composition of the individual panels seems to reflect an appropriate range of expertise and disciplinary backgrounds.	Yes
3. Did the program make appropriate use of reviewers to reflect balance among characteristics such as geography, type of institution, and underrepresented groups? Comments: With respect to geography and type of institution, there appeared to be appropriate balance. It was much more difficult to determine the balance of underrepresented groups.	Yes

[5] If "Not Applicable" please explain why in the "Comments" section.

4. Did the program recognize and resolve conflicts of interest when appropriate? Comments: They deal with this well.	Yes
5. Discuss any issues the COV has identified relevant to selection of reviewers. See above.	

A.4 Questions concerning the resulting portfolio of awards under review. Provide comments in the space below the question. Discuss areas of concern in the space provided.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE[6], OR DATA NOT AVAILABLE
1. Overall quality of the research and/or education projects supported by the program. Comments: Projects were often funded even after reviewers raised serious questions about the conceptualization, the design, and/or the methods of analysis. Based on the sample of funded projects that the COV reviewed, the COV concluded that ROLE seems to fund a range of projects of mixed quality on a wide variety of topics. The COV did see a substantial difference in quality between the funded projects and those that were declined. The funded projects were clearly higher in quality. The COV raised questions about the relationship of workshops and conferences to the research portfolio. In addition the COV wondered about the value and cost of some of these meetings.	Uneven
2. Are awards appropriate in size and duration for the scope of the projects? Comments: The program officers seemed to be expressing appropriately their independent views about both the size and duration of individual projects.	Appropriate
3. Does the program portfolio have an appropriate balance of: • High risk projects? Comments:	Data not available
4. Does the program portfolio have an appropriate balance of: • Multidisciplinary projects? Comments: Given the nature of the studies, there were a high number of multidisciplinary projects. This seems to be appropriate.	Data not available

[6] If "Not Appropriate" please explain why in the "Comments" section.

5. Does the program portfolio have an appropriate balance of: • Innovative projects? Comments: Many of the projects were innovative but it is difficult to judge whether the number is appropriate.	Data not available
6. Does the program portfolio have an appropriate balance of: • Funding for centers, groups and awards to individuals? Comments: This program primarily funds individuals.	Not applicable
7. Does the program portfolio have an appropriate balance of: • Awards to new investigators? Comments: In the past three years, it appears that about one-third of the awards have gone to new investigators. In addition, the ROLE program funds a large number of CAREER grants which are targeted for new investigators.	Yes
8. Does the program portfolio have an appropriate balance of: • Geographical distribution of Principal Investigators? Comments:	Yes
9. Does the program portfolio have an appropriate balance of: • Institutional types? Comments: Proposals from 191 institutions were listed, all but 29 were institutions of higher education, representing a variety of colleges and universities. Examples of the other 29 institutions include the American Library Association, the Exploratorium, the Department of Education and the American Statistical Association.	Yes

10. Does the program portfolio have an appropriate balance of: • Projects that integrate research and education? Comments:	See section C.
11. Does the program portfolio have an appropriate balance: • Across disciplines and subdisciplines of the activity and of emerging opportunities? Comments: The COV is concerned that the scope may be too broad.	Yes
12. Does the program portfolio have appropriate participation of underrepresented groups? Comments: Three underrepresented groups have proposal participation rates that meet or exceed the general population acceptance rate, except for the first year of the ROLE (2002). Native Americans have submitted proposals for three years and have not been successful, although the total number of submissions has been small. Composite (four years) underrepresented group participation rates are listed below by group: Native Americans –0% of 4 applications African Americans –20% of 48 applications Asian –19% of 61 applications Hispanic –20% of 48 applications (No data are available on applicants with disabilities).	Appropriate

13. Is the program relevant to national priorities, agency mission, relevant fields and other customer needs? Include citations of relevant external reports. Comments: The STEM learning, teaching and assessment issues addressed by the ROLE program are very much in line with strategic analyses of the state of scientific knowledge on mathematics and science learning and teaching. This includes areas where there are gaps in the knowledge base for mathematics and science that can yield near term benefits, as well as areas demanding a much longer horizon before the work achieves practical relevance because some critical but very basic scientific knowledge is lacking. The ROLE portfolio and priorities accords well with areas of strategic need identified in the following representative syntheses and reports: Donovan, S., & Pellegrino, J. W., (2004). *Learning and instruction: A SERP research agenda.* Washington, DC: National Research Council. Kilpatrick, J., Swafford, J., & Findell, B. (Eds.) (2001). *Adding it up: Helping children learn mathematics*. Washington, DC: National Research Council. RAND (2003). *Mathematical proficiency for all students.* Santa Monica, CA: Author.	Yes

14. Discuss any concerns relevant to the quality of the projects or the balance of the portfolio.

The scope of the funded research may be too broad. By focusing on such a wide variety of projects, ranging from f-mri studies of mathematical reasoning to administrative management of schools, the program may lose a center of gravity. This in turn translates into difficulties in explaining the core mission of the program and in making clear to the broader public the ways in which the funded research is helping advance science and mathematics literacy and career development in STEM areas. The COV suggests a more targeted focus that could be more easily communicated both to PI's and to the public.

At the same time the COV sees a clear need for funding research on learning and education within ROLE and NSF. There are considerable benefits to supporting research on the learning of science and mathematics within an organization that also advances fundamental knowledge in these disciplines. In addition, much of the research on learning and education is conducted using an array of scientific methods that conforms well with the mission of NSF.

It is important that the portfolio include research on STEM learning in community colleges where large numbers of our future teachers receive their only instruction in mathematics and science.

ROLE is to be congratulated for embracing both quantitative and qualitative research that is of high quality in almost all cases. It is important to recognize that multiple rigorous methods are necessary to yield results that can inform practice. Multiple methodologies should continue to be recognized by ROLE.

A.5 Management of the program under review. Please comment on:

1. Management of the program.

Comments: There are multiple components of program management that bear mention: (1) program announcement, (2) review process, and (3) interactions with PIs. All three areas of the program seem to be well managed and carefully executed. The program announcement clearly defines the scope of the research program, the areas of research to be addressed and the types of research and projects that are of potential interest. (However, see concerns about breadth raised throughout this report.) As noted in earlier sections, the grant review process is done in a careful and timely manner and the program officers provide a great deal of careful oversight of the process. Finally, the program officers seem to have a high level of professional interaction and collegiality with PIs as well as oversight of the individual projects in the portfolio. They help to insure that projects are on track and maintain a level of focus on the original goals of the proposed research.

2. Responsiveness of the program to emerging research and education opportunities.

Comments: The ROLE program seems to have assumed leadership within EHR with respect to research on learning and education, providing capacity to respond to major issues in STEM teaching and learning that are at the forefront of the field. In fact, they have defined a very broad portfolio of work that spans biological issues to organizational factors affecting STEM teaching and learning. Research done under the aegis of ROLE also seems to have served as an incubator for ideas and streams of work that led to the Science of Learning Centers. In addition, through their CAREER awards they have helped develop capacity in educational research. There is a downside, however, to the broad scope of the efforts they have taken on in the STEM educational research field. ROLE may have taken on too much and may be spread too thin for the size of the program and the funding resources available to it. Consequently, ROLE's impact is not as obvious as it might otherwise be. This is an issue for the future directions of ROLE as well as a broader EHR and NSF issue.

3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.

Comments: Given the current funding reductions it seems to the COV that it is critical to establish a process of internal prioritization that would maximize the effectiveness of ROLE.

In light of the need for focused and rational attention to STEM education, the COV urges ROLE to prioritize and publicize its efforts and results.

In developing its priorities it might be useful for ROLE to use the expertise of an external panel.

4. Additional concerns relevant to the management of the program.

The program does an excellent job of funding proposals from a diverse set of PI's across a wide geographic base and types of institutions. In terms of balance of research topics funded, there are concerns that the program tries to do too much and dilutes itself by not having more focus. There is a need to articulate more effectively the rationale for the core areas of research that the program seeks to fund. Program management should take a clear leadership role in articulating this mission and strategy. The COV considered the possibility that the focus should be on research that more directly addresses how to enhance the development of science and mathematics literacy especially in children and young adults.

PART B. RESULTS : OUTPUTS AND OUTCOMES OF NSF INVESTMENTS

NSF investments produce results that appear over time. The answers to the first three (People, Ideas and Tools) questions in this section are to be based on the COV's study of award results, which are direct and indirect accomplishments of projects supported by the program. These projects may be currently active or closed out during the previous three fiscal years. The COV review may also include consideration of significant impacts and advances that have developed since the previous COV review and are demonstrably linked to NSF investments, regardless of when the investments were made. Incremental progress made on results reported in prior fiscal years may also be considered.

The following questions are developed using the NSF outcome goals in the NSF Strategic Plan. The COV should look carefully at and comment on (1) noteworthy achievements of the year based on NSF awards; (2) the ways in which funded projects have collectively affected progress toward NSF's mission and strategic outcomes; and (3) expectations for future performance based on the current set of awards. NSF asks the COV to provide comments on the degree to which past investments in research and education have contributed to NSF's progress towards its annual strategic outcome goals and to its mission:

- To promote the progress of science.
- To advance national health, prosperity, and welfare.
- To secure the national defense.
- And for other purposes.

Excellence in managing NSF underpins all of the agency's activities. For the response to the Outcome Goal for Organizational Excellence, the COV should comment, where appropriate, on NSF providing an agile, innovative organization. Critical indicators in this area include (1) operation of a credible, efficient merit review system; (2) utilizing and sustaining broad access to new and emerging technologies for business application; (3) developing a diverse, capable, motivated staff that operates with efficiency and integrity; and (4) developing and using performance assessment tools and measures to provide an environment of continuous improvement in NSF's intellectual investments as well as its management effectiveness.

B. Please provide comments on the activity as it relates to NSF's Strategic Outcome Goals. Provide examples of outcomes (nuggets) as appropriate. Examples should reference the NSF award number, the Principal Investigator(s) names, and their institutions.

B.1 OUTCOME GOAL for PEOPLE: Developing "a diverse, competitive and globally engaged workforce of scientists, engineers, technologists and well-prepared citizens."

Comments:
The ROLE has made diligent strides in funding research that will serve many segments of the scientific, engineering, and general population. Currently, ROLE has the breadth in type of awards that range from individual research awards to workshop or conference awards. By definition, the research awards to individuals can be divided into research that can expand the work of scientists, propel a junior faculty member's research agenda, and concurrently develop knowledge for the development of well-prepared citizens.

ROLE is concerned with development of new scholars in several ways. First, the support of graduate students on projects orienting them to a culture of research on learning in the field of STEM education is an important priority. Second ROLE has become instrumental in providing new researchers with support for their work; 1/3 of awards have gone to new PIs. Third, ROLE provides new researchers with a venue for participation in the grant review process.

The sample of awards that we reviewed showed that most projects have an impact on the learning of citizens, and many projects have a direct impact on the learning of school children. Three examples of these awards are:

Kaput and Roschelle, "Understanding Classroom Interactions Among Diverse Connect Classroom Technologies," which deals with hand held PDA devices which are inexpensive and available to a large population of students;

Izsak, "Coordinating Students and Teachers Algebraic Reasoning," which is focused on the way that students and teachers worked together in addressing algebraic topics;

Ferrini-Mundy, "Knowing Mathematics for Teaching Algebra," which developed reliable and valid instruments to measure knowledge in large scale settings for teaching algebra among pre-service and in-service secondary school mathematics teachers.

B.2 OUTCOME GOAL for IDEAS: Enabling "discovery across the frontier of science and engineering, connected to learning, innovation, and service to society."

Comments: As noted above, some of the initial ROLE projects funded may well have inspired the Science of Learning Centers. In addition, several funded ROLE projects represent exciting new ideas that are likely to influence the effectiveness of education. For example, studies by John R. Anderson et. al., "Tracking the Course of Mathematical Problem Solving," have used eye-tracking methods to explore different components of mathematical skills involved in learning. These insights are now being merged with f-mri studies that provide converging sources of support for the idea of distinct mathematical skills and how they are involved in learning of mathematics. A second line of work is an educational exploration of the importance of relational knowledge and understanding as opposed to knowledge of features or elements. Vladimir Sloutsky's proposal,"Acquisition of Relational Concepts: Pathways to Proficient Thinking in Mathematics and Science," nicely takes prior research in this area and applies it to different content domains to ask how the role of relational concepts might vary across different aspects of science and mathematics. A third example is seen in conferences that promote new research programs and/or collaborations. For example, the conference organized by Duschl and Grandy on the nature of scientific inquiry, a topic that brings together several areas of cognitive science as well as educational researchers.

e.g. #0343196 Inquiry Conference on Developing a Consensus Research Agenda, Richard Dushl, Rutgers and Richard Grandy, Rice

Goal: To begin a scholarly dialogue about the nature of scientific inquiry that will help define a new interdisciplinary research agenda on science learning and reasoning goals for K-20 educational programs.

Dissemination: Proceedings of the conference of scholars from 1) learning sciences; 2) science studies; and 3) educational research will be published as an edited volume and made available as a CD. Also, presentations on outcomes will be given at AERA, National Association for Research in Science Teaching, and the History of Science Society.

B.3 <u>OUTCOME GOAL for TOOLS:</u> Providing "broadly accessible, state-of-the-art S&E facilities, tools and other infrastructure that enable discovery, learning and innovation."

Comments: Several grants in the sample provided evidence of the development of tools that provide "broadly accessible, state of the art Science and Engineering . . . tools …that enable discovery, learning and innovation."

1. Award 0434249 to Mary Jane Schultz, "Visualization in Science and Education" brought together participants in the 2001 and 2003 Visualization in Science and Education Gordon Conferences. The purpose of the meeting was to forge cross disciplinary ties and allow the 2003 participants to learn the practical lessons learned by the 2001 group. As the PI writes, "The practical lessons seldom make it into print, yet are critical for the optimum success of a project. " The purpose of the conference was "to ensure that the next generation of images is ever more effective at conveying the intended meaning." The project brought together scientists, acquiring the data and developing the models that enable them to know what cannot be seen. From that knowledge visualizations are created. The project then connects the work of the scientists to educators and cognitive psychologists. The cognitive psychologists help shape the visualization for the appropriate developmental stage of the audience. The third part of the project is the addition of educators capable of describing the impact of the visualizations "in the field" and "bringing the classroom to the table." The fourth group attending the conference is the evaluators who need to develop the tools to test the effectiveness of the visualization, asking if the correct message has been assimilated and whether the visualization tool facilitated the process. This combination of critical actors is ideal for understanding the learning process and providing critical information to individuals who can use it.

#0107032 – "Video Cases Online: Cognitive Studies of Preservice Teacher Learning "
Sharon Derry (Principal Investigator) – University of Wisconsin
Cindy Hmelo-Silver (Co-Principal Investigator) – Rutgers University

This program of experimental research, grounded in cognitive science theory about case-based learning and reasoning, is developing a pedagogy and theory of online video case study for teacher education. The research is conducted in the context of two innovative psychological foundations courses taught for teacher education majors at two major universities. Both programs use STEP Web, a professional development web site developed by the PIs for use in preservice secondary teacher education. STEP Web represents a hypermedia network of instructional resources designed to support teacher learning with video cases. The goal of instruction with STEP Web is to help teachers acquire instructionally relevant scientific knowledge about student learning and development. Using STEP Web as a test bed, the researchers have created and tested alternative theoretically motivated designs for online learning environments supporting video case study for pre-service teachers. They have conducted controlled studies examining how different learning-environment designs affect the individual and group learning processes of pre-service teachers, as well as the form and duration of teacher education students' case knowledge, and their abilities to combine and use that knowledge in reasoning about professional practice.

Workshop example:

0307027 Lane, Technology Assessment of Distance Learning Workshop

The purpose of the workshop was to assess the state of the art in distance learning technology. The goals of the project were to:

1. Assemble the leading thinkers in Distance Learning Technology to discuss the state of the art and best practices and their relationship to education and training;
2. Develop a research agenda for needed actions linking technology opportunities to ONR/NSF's strategic education and training objectives;

B.4 OUTCOME GOAL for ORGANIZATIONAL EXCELLENCE: Providing "an agile, innovative organization that fulfills its mission through leadership in state-of-the-art business practices."

Comments: Administration of the program has been greatly enhanced and streamlined by the use of Fastlane and other E-government standards. As a broadly defined program, ROLE is keenly aware of the need to be results oriented, especially in the current environment of high expectation created by its own success and reduced budget. The COV strongly believes that narrowing the scope of research will reduce the complexity of ROLE and will benefit the program overall.

PART C. OTHER TOPICS

C.1 Please comment on any program areas in need of improvement or gaps (if any) within program areas.

The COV concluded that the mission of ROLE as now conceived is far too broad to have strategic impact given the limited resources available. Currently, ROLE funds research that spans the gamut of very basic micro-level research on the biological bases of learning to macro-level research on policy and dissemination. In addition, the program supports multi-disciplinary work involving scholars from many disciplines that bear upon STEM education. These two aspects of the program result in broad representation of scholars across a number of domains and a broad array of research from basic to applied issues.

With limited resources, the COV recommends that ROLE will have the greatest impact if it narrows its focus in strategic ways, considering its comparative programmatic advantage within the National Science Foundation as well within all federal agencies that fund education research. For example, ROLE needs to position its portfolio of work so that it is distinctive from education research funded by the Department of Education and the National Institutes of Health. There is a clear need for a body of STEM learning research under the NSF umbrella that is not naturally supported by other agencies.

One way that ROLE might focus its work would be to fund only research that involves learning of science, mathematics and technology. The goal would be to fund field-initiated work from individual investigators that furthers the development of ideas, tools, and people in the field of the science of STEM learning. This would be distinct from Department of Education focus on the educational sciences, which is broader and centered on the formal educational system. In contrast, ROLE would fund research on STEM learning that might occur in multiple contexts, including communities, museums, and workplaces as well as more traditional educational settings. ROLE would also fund research on STEM learning across the lifespan—from young children to adults including teachers, parents, and adult learners in the workplace. However, ROLE would not fund research on major systemic issues of education policy or education reform unless tied directly to theories or research on human learning.

C.2 Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.

C.3 Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.

ROLE has funded innovative research in a variety of fields and disciplines; however, it does not appear that research outcomes are shared widely across the Foundation. For example, ROLE's leadership within EHR on research on learning and education has served as an incubator for ideas and streams of work that led to the Science of Learning Centers. Yet the COV found no evidence that research results from ROLE projects have been systematically shared with these Centers or with the Centers for Teaching and Learning. While individual program officers interact with colleagues from other directorates, it is only by chance that what is known about learning gets incorporated into the programs of these directorates. It is also not clear that NSF has a mechanism for wide dissemination of instructional materials, ideas and

tools that work. The COV believes that if NSF (and the education community) clearly knew the projects funded by ROLE and their implications, the total impact of NSF funding would be greater.
ROLE and EHR must lead conversations within the scientific community and the broader U.S. public about the importance of national science and mathematics literacy. The NSF directorates need better and more easily used information from EHR and ROLE about what works in mathematics and science classrooms.

C.4 Please provide comments on any other issues the COV feels are relevant.

The prior COV review requested a synthesis of findings from ROLE and related research. Such a synthesis would give this research greater impact. We did not find evidence that this synthesis had been undertaken and we again urge ROLE to do so.

See the COV 2002 report.

C.5 NSF would appreciate your comments on how to improve the COV review process, format and report template.

The COV would like to express its thanks to the excellent NSF staff work that allowed us to work efficiently. Materials were provided expeditiously and the NSF staff was available to answer our questions and provide essential additional information and background. We are grateful to them for the excellent work they are doing for science and for the nation.

SIGNATURE BLOCK:

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For the Research on Learning and Education (ROLE) COV

Susan C. Bourque
Chair

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