



Dealing with Intellectual Merit and Broader Impacts Criteria

Susan Burkett, Bev Watford, Dee Miller
Russ Pimmel, Barb Anderegg
Division of Undergraduate Education (DUE)

Stephanie Adams, Sue Kemnitzer
Division of Engineering Education and Centers (EEC)

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Caution

Most of the information presented in this workshop represents the opinions of the individual program offices and not an official NSF position.



NSF's Engineering Education Support

- NSF funds research and development proposals on engineering education
- Two main programs
 - EHR/DUE -- Course, curriculum and laboratory improvement
 - Deadline: 01/10/07 & ~ 5/07
 - ENG/EEC -- Engineering education research
 - Deadline: 8/15/07
- Others – check the NSF website



EHR/DUE's CCLI Program

Vision: Excellent STEM education for all undergraduate students.

Goal: Stimulate, disseminate, and institutionalize innovative developments in STEM education through the production of knowledge and the improvement of practice.

Components:

- Materials & pedagogy development
- Faculty development
- Implementation
- Assessment
- Research



ENG/EEC's Engineering Education Research Program

Vision: Basic understanding to enable the transformation undergraduate and graduate engineering education

Goal: Deeper understanding of how students learn engineering

Research Areas:

- Aims and objectives of engineering education
- Content and organization of the curriculum
- How students learn problem solving, creativity & design
- New methods for assessment and evaluation
- Attracting a more talented and diverse student body



Overview of Workshop

Goal:

To write more competitive proposals by properly addressing the review criteria

- Intellectual Merit
- Broader Impact
- Practical Aspects of the Review Process



Framework for the Workshop

- Learning situations involve prior knowledge
 - Some knowledge correct
 - Some knowledge incorrect (i. e., misconceptions)
- Learning is
 - Connecting new knowledge to prior knowledge
 - Correcting misconception
- Learning requires
 - Recalling prior knowledge – actively
 - Altering prior knowledge



Workshop Format

- “Working” Workshop
 - Short presentations (mini-lectures)
 - Group exercise
- Exercise Format
 - *Think → Share → Report → Learn (TSRL)*
- Limited Time – May feel rushed
 - Intend to identify issues & suggest ideas
 - No “answers” – No “formulas”
 - Raising awareness



Group Behavior

- Be positive, supportive, and cooperative
 - Limit critical or negative comments
- Be brief and concise
 - No lengthy comments
- Stay focused
 - Stay on the subject
- Take turns as reporter



Intellectual Merit –
Susan Burkett and
Stephanie Adams



Statement of Intellectual Merit Review Criteria

What is the intellectual merit of the proposed activity?

- How important is the proposed activity to advancing *knowledge and understanding* within its own field or across different fields?
- How well *qualified* is the proposer (individual or team) to conduct the project?
- To what extent does the proposed activity suggest and explore *creative and original* concepts?



Statement of Intellectual Merit Review Criteria (cont'd)

- How well conceived and *organized* is the proposed activity?
- Is there sufficient access to *resources*?



“Relative Ease Quotient”

What, in your opinion, is the easiest activity to address in a typical proposal? What is the most difficult?

- Advancing Knowledge and Understanding
- Qualifications of the team
- Creative and original concepts
- Well conceived and organized
- Access to resources



Scenario: Origin of a Curriculum Development Proposal

- ❑ *Prof X has taught Signal Processing at U of Y for several semesters.*
- ❑ *She has an idea for greatly improving the course by adding “new stuff”*
 - “New stuff”
 - Material (e. g., modules, web-based instruction)
 - Activities (e. g., laboratories, projects)
 - Pedagogy (e. g., problem based learning)
- ❑ *She has done some preliminary evaluation*
- ❑ *She decides to prepare a CCLI proposal*



Scenario: Professor X’s Initial Proposal Outline

- ❑ **Goals:** Develop “new stuff” to enhance student learning at U of Y
- ❑ **Rationale:** Observed shortcomings in educational experience of the students at U of Y and felt that *new stuff* would improve the situation
- ❑ **Project Description:** Details of “new stuff”
- ❑ **Evaluation:** Use U of Y’s course evaluation forms to show difference
- ❑ **Dissemination:** Describe “new stuff” using conference papers, journal articles, and web site



Exercise 1 Proposal Strategy

As a colleague, provide a few suggestions to guide Prof. X as she develops her curriculum development proposal



PD’s response Proposal Strategies

- ❑ Read the program solicitation
 - Determine how your ideas match the solicitation and how you can improve the match
- ❑ Articulate goals, objectives, & outcomes
 - Outcomes should include improved student learning
- ❑ Build on existing knowledge base
 - Review the literature
 - Present evidence that the “new stuff” is doable; will enhance learning; is the best approach
- ❑ Explore potential collaborations



PD’s response Proposal Strategies

- ❑ Use data to document existing shortcomings in student learning
- ❑ Describe management plan
 - Provide tasks, team responsibilities, timeline
- ❑ Provide clear examples of the approach
- ❑ Integrate the evaluation effort early
 - Build assessment tools around defined objectives and expected outcomes
 - Connect with independent evaluation experts



PD's response to Proposal Strategies

Identify strategies for dissemination

- Define a plan to contribute to knowledge base
- Address broader impacts
- Collaborate, form partnerships (build community)



Write Proposal to Answer Reviewers' Questions

What are you trying to accomplish?
What will be the outcomes?

} *Goals etc.*

Why do you believe that you have a good idea?
Why is the problem important?
Why is your approach promising?

} *Rationale*

How will you manage the project to ensure success?
How will you know if you succeed?

} *Evaluation*

How will others find out about your work?
How will you interest them?
How will you excite them?

} *Dissemination*



Goals → Objectives → Outcomes



Project Goals and Objectives

Defining Goals

Broad, overarching statement of intention or ambition

- A goal typically leads to several objectives

Sample Goal for Prof. X

The project is developing a signal-processing laboratory that is vertically integrated into the curriculum to illustrate theoretical concepts through application-driven exercises



Project Objectives

Defining Objectives

Specific statement of intention

- May be Measurable
- More focused and specific than goal



Exercise 2 Project Objectives

Activity

Write one or more objectives for this sample project goal

Sample Goal for Prof. X

The project is developing a signal-processing laboratory that is vertically integrated into the curriculum to illustrate theoretical concepts through application-driven exercises



PD's Response Sample Objectives

- Create laboratory exercises that give hands-on experience to enhance conceptual understanding
- Increase student retention rates (in program) because interest in topic is increased
- Increase retention of technical material for future courses
- Improve laboratory skills of students
- Improve student confidence or attitude about profession



Exercise 3 Expected Measurable Outcomes

Defining Outcomes

Statement of expected result

- Measurable with criteria for success
- An objective may lead to one or more outcomes

Activity

Write one or more expected measurable outcomes for this objective:

Increase student retention rates (in program)



PD's Response Expected Measurable Outcomes

Objective: Increase student retention rates

- Increase student graduation rates by _ percent
- Increase students' transition rates from first to second year courses from _ to _
- Increase the students' "Attitude towards discipline" as measured by surveys and interviews by _ percent



Project Rationale



Project Rationale

- Rationale is the narrative that provides the context for the project
 - It's the section that connects the "Statement of Goals and Outcomes" to the "Project Plan"
- What's the purpose of the rationale?
 - What should it contain?
 - What should it accomplish?
- What should an applicant include in their rationale?
 - What topics should a PI address?



Exercise 4 An Effective Rationale

Write a list of questions that the *Rationale* for a CCLI proposal should answer (pay particular attention to questions the reviewer will expect answered)

TSRL



PD's Response An Effective Rationale

- What does the knowledge base say about the approach?
 - What have others done that is related?
 - What has worked previously?
 - What have been the problems/challenges?
- Why is this problem important?
 - Is it a global or local problem?
 - What are the potential broader impacts?
 - How will it improve quality of learning?



PD's Response An Effective Rationale

- What is the evidence that the approach will solve the problem?
 - Address the defined outcomes?
 - Achieve the defined outcomes?
 - Improve student learning?
- What are alternate approaches?



PD's Response An Effective Rationale

- What are the potential problems & limitations?
 - What can be done about them?
- Has the applicant done prior work?
 - Has funded work lead to interesting results?
 - Are there any preliminary data and what do they show?



Project Evaluation Plan

- All proposals require an evaluation plan
- During the project, evaluation:
 - Monitors progress toward goals
 - Identifies problems
- At the end of the project, evaluation:
 - Tells you what you accomplished
 - Provides data for you to use in telling others



Exercise 5 Evaluation Plan

Read the sample *Evaluation Plan* and list suggestions for improving it



Sample Evaluation Plan

- Assessment of the Student Response Technology (SRT) will be both quantitative and qualitative. First, students will be surveyed at the end of the semester on the content, level of difficulty, and their perceived level of mastery of the concepts of Statics. Second, faculty members teaching the course using SRT will be asked to judge its effectiveness in monitoring student achievement throughout the semester. In addition, faculty members who have been teaching Statics courses for several years will be asked to compare students' abilities after using SRT with those in previous years who have not used SRT. Finally, the final grades of students using SRT will be compared with those from previous years who have not used the technology in the classroom.



PD's Response Evaluation Plan

- **Include formative assessment**
 - Provides feedback during the design and implementation phases
 - Helps monitor progress toward outcomes
- **Get help at the beginning –**
 - Involve an expert evaluator
 - Consider an outside (independent) evaluator
 - Size of budget
 - Importance of objectivity



PD's Response Evaluation Plan

Consult other sources

- = *NSF's User Friendly Handbook for Project Evaluation*
 - <http://www.nsf.gov/pubs/2002/nsf02057/start.htm>
- = Existing tools
 - Online Evaluation Resource Library (OERL)
 - <http://oerl.sri.com/>
 - Field-Tested Learning Assessment Guide (FLAG)
 - <http://www.wcer.wisc.edu/archive/cl1/flag/default.asp>
- Science education literature
 - *J. of Engineering Education*, Jan, 2005



PD's Response Evaluation Plan

- **Provide details on tools & experimental design**
 - Describe how
 - Students will be “surveyed”,
 - Faculty will be “asked”,
 - Grades will be “compared”
 - Indicate who will do these tasks
 - Indicate who will analyze and interpret the data
 - Try to measure deeper learning
 - Collect demographic data on student populations



PD's Response Evaluation Plan

- **Consider broadening the approach**
 - Examine effects on retention and diversity
 - Involve larger, more diverse populations
 - Collaborate



Broader Impacts – Bev Watford



Statement of Broader Impacts Merit Review Criteria

What are the broader impacts of the proposed activity?

- How well does the activity advance *discovery and* understanding while promoting teaching, training, and *learning*?

- How well does the proposed activity broaden the participation of *underrepresented groups* (e.g., gender, ethnicity, disability, geographic, etc.)?

- To what extent will it enhance the *infrastructure* for research and education, such as facilities, instrumentation, networks, and partnerships?



Statement of Broader Impacts Merit Review Criteria (cont'd)

- Will the results be *disseminated* broadly to enhance scientific and technological understanding?
- What may be the *benefits* of the proposed activity to society?



“Relative Ease Quotient”

What, in your opinion, is the easiest activity to address in a typical proposal? What is the most difficult?

- Discovery and Learning
- Broadening Participation
- Infrastructure enhancement
- Dissemination
- Societal Benefits



Effective Dissemination Plans

- Education proposals need a dissemination plan
- How does a proposal convince the reader (the reviewer or program director) that the project will:
 - “Contribute to the *STEM* education knowledge base”?
 - “Help build the *STEM* education community”?



Exercise 6 Effective Dissemination Plan

Read the sample *Dissemination Plan* and list suggestions for improving it



Sample Dissemination Plan

This project will serve as a pilot for other courses at the University of ____ and at other colleges and universities throughout the country. The results of our evaluation will be disseminated on the University's web site, which will contain a special page devoted to this NSF-sponsored project. Additional dissemination will occur through presentations at conferences, such as teacher education and science education conferences, regionally and nationally, and through articles published in peer-reviewed journals.



PD's Response Dissemination Plan

- Be more proactive in promoting website & materials
- Integrate community building, dissemination, and evaluation



PD's Response Dissemination Plan

- **Target and involve a specific sub-population**
 - Those who teach similar courses at other locations
 - Ask them to review various products, data, and approaches
 - Work with them to organize
 - Email exchanges and listserves
 - Informal meeting at a conference or on-campus
 - Faculty development workshops (on-campus and at conferences)
- **Explore beta test sites**



PD's Response Dissemination Plan

- **Be specific about how the project will serve as a “pilot”**
 - Strategy for evaluating and disseminating
 - Strategy for getting “buy-in” by others



PD's Response Dissemination Plan

- **Be more specific in publication efforts**
 - Indicate the specific conferences and journals
 - Include conference travel and journal page charges in budget
 - Include a tentative title & description of paper
 - Explore other venues
 - CUR (<http://www.cur.org/>), PKAL (<http://www.pkal.org/>), State Academy of Science meetings
 - Science news publication and lay press
 - Professional society and specialty listserves



PD's Response Dissemination Plan

- **Explore commercialization**
 - Discuss contacts with software and textbook publishers
- **Put material in a form suitable for the National Science Digital Library (NSDL)**



Exercise 7 - Review Proposal's Broader Impacts

Activity

Write the broader impacts section of a review

- Outline format



Sample Proposal

- Real proposal
 - Project Summary
 - Excerpts from Project Description

Assume

- CCLI/Phase 1
- \$150k (total) for 2 years
- Technical merit considered meritorious



PD's Response Review Comments

- **Scope of activities**
 - Overall-very inclusive and good
 - Well done but "standard things"
 - Did not address the issue of quality
 - No clear-cut plan
 - Activities not justified by research base
- **Dissemination**
 - Limited to standard channels
- Industrial advisory committee a strength



PD's Response Review Comments

- **Collaboration with other higher ed institutions**
 - Institutions appear to be quite diverse but use of diversity not explicit
 - Interactions not clearly explained
 - Sends mixed message – raises questions about partnership effectiveness
- **High school outreach**
 - Real commitment not evident
 - Passive -- not proactive
 - High school counselors and teachers not involved



PD's Response Review Comments

- **Modules are versatile**
- **Broader (societal) benefits**
 - Need for materials not well described
 - Value of the product not explained
 - Not clear who will benefit and how much
- **Assessment of broader impacts not addressed**



How would you rate this proposal?

- Excellent- 2 hands up
- Very Good- 1 hand up
- Good- 2 hands on head
- Fair- 1 hand on head
- Poor- forearms crossed



Exercise 8 - Enhancing Broader Impacts Effort

Activity

Identify additional or enhanced broader impacts activities that will strengthen the project



PD's Response Suggestions to Enhance

- **Make activities appropriate to project**
 - Establish a mentoring program for high school students
 - Use undergraduate students to interact with high school students
 - Connect to other projects if appropriate
- **Utilize entire PI team in development process**



PD's Response Suggestions to Enhance

- **Take better advantage of institutional diversity** (e.g., assessment of impacts of materials on diversity)
- **Improve Dissemination**
 - Add faculty workshops
 - Prepare exhibit for local museum



Exercise 9 - Characteristics of Broader Impacts Plans

Activity

Identify desirable features of a broader impacts plan or strategy



PD's Response Characteristics

- **Include strategy to achieve impact**
 - Have a well-defined set of outcome objectives
 - Make results meaningful and valuable
 - Make consistent with technical project tasks
 - Have detailed tasks for implementation and evaluation (did it work & why?)
 - Have a well stated relationship to the audience or audiences



PD's Response Characteristics

- **Don't use "tack on" evaluation and dissemination plans**
- **Investigate and discuss other broader impacts plans**
- **Include target group(s) in development**
- **Be creative!**



Summary

- **Use and build on NSF suggestions**
 - List of *categories in solicitations*
 - *Representative activities on website*
 - Not a comprehensive checklist
 - *Expand* on these -- be creative
- **Develop activities to show impact**
- **Integrate and align with other project activities**



Summary

- **Help reviewers (and NSF program directors)**
 - Provide sufficient *detail*
 - Include objectives, strategy, evaluation
 - Make broader impacts *obvious*
 - Easy to find
 - Easy to relate to NSF criterion



Summary

- **Make broader impacts *credible***
 - Realistic and believable
 - Include appropriate funds in budget
 - **Consistent with**
 - Project's scope and objectives
 - Institution's mission and culture
 - PI's interest and experience
- **Assure *agreement* between Project Summary and Project Description**



Review Process – Practical Aspects Dee Miller



Practical Aspects of Review Process

Reviewers have:

- **Many proposals**
 - Ten or more from several areas
- **Limited time for your proposal**
 - 20 minutes for first read
- **Different experiences in review process**
 - Veterans to novices
- **Different levels of knowledge in proposal area**
 - Experts to outsiders
- **Discussions of proposals' merits at panel meeting**
 - Share expertise and experience



Exercise 10 Practical Aspects of Review Process

Write a list of suggestions (guidelines) that a colleague should follow to deal with these practical aspects



PD's Response Review Process

- **Use good style (clarity, organization, etc.)**
 - Be concise, but complete
 - Write simply but professionally
 - Avoid jargon and acronyms
 - Check grammar and spelling
 - Use sections, heading, short paragraphs, & bullets (Avoid dense, compact text)
- **Reinforce your ideas**
 - Summarize them; Highlight them (bolding, italics)
- **Give examples**



PD's Response Review Process

- **Provide appropriate level of detail**
- **Pay special attention to Project Summary**
 - Summarize goals, rationale, methods, and evaluation and dissemination plans
 - Address intellectual merit and broader impacts
 - Explicitly and independently
 - Three paragraphs with headings:
 - "Summary"
 - "Intellectual Merit"
 - "Broader Impacts"



PD's Response Review Process

- ▣ Follow the solicitation and *GPG*
 - Adhere to page, font size, and margin limitations
 - Use allotted space but don't pad the proposal
 - Follow suggested (or implied) organization
 - Use appendices sparingly (check solicitation to see if allowed)
 - Include letters showing commitments from others
 - Avoid form letters



PD's Response Review Process

- ▣ Prepare credible budget
 - Consistent with the scope of project
 - Clearly explain and justify each item
- ▣ Address prior funding when appropriate
 - Emphasize results
- ▣ Sell your ideas but don't over promote
- ▣ Proofread the proposal
- ▣ "Tell a story" and Turn a good idea into a competitive proposal



Questions and Concerns During Proposal Preparation

- ▣ Read the solicitation and the *GPG*
- ▣ Get advice - NSF program directors & experienced colleagues
- ▣ "Imaginary panel" (Experts, novices, in-field/out)
 - How would they respond to a question?
 - How would they react to an idea? To a written section?
 - What else would they like to see?
 - What questions will they have?
- ▣ Use your judgment

Don't include a poorly developed section because someone told you that it is needed



References

Grant Proposal Guide

http://www.nsf.gov/pubs/gpg/nsf04_23/

Broader Impacts Activities

<http://www.nsf.gov/pubs/gpg/broaderimpacts.pdf>

A Guide for Proposal Writing

http://www.nsf.gov/pubs/2004/nsf04016/nsf04016_4.htm



Conclusion

Presentation at:

<http://www.nsf.gov/events/>

Read the solicitation!

Read the *GPG*!

Read the solicitation!

Read the *GPG*!
