Integrating educational outcomes with research in grant proposals

-*a researcher perspective*

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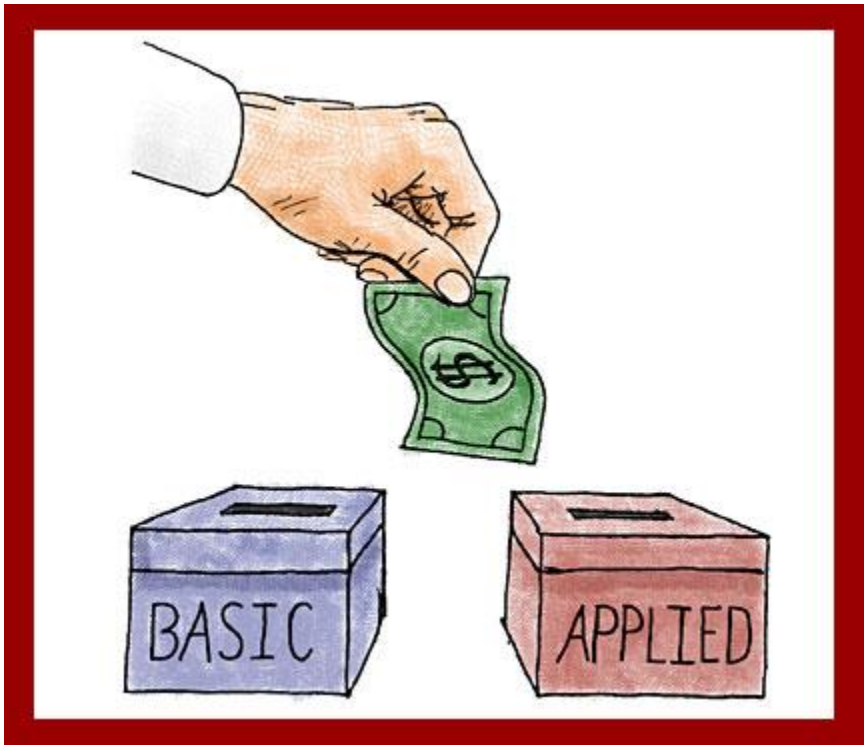
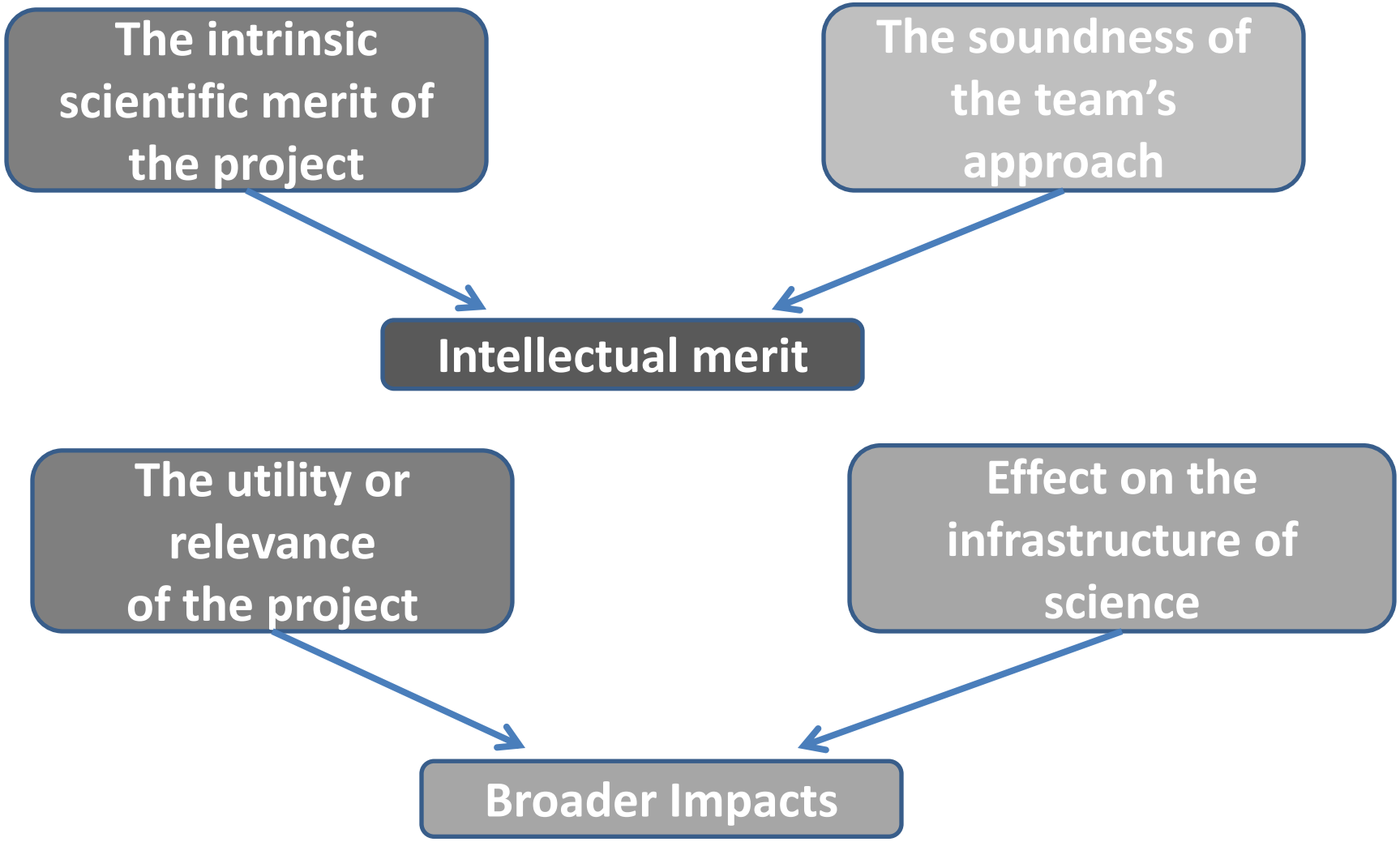
Outline

- Defining Societal Impacts
- Challenges
- Examples

Perception of Societal Impacts



Intellectual Merits & Broader Impacts



Educational Emphasis

- Tied into the “Broader Impact” section.
  - the potential of the proposed activity to benefit society and contribute to the achievement of specific, desired societal outcomes.

- “Broader impacts may be accomplished through the research itself, through the activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to the project.”

Broader Impacts includes…

1. Integrating research and education

2. Broadening participation of underrepresented groups

3. Enhancing infrastructure for research and education

4. Broad dissemination of scientific ideas and methods

5. Direct benefit to society

6. Increased partnerships between academia, industry, and other

7. Improved national security

8. Increased economic competitiveness of the U.S.

Integration of Research & Training

- **Advance discovery and understanding while promoting teaching, training, and learning**
  - Integrating research activities into teaching
  - Including students in research activities
    - High school students to postdoctoral fellow
  - Involve graduate and post-doctoral researchers in undergraduate teaching activities

Emphasis on Increased Participation

- **Broaden participation of under-represented groups -**by establishing collaborations with students and faculty from institutions and organizations serving women, minorities, and other groups under-represented in science.
  - Collaboration in active research projects
  - Research team presenting at the institutions

Infrastructure enhancement

- **Enhance infrastructure for research and education,**
  - by establishing collaborations with researchers in industry and government laboratories
  - developing partnerships with international academic institutions and organizations
  - building networks across U.S. colleges and universities

The Wine….

- **Broaden dissemination to enhance scientific and technological understanding**
  - by presenting results of research and education projects in formats useful to *students, scientists*, members of Congress, teachers, and the general public.

Economy and Security

- **Benefits to society**
  - when results are applied to other fields of science
  - technology to create startup companies
  - to inform public policy
  - to enhance national security

CHALLENGES: Emphasis on broader Impacts

- Are intellectual merit (IM) and broader impacts (BI) equally relevant?
  - PI perspective
    - Page restriction
      - Max 20% devoted
    - How detailed the plan should be
      - Innovative?
    - Budget restrictions
      - Who pays?

CHALLENGES: Emphasis on broader Impacts

- Reviewer Perspective
  - Team qualification for BI seldom evaluated
  - Budget appropriateness for the BIA seldom accounted for
  - Outstanding BI might not help out a ‘good’ IM
  - Outstanding IM might help out a ‘good’ BI

One cannot sell (**BI**) beyond what that is being made (**IM**)

CHALLENGES: Educational component

- Does broader impacts need to always have an educational component?
  - How many of the 10 components should be addressed?

- Education component in broader impacts
  - Beyond *training graduate students and postdocs*
    - Emphasis on involving K-12 students/teachers and underrepresented groups

CHALLENGES: BIA's link to proposed project

- Broader Impact Activities
  - Does it need to be tightly related to the project?
    - All research projects are 'transformative'
      - Mostly not of immediate application
    - Often too focused & advance to be digested by public
    - Hard to even convince the reviewers!!
  - Can it be public-spirited in outreach while productive in research
    - Citizen-scientists

CHALLENGES: Implementation

- Educational component
  - What level to concentrate?
    - Elementary school- cannot emphasis on core science but nurture the aptitude
    - High school – can absorb some part of the scientific question and would be enthusiastic to be involved
    - Undergraduate – can benefit most from developing interdisciplinary curriculum and research experience.

CHALLENGES: Implementation

- Educate teachers/students/public
  - Training teachers is more rewarding
- Developing new curricula
  - For school students need more expertise
- Reaching the policy makers through students
  - Council of Undergraduate Research
- Innovative approaches to engage the audience
  - Pretzi demo

CHALLENGES: Institutional role

- Institutional role in implementing BIA
  - Researchers are less trained to implement and evaluate BIA
  - The job should be assisted/overseen by educators
  - Can educator be included in the team solely for BIA?

  - BI activities could be plugged into already existing institutional programs
    - More focused and efficient use of resources
    - Sometimes considered lazy
      - Why to reinvent a wheel?

CHALLENGES: Institutional role

- Summer internships
  - Most meaningful experience
    - Local to international undergraduate students
    - Scientific expenses defrayed by the grant
    - But who pays for the accommodation of intern?
  - Departments can pool the resources to hire a professional for implementation of BIA
  - Facilitate the access of labs to high school students

Challenges- Evaluation

- Too Broad for Impacts?
  - Did the activities had the indented impact?
  - re-Test/Post Test for teachers and students
  - Focus Group Meeting after each workshop and during and after implementation
  - Site visits/observations to determine implementation of project on secondary level
  - Evaluation of lesson plans of those teachers who have completed the workshops,
  - Interviews with teachers and students

Examples

- Societal benefit
  - Understanding the influence of climate on polyphenol chemistry
    - Primary aim: Forecast soil nutrient and carbon dynamics
    - Secondary Implications
      - Fodder quality – polyphenols reduced digestibility
      - Food quality – polyphenols increases the health benefit of fruits and vegetables
      - Plant herbivore, plant stress- polyphenols as antifeedent and as sunscreen

Examples

- Scientific benefit
  - Method optimization for studying plant biopolymers
    - Primary Focus – Boston Area Climate Experiment
    - Implication
      - PHACE, FACE (ORNL and DUKE)
  - Interdisciplinary training for students

Examples

- Legislative Incentive for Future Excellence (LIFE) Scholarship program aimed at providing lab and field research experience to High School seniors in Governor's School in SC
- Creative Inquiry (CI) program
- Develop an undergraduate/graduate level course on terrestrial biogeochemistry
- Graduate Courses for In-Service Teachers
- Involve students from minority colleges and technical colleges

No need to reinvent the wheel!

Examples- Environmental Engineering

- Interact with local high school students and discuss environmental cycling of nanoparticles/trace metals, environmental chemistry, and water quality.
- Inform the students about the risks due to exposure to contaminants of concern in their local area.
- Measure the concentrations of contaminants in groundwater samples collected by the students.
- Expose graduate students to teaching and research at high school and undergraduate levels.
- Provide instructional materials to teachers via a workshop.

Examples

- Field and lab experiments through summer workshops
  - involves rising-senior students
  - students will be selected following one-on-one interview
  - Learn about plant invasion and plant roots
    - Field visit and ‘pretty’ experiments
  - Allowing the students to take the experiment back to their schools
    - Provide with rhizoboxes
    - Allow the trainees to train their peers
      - Instill leadership qualities
      - Involving students beyond summer

Examples

- One-week workshop during winter recess
  - Training on light microscopy techniques
  - Observing the root cross sections

- Next year interview will be facilitated by previous year's trainees
  - Previous year's trainees will be mentoring the new students in the school
  - Repeat the process

Examples

- **Train a TEAM of secondary school teachers**
  - **Project involves, biology, physics, chemistry**
  - trained on the general research aspect of this project relevant to their disciplines
  - two weeks at Clemson working in the lab with graduate students and postdoctoral scientists
  - will supervise the high school students during the school year in Rhizopot studies
  - following summer the cohort of teachers will conduct independent research projects at Clemson
  - Developing curriculum that incorporates all the activities
    - Various projects involve subsequent grades

Examples- Outreach to Public

Boston Area Climate Experiment

Outreach- To scientists

Class room activities

Outreach- Nanotech