Handout #1

Impact and Transportability

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Important Notes

- Most of the information presented in this workshop represents the opinion of the IWBW project team and not an official NSF position.
- Participants may ask questions using the *QUESTION BOX* on the meeting screen.
- Responses will be collected from a few sites at the end of each Group Activity. At the start of the Group Activity, we will identify these sites in the *CHAT BOX* and then call on them one at a time to provide a few of the ideas their group discussed.

Preliminary Comments on Workshop

- More than a set of guidelines on impact and transportability
- Intended to change the way you think about impact and transportability.
  - Improve your understanding
  - Help you learn
- Engagement makes learning more effective
  - Good learners are not simply listeners.
- Active, collaborative process to improve learning

Active & Collaborative Learning

- Effective learning activities
  - Recall prior knowledge – actively, explicitly
  - Connect new concepts to existing ones
  - Challenge and alter misconceptions
  - Reflect on new knowledge
- Active & collaborative processes
  - *Think* individually
  - *Share* with partner
  - *Report* to local and virtual groups
  - *Learn* from presenter's response
  - *Learn* from the IWBW team's response

Participant Activities

Two types of activities

- Group Activity ~ 6 min
  - Think individually ~ 2 min
  - Share with a partner ~ 2 min
  - Report in local group ~ 2 min
  - Report to virtual group
    - A few institutions selected
    - Check Chat Box for your Institution's name
- Individual Activity ~ 2 min

IWBW Goals and Expected Outcome

Goal: Enhance the participants' understanding of strategies for developing a project that is adaptable and potentially transformative so that they can more effectively address transportability and dissemination in preparing proposals or in implementing funded projects.

Expected Outcomes: At the end of the workshop, participants should be able to:

- Discuss the characteristics or features that make a project transportable
- Discuss the factors that limit the adoption of a newly developed approach at other sites.
- Describe strategies for making others aware of a new approach, for engaging them in its development or use, and for enabling them to use it.
- Identify strengths and weaknesses in a dissemination plan and suggest improvements.
- Discuss the characteristics or features of a potentially transformative project in the NSF context.

The Need for Transportability

- Most NSF education programs require project transportability (broader impact, transfer within an institution or to other institutions)
  - Example: Review criteria for 2010-2013 TUES program include:
    - Will the project produce exemplary materials, processes, or models that can be adopted by other sites?
    - The new solicitation is expected early in 2013

Individual Activity: Project Transportability

Reflect on your experiences of when you became aware of and decided to try a new method or tool you learned about from an educator at another institution.

- Based on this reflection, what characteristics should be included in a project to make it more transportable?

Think individually ~ 2 min and write your responses

Handout #2

Response: Features of Transportable Projects

Transportable Projects:

- Have a built-in flexibility – e.g., in the required software
- Factor in how the approach could be used:
  - In other curricular models, other courses, or other disciplines
  - With other teaching styles
- Have clearly stated learning outcomes
- Address a common need
- Minimize special equipment needs and implementation costs
- Collect convincing evaluation data
- Provide options for gradual scale up
- Involve faculty at other sites

Group Activity: Propagation Barriers

NSF has funded many educational development projects to change undergraduate STEM education without much evidence that effective approaches have spread to other sites.

- What are some of the common reasons why new effective educational approaches fail to propagate?
  - Think individually ~ 2 min
  - Share with a partner ~ 2 min
  - Report in a local group ~ 2 min

Handout #3

Response: Factors that Inhibit Propagation

- Lack of adequate department and institutional reward systems for innovation in teaching
- Faculty may not have primary identities as educators (their focus and motivations center around identities as STEM researchers)
- Lack of resources and time on the part of potential adopters
- Faculty may lack the expertise and sense of self-efficacy needed to implement the new approaches
- Lack of attention to contextual differences by developers (e.g., course size, institution size)
- Does not address a perceived problem

Response: Factors that Inhibit Propagation (Cont.)

- Not aligned with curricula at other sites
- Too specific to a particular course or curricular model
- Material not well developed
- Too complicated, costly, time-consuming, or specialized
- Poor dissemination strategies by the developers of the approaches
- Limited assistance during implementation by others
- Effectiveness not clear
- No compelling evidence that it is effective or makes a difference

Dissemination Delphi Study- TUES PIs

Rank order of project characteristics that influence dissemination from a Delphi study involving 33 PIs

- Relative Advantage
- Ease to Implement
- Ease of Use
- Practicality of the Concept
- Relevance to the discipline's issues
- Adaptability
- Compatibility

Bourrie, Working Paper 2013-001,Auburn University

Common Approach to STEM Educational Change

- Develop and disseminate model
  - Transfer or transmission model
- Developer (change agent)
  - Creates instructional materials and strategies
    - Significant effort
    - Research-based
  - Tries to convince other faculty to use them
    - Postings, presentations, publications
    - Short, one-time workshop

http://www7.nationalacademies.org/boseDancy_Henderson_Commiss ionedPaper.pdf

Some Problems with Develop-then-Disseminate Model

- Importance of local factors may be overlooked
- Faculty will need more than one exposure to materials and ideas
- Faculty are likely to need ongoing support when adopting materials of others

Dancy,http://www7.nationalacademies.org/boseDancy_Henderson_Commiss ionedPaper.pdf.

Faculty Change Takes Time

Sequential change models

- Pre-awareness – Willing to read a one-pager
- Awareness – Willing to read longer summaries
- Interest – Willing to read journal or conference publication
- Search – Willing to attend a 2-4 hr workshop
- Decision – Willing to attend a 1-2 day workshop
- Action – Willing to implement

http://fie-conference.org/fie2001/wsdindex.html
Froyd, FIE, 2001

Faculty Change Takes Time

- Faculty cannot be moved from Pre-awareness to Action with a single workshop
- Change is not an event – it is a process

http://fie-conference.org/fie2001/wsdindex.html
Froyd, FIE, 2001

A More Adaptable Approach

- Matched to how faculty members actually change
- Dancy and Henderson's Rational Faculty Model
  - Provide easily modifiable material
    - Users will customize
  - Provide research ideas with material
    - Users understand the rationale
    - If not, risk inappropriate adaptation, e.g., clickers for attendance
  - Make it clear what aspects will transfer under what conditions
    - Identify critical elements
  - Recommend modification for different situations

http://www7.nationalacademies.org/boseDancy_Henderson_Commiss ionedPaper.pdf

Categories of Strategies for Engaging Others in a Project

- Encouraging others (Easiest)
  - Making others aware of and interested in your materials or technique (Dissemination)
- Facilitating others
  - Designing materials or techniques so that others can easily use them
- Enabling others (Most effective)
  - Actively helping others use your materials or technique

Group Activity: Dissemination Strategies

- List strategies that a PI could use to encourage, facilitate, and enable others to adopt new educational materials or a new educational technique.
  - Think individually ~ 2 min
  - Share with a partner ~ 2 min
  - Report in a local group ~ 2 min

Handout #4

Response: Encouraging

- Post, present, and publish the innovation and evidence of effectiveness
- Present workshops at your institution or at national meetings
- Use professional organizations or other appropriate existing communities
- Make personal connections to others' needs
- Post the innovation on more widely accessed sites
  - Connexions site (cnx.org), nanohub, etc.
  - Search engine optimization
- Use technology
  - Videos and social media (YouTube, Facebook, Google+)
- Provide an Information package (a "sales brochure")
  - Statement of need and importance, learning objectives
  - Summary of approach
  - Evaluation data, assessment evidence
  - Stories, scenarios, advice for use and troubleshooting

Response: Facilitating

- Show how the approach could be used:
  - In other curricular models, other courses, or other disciplines
  - With other teaching styles
- State clearly the expected learning outcomes and link to needs
- Minimize special equipment needs and implementation cost, consider virtual approaches
- Collect convincing evaluation data and share evaluation instruments and processes (Formative as well as summative)
- Summarize the approach's rationale in a simple story
- Provide options for gradual scale up

Response: Enabling

- Continued support
  - Organize a support group (a community of practice)
  - Virtual workshops and support groups
  - Wikis
- Prepare user's guide
  - Pitfalls and barriers to adoption
  - Alternate approaches (what is essential and what is not)
  - Video demonstrations
- Recruit a few faculty at other sites that teach the course and ask them periodically to consider
  - How well the approach fits their course and their style
  - How could it be made more compatible
  - What data would convince them

Response: Also Consider Collaborating

Encourage others to engage in designing and developing your materials and approaches by:

- Sharing control
  - Allow others to develop pieces of the material
  - Enable partners to contribute to the posted material
  - Identify new partners at conferences and workshops
- Developing a common evaluation process and database
- Building in review and improvements at key points
- Developing group approaches for engaging and facilitating others
- Including collaborators as Co-PIs, members of an advisory board, etc.

Group Activity: Critiquing a Dissemination Plan

Read the Dissemination Plan provided as a pre-workshop reading.

- Identify strengths and weaknesses
- Suggest improvements
  - Think individually ~ 2 min
  - Share with a partner ~ 2 min
  - Report in a local group ~ 2 min

Handout #5

Response: Dissemination Plan's Strengths

- Strengths:
  - Local and national dissemination
  - Identifies specific partner institutions
  - Targets broadening participation goals
  - Includes assessment and evaluation for all partners
  - Includes modules, materials, and implementation support
  - Includes faculty development
  - Includes letters of collaboration

Response: Dissemination Plan's Weaknesses

- Weaknesses
  - Website dissemination is passive
  - Journal and conference publications do not appear strategic.
- Suggested improvements
  - Create more awareness of web-based materials through listserv or other active mechanisms appropriate to the targeted communities.
  - Strengthen connection with formative assessment objectives

NSF Definition of Transformative Research

"Transformative research involves ideas, discoveries, or tools that radically change our understanding of an important existing scientific or engineering concept or education practice or leads to the creation of a new paradigm or field of science, engineering, or education. Such research challenges current understanding or provides pathways to new frontiers"

http://www.nsf.gov/about/transformative_research/definition.jsp

Individual Activity: Potentially Transformative Project

Consider the NSF discussion of potentially transformative research.

- Describe some features or characteristics that would make an educational development project "potentially transformative"?

Think individually ~ 2 min and write your responses

Handout #6

Response: Potentially Transformative Educational Development Projects

- Address a problem that the community judges to be significant and important
- Advance understanding of how people learn STEM subjects and how best to support that learning in all students
- Synthesize a large quantity of previous results
- Provide substantial new insight into an existing problem or clearly formulates a new problem
- Motivate educators to think differently about how they teach

Response: Potentially Transformative Education Development Projects

- Use approaches that make sense intuitively and are grounded in the education research
- Develop effective products, methodologies, learning technologies, curriculum materials, etc.
- Have transportable elements that other educators could adopt or adapt
- Are relatively easy and inexpensive to implement
- Have a plan to engage and enable the appropriate academic community
- Make strategic use of existing dissemination practices and introduce new ones
- Have an extensive evaluation component

TUES Solicitation (2010-2013)

The 2010-2013 TUES solicitation "especially encourages projects that have the potential to transform the conduct of undergraduate STEM education, for example, by bringing about widespread adoption of classroom practices that embody understanding of how students learn most effectively. Thus transferability and dissemination are critical aspects for projects developing instructional materials and methods and should be considered throughout the project's lifetime. More advance projects should involve efforts to facilitate adaptation at other sites."

The new solicitation is expected in 2013

Thanks for your participation!

- This concludes the virtual session. Thanks for your participation.
- There will be a concluding local session where participants will reflect on their experiences in the virtual session
- All participants will receive an email message with a link to the post-workshop evaluation survey. Please go to the site and complete the survey so that we can identify areas for improvement and have information to report to NSF

Acknowledgement

- This workshop has been offered through a partnership between the American Association for the Advancement of Science (AAAS), Louisiana State University, and Higher Education Services, Inc.
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Pre-Workshop Handout

Dissemination Plan

Our dissemination plan will facilitate the adaptation and implementation of this project at other institutions, and will significantly broaden its impact. The materials that we develop will be highly transferable and scalable to other instructors and institutions including G6-12 schools and universities. Intensive effort to communicate our ideas, our results, and our products with the SMET and education communities will be made during the project and after its completion. The audience will be 4-year college and university SMET faculty and secondary school science and mathematics teachers. In order to increase the participation of underrepresented groups in this project, we have chosen to partner with nearby schools that have a more diverse student body than _____ University's, which is only 6% minority and 16% women in engineering overall. We are committed to helping our partner institutions adopt and assess our modules. This will include handouts, information necessary for materials acquisition, equipment fabrication and alternatives, laboratory set-up, laboratory instruction, safety considerations, problem solving, and ethics modules. We will train instructors as necessary, and we will provide assessment instruments. We have established the following partners to support and adopt our modules:

- _____ University will adopt our modules for use in the Biomedical Engineering program. The BME Program at Stevens attracts a fairly diverse student body with 12% minority and 44% female representation. A beta-tester agreement is attached.
- _____ College will adopt our modules for use in the Chemical Engineering program. Manhattan's ChE program has a student body with 12% minority and 41% female students. A beta-tester agreement is attached.
- The _____ School District will provide the opportunity for us to have hands-on activities at their STEM night. The PI is currently a participant in this event, in which students and families enjoy an evening of exciting STEM activities and learn about careers in STEM fields.
- Students at the Academy of Chemical and Technological Engineering at _____ High School will participate in the artificial organ modules through the Freshman Engineering Clinic at _____ University. Through a partnership with this university, Academy students participate in Freshman Engineering Clinic II as well as physics and composition courses the University.
- Teachers from _____ middle schools will participate Engineering Clinics for Teachers Workshop at _____ University. This annual workshop is a continuing education opportunity for area teachers and is attended by 35 middle and high school teachers each summer. We will train the teachers to use the educational materials and provide support needed for them to integrate the activities into their curriculum. We will provide assessment instruments in which project-related questions are mapped to State and National Standards. A letter of support is attached.
- Our G6-12 activities will be used with middle and high school students via several existing programs: Engineers on Wheels, Attracting Women into Engineering (A program serving 150 7^{th}/8^{th} grade girls per year), RISE (a 3-day program for 50 high school students/year), and CHAMPs (a college-bound program for 250 middle and high school students/year from nearby urban areas). The attached letter of support provides more detail on these outreach programs.

To facilitate adoption of our materials beyond our partner schools, we will create a website that will provide all the information necessary to implement this project at different levels of instruction. Various media will be used to communicate our results, including: (1) publications in refereed journals such as *Adv. Eng. Ed.* and *Chem. Eng. Ed.,* (2) presentations at national conferences such as WEPAN, ASEE, ASME, IEEE, AIChE and FIE and (3) at least 6 open houses per year at _____ University, attended by approximately 250 high school students and parents from the region.