EESE: Nationwide Nanotechnology Ethics Education Development

Education Award: SES-0622978

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University of New Mexico

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Educational Goals

1. Pilot transfer of a 3 semester hour senior/graduate-level UNM course, **"The Societal and Ethical Implications of Nanotechnology"** to five collaborating institutions

2. To reshape this material to incorporate these new perspectives, to meet evolving teaching needs, and to reflect the advance of the technology.

3. To evaluate the effectiveness of 'non-local' curricular materials in teaching the ethics of emerging technologies, particularly in supporting faculty without experience in this area.

4. Development of a national electronic resource

Nano & Society in the NNIN

- The NSF-funded National Nanotechnology Infrastructure Network makes nanotechnology user facilities available to industry and academe,
- NNIN has extensive SEI, education, training and outreach activities
- UNM & pilot sites all NNIN members
- Recent SEI survey of nanotechnologists by Robert McGinn (Stanford U.) resulted in recommendations for development of nanotechnology ethics curricular materials

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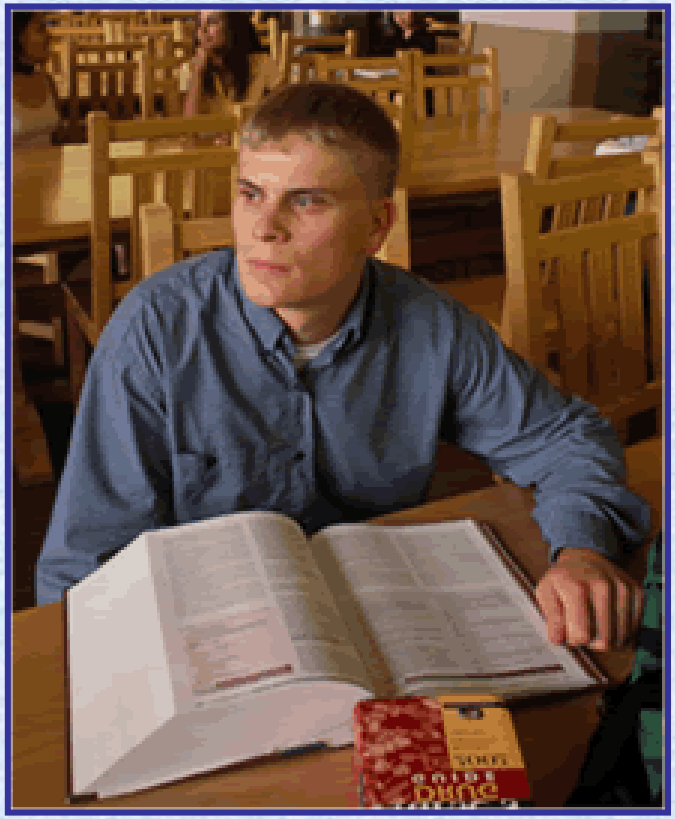
Why Nano Ethics Education at the Graduate Level?

- Ethics education is largely absent in doctoral engineering programs - where nanotechnology is being taught as a specialty
- Interdisciplinary nature of nano requires:
  - Appreciation of ethical issues beyond basic engineering ethics
  - Multi-disciplinary function - between engineers and scientists but also doctors, lawyers and business people.
- Consideration of social and ethical issues (SEI) needs to be integrated with the development of emerging technologies
- Increasing awareness of need for public participation in debate of scientific issues

Educational Outcome
Objectives of a Nano Ethics Course

Students should develop:

- Awareness of the multiple issues they will meet in their nanotech careers
- Capacity for critical analysis of ethical and societal dilemmas
- Flexibility and insight necessary to take an ethically responsible position when faced with unprecedented circumstances
- Understanding of the scientist's responsibility toward and interaction with society



And, ideally -

- 'Emotional engagement' with the ethical context

Methodologies

1. Course has interactive, participatory, modular format - suitable for ‘across-the-curriculum’ integration

2. Modules include:
   - Introduction to nanotechnology
   - Introduction to ethical theory
   - Analysis of issues intrinsic to nanotechnology
   - Project - Survey of public attitudes to technology / Interviews with nanotechnologists
   - Guest speakers for expert input nano IP, bioethics, nano start-ups, etc

3. Nationwide electronic resource will be developed for web-based access to materials

4. Faculty and student assessment

Covering the Nano Issues..

Environment & H&S

Human Enhancement

Privacy

Legal & Regulatory

Education

Public Perception

K. Mills 3/15/07

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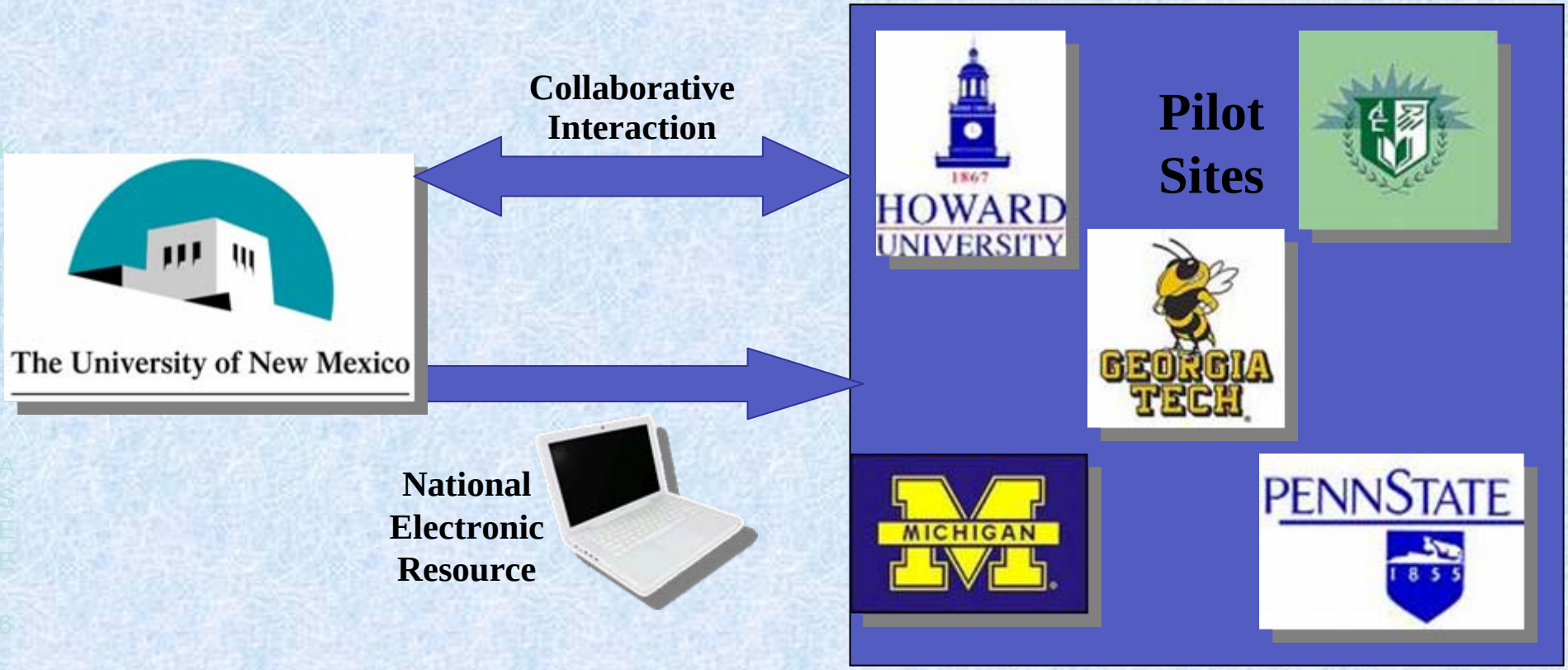
Nano Ethics Materials Flow Between UNM and Pilot Sites



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Early Findings … Run the Gamut

- **From:**
  "Thank you for the ppt version of the course materials. These are incredibly helpful - I am going to use the nanohistory one tomorrow… This is a HUGE help for me this semester."
  Prof Kendra Sharp, PSU, who is using these materials in her ME course 'Expanding View: Micro and Nanoscale Science and Engineering in the Larger World'.

- **To:**
  "*Now here is the problem: I talked to (name removed to protect the guilty), the director of the (anonymous nano place), and my impression is that he sees "ethics/public policy" as more regulations on the way and a barrier to the development of nano….. In short, nano-ethics is a hard sell. (Can you help me with) ideas and advice how to sell the course to engineers and scientists?"*
  Anonymous Prof who wants to use the material (not at one of the 5 pilot sites):

- Circumstances alter cases

Challenges and Opportunities

- Effective participation by non-funded collaborators who are under significant time pressures
- Legal issues associated with disseminating effective teaching materials
- Institutional Review Board (IRB) issues posing certain complications.
- Increasing interest – by past students and other institutions.

The Moral of the Tale -

Get the Vatican on Your Side!

Dives in Misericordia church in Rome uses the catalytic properties of titanium dioxide under UV rays to keep the cement white. The architects refused permission to use photos, even for educational purposes. So… This photo was taken especially for the project by a priest in the Vatican!

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External Evaluation

- Dr Suzanne Brainard; Priti Modi, Elizabeth Litzler
- Goal
  - Assess implementation of curriculum modification project by performing formative evaluation at 5 pilot institutions
- Objective
  - Provide continuous feedback to PI and participating institutions, enabling maximization of curriculum usage nationwide
- Instruments
  - Faculty Interview Protocol (confidential)
  - Student Feedback Survey (anonymous)

Course Elements

- **Introduction to nanotechnology**
- **Introduction to ethical theory**
- **Analysis of issues** intrinsic to nanotechnology
- **Project** - Survey of public attitudes to technology
- **'Applying the imagination'** - an examination of nanotechnology in fiction and the movies, and the use of images in the nanotechnology community
- **Guest speakers** who bring specific expert input on topics such as intellectual property in nanotechnology, bioethics, legal and regulatory issues, and more…

Disseminating Nanotechnology Ethics Education

- This project will take a **new graduate-level course, "The Societal and Ethical Implications of Nanotechnology",** developed at the University of New Mexico (UNM) by the program PI, Kirsty Mills, and make it adaptable and transferable across a wide range of institutions.
- We will do this by conducting **pilot-tests at five collaborating institutions**: Howard State University, Pennsylvania State University, the University of Washington, Georgia Institute of Technology, and the University of Michigan.
- This is a 3-credit 400/500-level course, cross-listed in School of Engineering / College of Arts and Sciences, and a core course on new UNM NanoScience and MicroSystems (NSMS) curriculum
- Interactive, participatory & modular format - suitable for 'across-the-curriculum' integration
- UNM and the collaborating institutions are all partner institutions in the NSF-funded National Nanotechnology Infrastructure Network (NNIN).

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1st/2nd Quarter Tasks

- Purchase servers for electronic resource
- Install operating system for electronic resource and establish redundant failover set-up
- Install web server and other access software for electronic resource
- Create website (ongoing)
- Obtain photo permissions for media elements (ongoing)
- Establish ‘library’ of course materials (ongoing)
- Prepare for video/webcasting of guest lectures; investigate iPod downloads
- Liaise with collaborators at pilot sites to create module objectives in terms of local pedagogic requirements (ongoing)
- Complete IRB authorizations at pilot sites
- Launch front-end evaluation activities