Workshop and Module Design—Part 2—Human Systems, Sophomore Module on Policy for Nanotechnology Development

NSF Nanotechnology Undergraduate Education grant (#EEC-1138257) focused on creating interdisciplinary modules about the social, ethical, environmental, and economic impact of nanotechnology for all students at the Colorado School of Mines. (For an overview of the project plan, see **NanoSTEP: Nano-Science, Technology, Ethics and Policy Poster Presentation to NSF EEC conference March 2012**) Dr. Corinne Packard, a professor in the department of Metallurgical and Materials Engineering who works with solar cell nanomaterials, was the PI. The team of Co-PIs and Senior Personnel were drawn from the multidisciplinary Liberal Arts and International Studies department which is responsible for delivering core courses in humanities and social sciences. The first part of the project was a module for the freshman ethics and writing course, Nature and Human Values, which included a common lecture and reading assignments and different course activates and discussions about the risks and benefits of the technology. (**See Workshop and Module Design—Part 1—Nature and Human Values**). The second part of the project was a module for the sophomore-level course, Human Systems, a history of sociological, religious, political, and economic systems. For this course, the focus of the module was on policy and international relations in technology development. (**See Workshop and Module Design—Part 2—Human Systems**). We disseminated our work at several conferences and to universities in China and Spain, but most notably contributed a panel discussion with several team members at APPE 2013 in San Antonio (See **Association for Practical and Professional Ethics 2013 Conference Presentations**). We have written two papers about the results (See **Nanotechnology Ethics and Policy Education: Learning and Sharing Across Boundaries**) and another forthcoming.

Classroom Interventions—Part 2—Human Systems

Students were asked to read and write about nanotechnology and were assessed both before and after the module for changes in their thinking and application of concepts in a written response.

STUDENT ASSIGNMENT

Scenario with questions to assign during the first week and then again during the last week of HS classes. We will collect all results and be able to discuss and compare.

Important qualifiers:

First, remember that the primary goal of our HS involvement in NanoSTEP is the opportunity to work together. In the process we are able (a) to show ourselves and the CSM administration that a large group of faculty from LAIS can secure an NSF grant (NanoSTEP is the most interdisciplinary NSF team on campus!) and (b) to do some things in HS that we have always said we wanted to do (but have not done much of: that is, have some discussions in which we share more about our work and try to articulate with NHV) and get paid (modestly) for it! Nano is, for us, primarily another instantiation of ourselves as a community of scholars.

This was emphasized again in our NanoSTEP HS workshop when we concluded that in HS we should emphasize not what nano can add to HS but what HS can add to nano. We said that our objective in HS was to teach "how the [globalized] world works" and "how we got where we are" and put the way things are today in broader context or perspective. And we are interested in how this teaching can inform our (and our students') understanding of nano.

So this assignment or exercise is to see, in a very preliminary way, whether what we teach in HS can help or encourage students to reflect on nano in ways that are more appreciative of how the world works than might otherwise be the case.

Second, as a PRELIMINARY effort to create an assignment that might help us (and the students) understand whether in fact HS can inform the understanding of nano, we concluded that we would create a scenario involving nano and ask for students to respond to it (a) during the first week of classes and again (b) during the last week of classes. In comparing these two assignments students themselves might actually come to a better appreciation of what they have learned, and we as teachers might get a better purchase on what we in fact teach. These assignments would be required, but could be graded any way that instructors liked: complete/incomplete, letter grade, number grade, whatever. They would count for something, but not much. THERE ARE NO PREDETERMINED RIGHT ANSWERS.

There was a consensus that this would fit in easily with our efforts to have common standards for assignments and the amounts of writing to be included in HS. Joe has proposed that the two assignments together count for 2% of the semester grade. I don't think there has been any dissent from this proposal.

Third, each faculty member would do something on nano during the semester, but the amount and what will be left up to the discretion of individual instructors. The core NanoSTEP team will try to provide as much support as possible. This will take form primarily in the creation of the following scenario and the coordinating of an HS Central BB web site where resources will be posted. We welcome your direction for what to post. This site will be up very shortly. You will receive more details from Laura Heller.

At the same time, instructors will be asked to provide some narrative summary of what they did with nano. Then at the end of the semester we will have another workshop to discuss what happened. Again, for emphasis, no external authority will conclude anything from what happens. The conclusions will be up to us; they will arise from our own reflections and discussions.

Finally, **fourth**, there is no assumption that the same assignment will be used in future HS classes. What we are doing in Spring 2013 is an experiment that we may conclude we want to continue — or that we want to have had as a one off.

Scenario: Nano-Coat is a new United States based corporation that is becoming a leader in the manufacture of specialized paints and other surface coatings. These paints and coatings, developed from techniques utilizing nanoscience and nanotechnology, exhibit distinctive features (e.g., self-cleaning and highly water resistant). But many products have not yet been fully approved for manufacture and sale in several European countries. Furthermore, the company projects the emergence of a vast market in the developing worlds of Latin America, Asia, and Africa. After surveying investment opportunities in all three regions, the Nano-Coat has chosen to site a new industrial plant in the Republic of Mchana, a gold-exporting African country with below average life expectancy and a high proportion of poor people. The leader of the Republic of Mchana, President Akili, is excited about the decision made by Nano-Coat, which he thinks will put his country on the technological map and uplift his people economically. He finds it puzzling that some Western and Asian countries have rejected investment approaches from Nano-Coat.

Respond to as many of the following questions as you can with as much detail as you think appropriate.

1. What economic, political, social, and cultural factors might be encouraging Nano-Coat executives to consider constructing a plant in the Republic of Mchana?
2. What calculations or considerations might have led President Akili to welcome Nano-Coat despite resistance elsewhere?
3. What kinds of responses or reactions might be expected from worker organizations, human rights advocates, and economic planners in Western countries regarding the Nano-Coat decision?
4. Does this investment fit with historical scenarios of how countries become economically and technologically capable? Do you share President Akili's enthusiasm?
5. If you were a concerned citizen of the Republic of Mchana who had also taken NHV and/or Human Systems at CSM, what information might you want to collect in order to be assured that President Akili has made a reasonable decision?

Nanotechnology assignment

Instructions:

Assignments are due [DATE TBD by instructor] to SafeAssignment on Blackboard. You must include your CWID on your essay. If you elect to have your essay used for research purposes, the CWID will be replaced by a random number for the purposes of data collection and analysis.

Papers must be at least 250 words total (not including restatements of the questions).

You must complete the first and second parts of the assignment to receive credit. Essays are subject to the same policies on plagiarism (including self-plagiarism) as are other writing assignments for this course. In other words, you may not turn in the same essay twice and receive credit for the assignment.

Do not do extra research about nanotechnology in order to complete this assignment. Use your already existing knowledge and any relevant information from your NHV and Human Systems courses.

Prompt:

Nano-Coat is a United States based corporation that is becoming a leader in the manufacture of specialized paints and other surface coatings. These paints and coatings, developed from techniques utilizing nanoscience and nanotechnology, exhibit distinctive features (e.g., self-cleaning and highly water resistant). But many products have not yet been fully approved for manufacture and sale by the European Union. Furthermore, the company projects the emergence of a vast market in the developing worlds of Latin America, Asia, and Africa. After surveying investment opportunities in all three regions, Nano-Coat has chosen to site a new industrial plant in the Republic of Mchana, a gold-exporting African country with below average life expectancy and a high incidence of poverty. The leader of the Republic of Mchana, President Akili, is excited about the Nano-Coat decision, which he thinks will put his country on the technological map and uplift his people economically. He finds it puzzling that some Western and Asian countries have rejected investment approaches from Nano-Coat.

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Script for introducing the assignment and research:

With funding from the National Science Foundation, a team from the Colorado School of Mines is conducting research about the introduction of concepts related to nanotechnology into the undergraduate curriculum. As a part of this study, we are collecting information about students' opinions about nanotechnology research and applications. This information is being collected in two ways.

First, today you will given the opportunity to complete a short survey about nanotechnology. Your participation is entirely voluntary, and your choice to participate will not affect your grade in this course in any way.

Second, you have the option of having a regular assignment for this course be also included in a research pool for the project. As a part of your regular coursework for Human Systems, you will be asked to write two essays about nanotechnology. These essays will be graded and included in your final score for the course. You must complete both essays and upload them to the SafeAssignment tool on Blackboard to receive credit. Essays are subject to the same policies on plagiarism (including self-plagiarism) as are other writing assignments for this course.

If you elect to participate in the nanotechnology study, and indicate as such on the informed consent form I will pass out, your essays will be also be anonymized and included in a pool of student essays from Mines. All information will be handled in a strictly confidential manner so that no one will be able to identify you when the research results are recorded and reported.

There are no risks to you in completing these surveys and essays. Your participation in the study is entirely voluntary and your decision to do so or not to do so will not affect your grade for this course in any way.

If you have further questions about the study, you may contact Corinne Packard, using the information on the informed consent form.

Assessment—Part 2—Human Systems

Protocol for collection of NanoSTEP data for Human Systems

At the Human Systems faculty workshop, participants decided that a useful focus of the NanoSTEP research would be to investigate what, if any, effect taking the Human Systems course has on student opinions about nanotechnology. Students will therefore write two essays, one at the beginning and one at the end of the course, responding to a prompt about nanotechnology in the developing world.

Laura Heller will introduce students to the nanotechnology assignment during the **second week** of classes.

- She will be in charge of reading the script and collecting informed consent forms.
- She will also administer the survey.

The essays will be a required assignment for the course and will be factored into their final grade. Essays will be graded on a pass/fail basis and will count for 2% of their final grade (or 1% each). Students must complete both essays to receive credit for the assignment.

Instructions for the essays:

- Create a **Safe Assignment** in Blackboard for the assignment. After you have added her to your Blackboard course as a TA, Laura will download the essays from the students who gave informed consent. Do not use the Assignment tool, as it presents challenges for downloading the essays all at once.
- Copy the instructions and prompt in the "instructions" or "description" section of Safe Assignment.
- Inform Jessica Rolston when the essays are due so that Skylar may begin analyzing them.

Include nanotechnology in the course as you see fit. PowerPoint presentations are available for your use from the NanoSTEP Blackboard work area.

- We are NOT assigning nanotechnology articles for students to read.
- Assign the second essay after the nanotechnology material has been delivered in your course.

Send the following to Jessica Rolston:

- Course syllabus
- Information on when the essays were assigned and turned in.
- Short description of what nanotech material you included in your course (e.g. Corinne's slides, Carl's slides, etc.).

HUMAN SYSTEMS SURVEY Fall 2013

Bubble in your CWID on the Scantron and write it here: _____

1. What is your primary race/ethnicity?
    a. Asian or Asian-American
    b. African-American
    c. Caucasian
    d. Latino
    e. Other

Use bubbles on lines 2 and 3 of the Scantron to answer the following question: Where did you primarily grow up?

2.
    a. Middle East, North Africa, and Greater Arabia
    b. Europe
    c. United States or Canada
    d. Latin America and the Caribbean
    e. Sub-Saharan Africa

3.
    a. Australia and Oceania
    b. Other

4. What year are you at CSM?
    a. First
    b. Second
    c. Third
    d. Fourth
    e. Other

5. What is your major?
    a. Engineering (civil, mechanical, etc.)
    b. One of the sciences or pre-med
    c. Mathematics
    d. Computer science
    e. Other or Undecided

6. Have you taken NHV since Spring 2012?
    a. Yes b. No

7. Have you taken Principles of Economics at CSM?
    a. Yes b. No

8. If you have heard about nanotechnology before today, are any of the following primary sources of your information?
    a. Trade or professional journals
    b. Friends and family
    c. Course work at CSM or elsewhere
    d. I have not previously heard about nanotechnology

Products and Deliverables—Posters, Presentations, and Papers

POSTER from NSF conference

Scholarly products: **Nanotechnology Ethics and Policy Education: Learning and Sharing Across Boundaries**

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Laura Heller *lheller@mines.edu;* ***Cortney Holles*** *cholles@mines.edu;* ***Carl Mitcham*** *cmitcham@,mines.edu;* ***Derrick Hudson*** *dhudson@mines.edu, Colorado School of Mines, LAIS Division*

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Consumer Products Inventory, www.nanotechproject.org/inventories

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