Appendix B

2007 CCNY NUE
Pilot Test Report

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Overview

During the spring of 2007, the CUNY-NUE project pilot tested its *nanotech nuggets* modules, the new nanomaterials course (CHE 59808), and the data collection protocols to be used in next year's field test of the new nanomaterials course. The purpose of the pilot test was to gather formative feedback on what worked well and what could be improved with regard to the course materials and the data collection protocols. This report focuses on the findings from the pilot test of the data collection protocols used with the nanomaterials course. It also includes some preliminary feedback from two visiting speakers on their experiences with this pilot program. Over the summer, a formal debriefing will be held with the faculty who developed and pilot tested the nanomaterials course and the *nanotech nuggets* to gather more detailed information about what worked and what could be improved. All of the pilot test data will be used to revise the course materials and data collection protocols for the upcoming field test in the fall of 2007.

Course Goal Assessment

Purpose and Nature of the Instrument

The purpose of the Course Goal Assessment is to 1) assess the change in students' knowledge of nanotechnology and nanomaterials and 2) interest in nanotechnology. As such, the Course Goal Assessment is administered at the beginning and end of the course as a paper-and-pencil survey.

The Course Goal Assessment used in the pilot test included eight questions to measure students' general knowledge of nanotechnology and nanomaterials, ten questions to measure specific knowledge of nanomaterials, and six questions to assess students' interest in nanotechnology.

Method

The Course Goal Assessment was pilot tested in two classes: the new nanomaterials course (CHE 59808) and an introduction to material sciences course (CHE 310), in which the new

instructional materials were not used. A total of sixteen students completed the pre- and post-assessment in the CHE 59808 course and nineteen completed it in the CHE 310 course.

Results, Recommendations and Action Steps

Student Interest

The six questions on the Course Goal Assessment that related to student interest in and previous exposure to nanotechnology were easy for students to answer and seemed to differentiate well among students with differing levels of interest. Of the three interest questions, roughly two-thirds of the students in the nanomaterials course reported an interest in a career in nanotechnology compared to only 50% who were interested in doing undergraduate research in nanotechnology and 40% who would like to write an article for a campus publication or popular science journal on nanotechnology.

As might be expected, all or almost all of the students in both the nanomaterials course and the introductory (non-nano) course believed it is useful to learn about nanotechnology, most had first heard about nanotechnology in high school, and only a few had been previously exposed to nanotechnology in other undergraduate courses. The similarity of student beliefs in the importance of nano and previous exposure to it in the nano-focused and non-nano focused course is an important control for the field test. It suggests that students who enroll in the nanomaterials course do not necessarily have greater exposure (i.e., knowledge) coming in.

Formatting

One revision to be made to the Course Goal Assessment is to add additional instructions to each question (i.e., "circle all that apply" or "circle one") for clarification and to reformat the protocol such that all response categories are presented in the same format. For example:

Q1. Which of these applications represent nanotechnology inventions (circle all that apply)?

a. gene therapy
b. the first solid state transistor
c. quantum dots
d. colored lead glass in church windows
e. optical fiber

A second suggested revision is to review all of the questions that include more than one correct answer (i.e., "circle all that apply) and decide whether to present these questions in a different format (i.e., matching, true/false). The rationale for this suggestion is that the assessment used in the pilot test included several questions with multiple correct answers, which are, in essence multiple questions within one. This places a greater demand on the student than simply breaking apart the questions into individual items.

Item Analysis

Finally, it is suggested that after the faculty debriefing about the course, the CUNY-NUE development team work with the evaluator over the summer to review the responses to individual questions on the Course Goal Assessment. This informal item analysis will allow the development team to identify specific revisions that may need to be made to the instructional materials and/or the assessment. The individual item analysis highlights misconceptions students may have about the material (i.e., most students choosing the same incorrect response), issues with vocabulary (i.e., introducing new vocabulary into the assessment that was not included in the course or only used in passing), and the need for revisions to the instructional materials (i.e., students are not grasping key concepts because they were not fully addressed in the course or faculty noticed confusion around the concept). As part of the item analysis, the development team will be asked to revisit how each question maps back to the lesson objectives to ensure that any subsequent revisions result in an assessment that fully aligns with the materials. The final revised assessment will be informally pilot tested with up to nine students from the spring 2007 class to obtain their feedback on clarity of instructions and vocabulary, and the time required to administer the assessment.

Summary

The pilot test results highlighted the general need for changes to the format of the assessment. An informal item analysis will be conducted over the summer to allow the development team to review and revise individual items with the assistance of the evaluator and reconfirm the alignment of the assessment with the learning objectives of the instructional materials. The final revised assessment will be pilot tested with some students from the spring 2007 class to confirm the time required for administration and the clarity of the instructions, format, and vocabulary.

ABET Course Feedback Survey

Purpose and Nature of the Instrument

The purpose of the ABET Course Feedback Survey was to gather student opinions about the quality and utility of the nanomaterials course. The ABET survey included seventeen questions related to the course objectives (i.e., did students feel they learned specific material) and fourteen questions related to the course quality (e.g., rating the materials, instructor) to which students were to respond on a scale of -3 (strongly disagree) to +3 (strongly agree).

Method

The ABET Course Feedback Survey was administered to students enrolled in the new nanomaterials course (CHE 59808) as a paper-and-pencil survey. Sixteen students completed the survey at the conclusion of course pilot test in the spring of 2007.

Results, Recommendations and Action Steps

Formatting

One revision to be made to the ABET Course Feedback Survey, which is a template used throughout the Chemical Engineering Program, is to number each question sequentially and remove blank lines between questions.

Given the length of this survey and the length of each individual question, both of which require considerable reading on the part of respondents, a second and related suggestion is to rephrase the one question on course objective (Q4) written in the negative to make it easier for the respondent to complete the survey. For example, the question that asks: "This course did **not** make me…" should be rewritten in the affirmative "This course did made me…". In addition, Q17 should be rewritten from "An ability…" to "My ability…".

Review Student Ratings

As shown in Table 1, with regard to the course objectives, overall, students agreed that their knowledge of specific nanomaterials and nanotechnology concepts and principals, related skills, and understanding of ethical and contemporary issues related to nanotechnology increased as a result of their participation in the CHE 59808 nanomaterials course. Other ratings in this table indicate that the instructional materials could be somewhat improved. It is suggested that the development team review all ratings below +/-2 ("agree") to determine 1) whether this objective is a key focus of the course and thus should be included in the ratings and 2) if it is a key learning objective, how the instructional materials and/or instruction might be modified to improve outcomes in this area.

Student ratings of the course quality are shown in Table 2. Overall, students agreed that the course included features associated with quality teaching and learning (e.g., relevance, clear expectations for learning, instructor was helpful, homework was useful, illustrations and examples were effective). Still, as was also reflected in their comments (see below), students highlighted the need for more clarity on the prerequisite courses and clearer communication of what the course entailed. Overall, students were only somewhat likely to agree that what they learned from the course was worth the time and effort they put into it. Again, this reflects student comments that perhaps too much material was covered during the course.

Consequently, it is suggested that the numeric responses to individual questions on ABET Course Feedback Survey and the student comments be reviewed during the item analysis session that will be conducted on the Course Goal Assessment. Most of the student comments were general, but spoke to what worked and what could be improved with regard to the nanomaterials course. Some examples of student comments are:

> *"I was able to **explore the background and applications of nanomaterials for the first time so intensely**. We had to choose a topic to do a term paper and this allowed*

*us to get more involved in industrial application. Also the **industrial speakers** gave us insight on the applications of nano in many fields."*

*"**Clear cut prerequisites** would be greatly appreciated and a great addition – it was lacking in the inaugural debut of the class."*

*"The **homework assignments** really helped [familiarized me with synthetic routes to nanomaterials]."*

*"I liked the **interdisciplinary** nature of the course."*

*"**Too much material**." …"Too many things to cover."*

Students also commented on what interested them most, what was clear to them and what could have been emphasized more, and the helpfulness of professor.

Summary

Overall, student ratings indicate that the course quality and utility, even during the pilot test, were on track for a successful field test. Students acknowledge that they were learning new knowledge and skills, while identifying some areas that could be strengthened.

Feedback from Industry Speakers

Representatives from two different industries that work with nanotechnology came to speak to students in the nanomaterials course. Both speakers were impressed by the level of student understanding of and engagement with the topic, and commented that the timing of their visits allowed students the opportunity to prepare ahead of time so they could make the most of the experience:

*"I have interacted with undergraduates on this and similar topics before. From my experience, your students were the best prepared to discuss the topics of nanotech and how my work fit in. I was especially impressed by their willingness to interact with me on the topic. Undergraduates are often reluctant or uncaring about the importance of ferreting out answers from speakers so that they maximize their own clarity. These kids reminded me more of graduate students in their confidence in the topic and their eagerness to know more. **So I think the part that worked really well was having a well-prepared group for the seminar, meaning that the timing of my visit was perfect in the overall scheme of your course."***

*"This was a very positive experience and I appreciate the opportunity to participate. I was very impressed by the **students – they had clearly done their homework on [my organization], were very attentive during my lecture and asked detailed, thoughtful questions that showed a high level of understanding and engagement with the topic."***

One speaker also commented on the types of advance materials speakers might want to have in preparing for their visit:

> *"I can't think of anything that didn't work well, but one suggestion comes to mind. After the course I glanced at the exams you had given the students and it gave me additional perspective on the level and breadth of the course itself. This* ***would have helped me tailor my talk a little more for the audience if I'd seen materials like this in advance of my visit****. You might consider sending some representative assignments like that along with the syllabus and other more general information for outside speakers in the future. But, rest assured, my visit was an extremely positive one."*

Finally, both speakers commented on the long-term benefit to the field of courses such as this one and the importance of collaboration between academia and industry:

> *"For [my company], this gives us some direction around where we should look for personnel who have broad nanotech backgrounds but also specific abilities in areas we are about like soft matter. I know my colleague has been working with another CUNY faculty member to develop an industrial spin-off course from the one used now in the soft matter area and* ***this sort of cross-level cross-disciplinary effort will be extremely useful to [my company] in training its current and new employees so they can start contributing early in their careers."***

> *"I also found it quite beneficial to meet with a number of the faculty prior to my lecture to explore areas of mutual interest.* ***I was impressed with the quality and breadth of research going on in the department.*** *[My company] is a global biopharmaceutical company but our research facilities are concentrated on the west coast of the U.S. We compete for talent with pharmaceutical companies concentrated in the New York / New Jersey area.* ***Building awareness of our company among top talent pools is a priority, and my involvement with the CCNY NUE effort helps meet this objective."***

Summary

Initial feedback from the outside speakers from related industries suggests that the CCNY nanomaterials course, as piloted this year, not only made very appropriate use of this external resource for students enrolled in the course but also illustrated the utility of the course to the broader industry through professional collaborations.

Table 1. Mean student ratings of course objectives on ABET Course Feedback Survey for CHE 59808, pilot test, spring 2007.

Course Objectives	Mean*
1. This course gave me a thorough understanding of nanomaterials and let me rationalize why they are nanomaterials.	2.06
2. This course gave me a thorough knowledge of the major concerns of the chemical industry and society on ethical, economical, environmental and health related issues associated with nanomaterials and their application.	1.94
3. This course increased my skills to explain terms generally used in nanoscience and nanotechnology.	2.00
4. This course did **not** make me thoroughly familiar with existing and potential applications of nanotechnology.	-2.25
5. This course familiarized me with synthetic routes to nanomaterials.	2.44
6. This course increased my understanding of the operating principles and limitations of scanning and electron probe techniques.	2.00
7. This course made me familiar with standard computational packages for molecular dynamics simulation to structural and transport aspects at the nanoscale.	**1.81**
8. This course gave me some knowledge of how the dimensions of a material affect the interaction of light and matter.	2.38
9. In this course I learned how to predict and calculate mechanical properties of nanomaterials and composites containing nanomaterials.	**1.50**
10. I have developed an ability to apply knowledge of mathematics, science and engineering.	**1.56**
11. I now have the ability to identify, formulate and solve chemical engineering problems.	**1.00**
12. I now have an understanding of professional and ethical responsibility.	**1.50**
13. I now have the ability to communicate efficiently.	**1.88**
14. I now have the broad education necessary to understand the impact of engineering solutions in global and societal context.	**1.88**
15. I now have a recognition of the need for, and an ability to engage in life-long learning.	2.44
16. I now have a better knowledge of contemporary issues.	2.13
17. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice has increased.	2.19

*On a scale of -3 (strongly disagree) to +3 (strongly agree).

Table 2. Mean student ratings of <u>course quality</u> on ABET Course Feedback Survey for CHE 59808, pilot test, spring 2007.

Course Quality	Mean*
1. The instructor made clear the important points I had to master for this course.	2.19
2. The syllabus was followed (if there was no syllabus, circle -3)	2.75
3. The instructor did ***not*** present the material in a way that made it clear what was to be learned and why.	-2.53
4. The relevance of this course to chemical and other areas of engineering was made clear.	2.00
5. The prerequisite courses did ***not*** adequately prepare me to take this course.	**-1.73**
6. The instructor was available during office hours, by E-mail, or other means of consultation.	2.88
7. The homework was helpful in learning the course material.	2.44
8. The instructor made good use of teaching media such as PowerPoint presentations and Blackboard.	2.88
9. The course content did ***not*** meet my expectations.	**-1.13**
10. The course material in both content and techniques was enhanced by well chosen examples and illustrations.	2.25
11. Grading of homework and quizzes was done in a timely manner (courses only). Grading of reports was done in a timely manner (labs and design courses).	2.81
12. The instructor ***<u>dis</u>***couraged questions and class discussion.	-2.88
13. The textbook was ***not*** very helpful in learning the course material.	**-0.57**
14. What I learned from this course was worth the time and effort I put into it.	**1.75**

*On a scale of -3 (strongly disagree) to +3 (strongly agree).