Project Title: To Design and Implement a Research Based High-Impact Tier II course on Nanotechnology

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Abstract
The grant provided funds to support partially the time spent in design and development of a new high impact course for students to understand the modern-day field of Nanotechnology and its impact on future human lives and societies. The present report describes several significant outcomes which were achieved along with future activities.

Project Summary
The present report summarizes the development occurring from a 2011 CSU Summer Curriculum Development Grant for “To Design and Implement a Research Based High-Impact Tier II course on Nanotechnology”. The project was completed as proposed and the result is the design and development of a research based High Impact course in Tier II LAC category based on the state of the art field of Nanotechnology. This course will benefit students not only by gaining experience by getting exposed to relevant literature but also will provide awareness of research and advances in nanotechnology.

The proposed course will diversify the Computer Science course offerings at Eastern and will be designed for students in a Liberal Arts setting so that students from various departments can take the course and get benefits of getting involved with actively contested questions, and cutting-edge technologies. National Science Foundation (NSF) has strongly supported for designing courses to connect key concepts and questions with students’ early and active involvement in systematic investigation and research. This will be one of such courses. Eventually students are expected to sense the excitement that comes from working to answer important questions.

Nanotechnology is being considered as the “Next Industrial Revolution” with the potential to transform nearly all aspects of human life. According to the NSF, the nanotechnology workforce will reach two million by 2015. It is vital to prepare students as future leaders in a world where nano-science and technology will bring the next industrial revolution. This field is exceptional because it combines many disciplines including Physics, Biology, Chemistry, Social Science, Materials and Environmental Science. The complexity of nanotechnology not only requires a concerted effort among specialists in each of these fields, but there is also an increasing need to disseminate
this knowledge to the wider population in order to create public awareness and to build workforce competitiveness.

Nanotechnology has been the potential to improve things and immensely influence our future world by solving the problems which are yet to be solved. Whether we are scientists or activists to protect our world from further harm, it is important to learn and understand nanotechnology. What is the impact of “nano” on future human lives and societies? How should we proceed for this new form of science and technology? What can we learn from the past experiences to avoid mistakes?

**Nanotechnology Initiative in Connecticut:** Over the past seven years, Connecticut has been at work advancing Nanotechnology development in the state. That began with work by the Advisory Council for Nanotechnology, which includes the Department of Higher Education. Legislative interest and expectations required Connecticut to develop an action plan to advance Nanotechnology. The CSU System recognizes the growing importance that nanotechnology has on Connecticut’s economic future. In summer 2008 CSU System office formed a CSUS Nanotechnology Committee through designation the representatives from all four CSUS universities. I was selected to represent Eastern.

The grant contributed to some significant work in progress. Completed activities and future work are outlined as follows:

1. **The goals of the course were set:**
   The goal of this *High Impact* course is to enable students to:
   - Examine, organize and synthesize information in ways appropriate to the emerging field of Nanotechnology.
   - Act in informed and ethical manner in our future global society which is anticipated to be affected by the advancements in Nanotechnology.
   - Foster curiosity and a passion for learning more on both positive and negative impacts of nanotechnology.

2. **Catalog course description and course objectives were outlined:**
   - **Catalog Course Description:**
     The objective of the course is to attract young minds to the introduction of the cutting edge field of nanotechnology. Students will be exploring how nanotechnology provides opportunities to multidisciplinary study. Students will address benefits of nano-science and technology and its societal problems in including health, environment and energy. This introductory seminar course without any prerequisite to be enrolled not only by science majors but also by non science and undecided majors and will provide science literacy for humanities majors.
   - **Course Objectives:**
     This is a new course offered by ECSU on this contemporary subject. This new course would fit into the TIER II category. Broadly, the objectives of this course can be summarized as follows:
• To introduce the students to the broad interdisciplinary field of Nano science and technology and the technology behind it;
• to consider the societal implications of nanotech in the context of social, scientific, historical, political, environmental, philosophical, ethical, and cultural ideas applied from other fields and prior work;
• to develop student’s thinking, idea producing, questioning, and communication skills (written and verbal).

3. In search of course reading for nanotechnology:

• Text Book:
One of the most challenging aspects of this unique course is to find a suitable text which will meet the course goals. Deciding on a text book is always a challenge as my philosophy is to make student buy not more than one text book. In the process of designing the course, considerable amount of time was spent in research of currently available books and reading materials and to find out suitable materials for Tier II level research and discussions. Following are the text for the course:

 ✓ Primary text:
  • Nanotechnology: Science, Innovation, and Opportunity by Lynn E. Foster

 ✓ Secondary text (students does not have to buy this, I will have multiple copies):
  • Nanotechnology: A Gentle Introduction to the NEXT BIG IDEA by Mark A. Ratner and Daniel Ratner

• Additional reading materials:
Readings will consist of scholarly articles, book chapters and popular essays written by scientists, activists, philosophers, and public policy experts. Additional material will be drawn from various websites that address nanotechnology.

4. To design course elements:
The course is designed to integrate lectures with seminars and projects. For example, I would introduce a given topic via lecture. Students will then get involved researching current publications on the topic, and then process student discoveries/learning about the topic in a seminar format in which students would deliver small-scale individual or group presentations. The seminar portion would enhance a student’s ability to talk before a group of people and improve in their presentation skills, answer questions and defend their conclusions. This will create a learner-centered class in which students become active participants in the learning process. I believe when student actively participate in class, their interest in the subject increases.

Extensive research was done over summer 2011 to locate multiple reading materials (listed in the syllabus) on each of the topics, which will be suitable for our Tier II students. Following is a list of topics to be considered in the course:
Debates and response papers:
One of the major goals of this course is to foster critical thinking skills in student’s mind. One of the characteristics of good critical thinker is to – organize thoughts and articulate them concisely and coherently. The assignments (organized in class debates and response papers) will be designed to enhance their ability to communicate effectively with others orally, visually and in writing. They will be required to engage in debates through which they are expected to demonstrate respect for others points of view dissimilar from one’s own. In class debates will assess student's grip of the course readings and will probe how well informed students are about the major ethical, social and political issues in the debates surrounding nanotechnology.

Response paper topics:
- How can Nanotech solve world’s water (one of the vital problems) problem?
- Negative effects of Nanotechnology applications on Health and Environment.

5. Ongoing activities:
- A tier II course proposal will be submitted to LAPC
- Dissemination: Because of the innovative and distinctive nature of this course and as a means of getting feedback on the course design, I will submit presentation at the annual CSU Computing Conference. Feedback from colleagues from the other CSU institutions (together with feedback from student evaluations) will be used to refine the course. In addition, I will look for other appropriate venues to present the design, development and experience of this course.

Final Budget
Summer stipend (worker compensation/fringe benefits will be deducted from this amount) of $2500 will be used for partial compensation for this work once salaries are processed.