Professors' Instructional Approaches and Students' Perceptions of nanoHUB Simulation Tools

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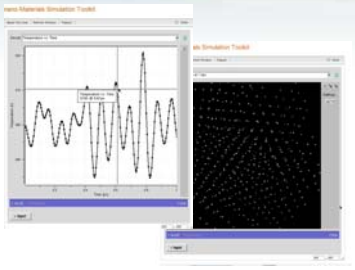
Introduction:

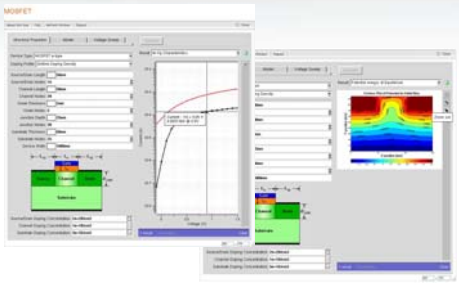
Simulations:

- can provide a critical element of learning experiences,
- have become a critical part of computational science, and
- are considered as the "third-leg" of the contemporary methodologies of science
- can provide multiple representation to enhance comprehension and insight

Opportunities exist to use the same simulation as both a *tool* for experts and a *learning environment* for novices.

What needs to be done to accomplish this duality?





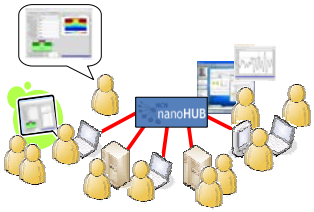
The tool:

The Network for Computational Nanotechnology (NCN) has developed nanoHUB as a resource for advancing nanoscience and nanotechnology

nanoHUB.org focuses on:

- pioneering the development of nanotechnology from science to manufacturing through innovative theory,
- providing research quality exploratory simulation, and
- novel cyberinfrastructure that support communities for research and learning

It has become an outstanding educational source in nanotechnology-related concepts and theory.



Methods:

Goal: Identify professors' instructional approaches and students' perceptions of using the nanoHUB's simulations as learning tools.

How do instructors integrate nanoHUB resources into their instructional practice?

What are students' perceptions of using nanoHUB simulation tools?

Does students' level of expertise and interest in the course content relate to their satisfaction with the instructional approach?

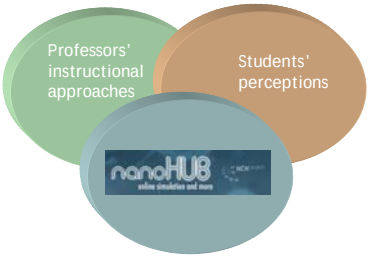
The participants for the study included:

- two professors in the NCN and
- 34 students who are enrolled in the graduate level classes these professors teach.

The data collection procedures included: interview professors and survey students.

Students responded to the survey by indicating their level of agreement with a statement based on their experience. The rating was assigned as follows:

Strongly agree	4
Agree	3
Disagree	2
Strongly disagree	1



Results:

Framework: Wiggins and McTighe's backward design

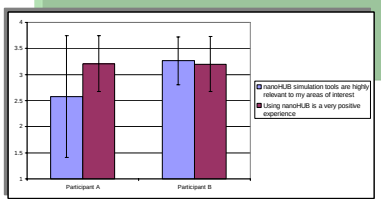
Learning Outcomes

simulation tools were used to convey concepts having "endurance value beyond the classroom"

Instructional goal: To give their students a sense on how investigations must be conducted in their areas of expertise as well as ways in which professionals work on those disciplines.

Instructor A emphasized that the cognitive benefit for students is to help them develop a more intuitive understanding on what is happening with the materials from a molecular point of view.

Instructor B focused on helping students develop a more intuitive feel for the process of designing semiconductor devices by identifying and manipulating the important parameters and measurements to be considered in a model.



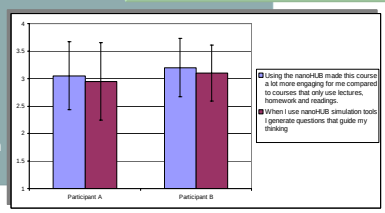
Instructional Approach

Frequency of use:

- Instructor A used the simulation tool to cover one specific learning goal
- Instructor B made an intensive use of the simulation tools within the entire semester following a progression of complex activities culminating in a design challenge.

General approach:

- Introduce the basic concepts in class, describe the models and analytical and practical solutions
- Explain how to operate the simulation tool
- Solve the same models by simulation
- Elicit from their students to compare the approximations done in class versus the exact solutions computed by the simulation tools



Evidence of Learning

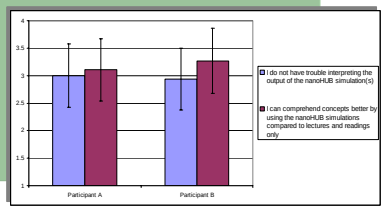
The participants designed assessments featuring real challenges

Instructor A focused his assessment in:

- predicting behavior of materials according to specific parameters
- comparing the behavior with experimental values
- reading a journal article and predicting parameters of a specific material using th simulation tool and then
- comparing student's solution with the solution given by the article authors.

Instructor B focused his assessment in:

- designing devices to meeting industry target parameters
- reading a paper that presents some measured data from a current generation device
- tweaking the parameters in the model so they can get a best fit
- meeting parameters of a next generation device



Implications:

Results indicate the potential of integrating the nanoHUB simulation tools into formal learning experiences.

Instructors leveraged nanoHUB simulation tools potential in providing students with authentic learning experiences in which knowledge was successfully applied to practical applications.

The students' surveys show favorable results in how professors incorporate nanoHUB simulation tools to learning experiences in different disciplines.

Future work: How can instructors in undergraduate courses follow similar approaches? Would additional scaffolding be needed?