Computing Across the Curriculum

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Recognizing that a traditional liberal arts education supports a wide range of needs and emphasizes individualization of learning style, Allegheny College began searching more than three years ago for computer support that would: (1) not demand conformity to existing instructional software and that, (2) help answer the needs of Allegheny students. Faculty identified those pedagogical problems they found most intractable and the goals they hoped to achieve in their courses. A computing committee decided that local development of computer-based tools and lessons—custom-designed by faculty—was one of the approaches that held promise for addressing the demands of a liberal arts curriculum.

Over the past three years, Allegheny has created a large program for development of computer tools and lessons for disciplines ranging from religious studies to physics. Today there are 43 classes in chemistry, biology, philosophy, English, physics, mathematics, geology, and religious studies using software developed on NeXT computers by faculty and Educational Computing Services staff. Following is a partial list of applications:

- ***Reimann Sums***—A front end to *Mathematica* to illustrate the concepts of a lower, midpoint, and upper Reimann Sum and their relationship to the concept of an integral
- ***English 100 Lessons***—A suite of 12 separate applications that teach important concepts in writing
- ***Reader's Response***—An easy-to-use bulletin board for students to raise questions about their reading and for other students to give responses to those questions
- ***Annotate***—An application that allows faculty in all disciplines to insert voice comments into papers that students submit electronically via NeXTmail
- ***Gene Mapping***—Simulates a standard experiment to locate genes on a chromosome (see Figure 1)
- ***Secants***—For instruction in calculus to show the relationship between the secant at a point and the derivative of a function
- ***Commentator***—Allows students to select a portion of a text and make it a button that will bring up written and/or voice commentary on that selection
- ***Landslide***—Shows students the geological forces in soil and rock strata and allows learning experimentally about what conditions produce landslides
- ***Barrier***—A physics application that displays a time-dependent wave function for a particle approaching and interacting with a potential barrier giving a graphical demonstration of a fundamental quantum mechanics principle
- ***Table***—A periodic table developed as a tool for students to use while working on other chemistry applications
- ***Idiom***—Helps foreign students taking English as a second language learn American idioms

This represents a fraction of the applications developed Allegheny. The central feature of the curriculum is that faculty are creating new, computer-based simulations and tools for teaching traditional liberal arts subjects. In the process, they re-explore these subjects and find new insights both for their teaching and for their research.

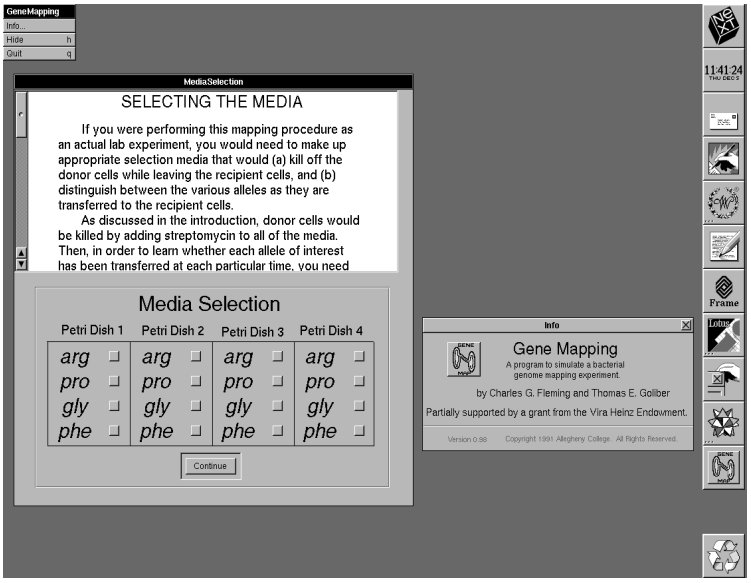

Figure 1 *Gene Mapping, a simulation of an experimental procedure known as "interrupted mating technique" that can be used to determine the relative locations of genes on a bacterial genome.*

The Role of NeXT at Allegheny

Three aspects of the NeXT platform are essential to Allegheny's goal of individualization of learning. First and foremost is NeXTstep—the most powerful development environment available. Without the Application Kit and Interface Builder, it would be impossible for a large number of faculty at a small liberal arts college to develop computer tools and lessons for use by students in the classroom. What previously would have taken faculty and staff months or even years to complete, now takes only days. This makes it feasible to develop instructional applications in the same amount of time that one would have spent on developing traditional lessons—yet with much more powerful and profound results.

NeXTstep has turned many faculty at Allegheny from computer users into application developers. The breadth of this result is incredible: faculty in chemistry, biology, mathematics, philosophy, geology, and physics develop their own instructional software. Others in these areas, plus those in English and religious studies, design lessons to fit their needs that are then created by Educational Computing Services.

The second crucial feature is the range of representations that the NeXT environment allows. The power of PostScript drawing allows us to create many varied graphical representations of subjects that otherwise would be reduced to text. The combination of textual and graphical representations appeals to a wide variety of cognitive styles among our students, thus answering individual needs. Sonic representations are also possible, as in the case of voice commentary on papers. Many students respond better to voice comments than written ones. The range of representations that is possible with NeXT allows us to cast wide pedagogical nets.

Finally, the ease of use of such a powerful environment is crucial. The central focus in all our classes, except computer science, is on the course material—not on the computer. We have students using NeXT computers in less thanhour. Soon they are using our custom applications as well as commercial applications, such as WordPerfect and Lotus Improv, with such ease that they can focus on the problem or material at hand rather than the syntactical difficulties of the computer (which one would find with another platform).

At a traditional liberal arts college, this "transparency" of the computer as a teaching and learning tool is essential. Electronic mail—NeXTmail—has also created a revolution in communication between faculty and students. Many faculty now make assignments that require the use of e-mail among students to promote collaborative learning.

It is impossible to summarize the benefits of NeXT technology for what we call "Computing Across the Curriculum." It is fair to say, however, that a combination of features: (1) a powerful development environment, (2) the ability to provide a range of representations of reality, and (3) the transparency of the machine, makes NeXT the only computer that would allow Allegheny to use computers in the classroom the way it does today.

For more information on computing at Allegheny College, please contact:

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Joel Smith is a historian and philosopher of science who received his Ph.D. in history and philosophy of science from the University of Pittsburgh in 1987. His research interests include the structure of scientific theories, the history of quantum theory, and non-standard logics. His special interest centers on the the nature of scientific representations of the world—their logical structure and the role they play in the discovery process. Smith has taught in the History and Philosophy of Science Departments at Allegheny College and Indiana University. For the past two years, he has directed an effort by faculty and staff at Allegheny to find a more significant role for computer-based representation and reasoning in support of teaching, learning, and research at the college.

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