Navigating the cyberlearning landscape: A case study involving teaching the central dogma of biology

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Introduction

Cyberlearning—learning that is mediated by networked computing and communications technologies—is increasingly influencing undergraduate science education and is providing useful new models for engaging students (Borgman, 2008). Cyberlearning, as effective and innovative efforts to harness the immense resources available on the web and applying them to learning is a significant challenge facing educators today. This project sets out to identify and characterize ways that college biology faculty can use digital resources to engage students in meaningful learning (Jonassen et al., 2003). We focus on a single core topic area, the central dogma of molecular biology, highlighting example resources and strategies that can be applied to other topics and courses. Our goal for the project is to raise faculty awareness about the availability of diverse online resources and suggest innovative teaching approaches that take advantage of the new information landscape. This poster contains a sample of the materials that have been compiled, a pedagogical characterization of the types of resources available, a discussion of search strategies for finding resources and suggestions for their use in teaching undergraduate biology.

Digital libraries: online sources of learning materials

The National Science Digital Library program has produced curated collections of online teaching and learning materials built through contributions from the education and research communities (Mervis, 2009). Unfortunately, there is not one centralized database of all materials available, but rather, materials are spread out across many different digital libraries, each having their own organization and focus.

Example activity: using multiple animations to dissect transcription and translation

The example assignment shown below takes advantage of the many different representations of the processes of transcription and translation that can be harvested from digital libraries. After viewing three different animations, students answer questions regarding how each video portrayed a certain aspect of the topic. They can examine the level of detail in each video and why certain features were portrayed as they were. By examining multiple sources, the students get different perspectives that can be combined to enhance their understanding of the subject. This practice gives the student more engagement with the material, rather than simply watching a single video, requires comparisons across representations, and allows the student to make decisions about the quality of each representation, as a teacher would when choosing an animation to show to the class.

What are the challenges of teaching the central dogma?

The central dogma of molecular biology is an essential topic for all Introduction to Biology courses. It is fundamental to understanding biology and is reiterating and built upon in nearly every advanced Biology course. It is often a difficult concept for students to grasp, particularly the way in which information flows from DNA to RNA to protein (e.g., Glykos, 2011). The processes involved are highly dynamic and require many different factors, making them difficult to visualize.

How can cyberlearning facilitate meaningful learning?

Listed below are some practices that cyberlearning activities can mediate or encourage. They emphasize student-centered approaches where learning is active, intentional, constructive, authentic, and cooperative (Jonassen et al., 2003).

Providing high-quality content – A variety of learning resources can be found online for any given topic.

Student-directed learning – Students are actively involved in the obtaining and processing of information.

Collaboration – Students work together to build more meaningful work than each student could achieve on his/her own.

Using scientific data – Students can view, manipulate, and interpret real scientific data in order to test hypotheses and form conclusions.

Modeling professional practices – Through activities such as case studies and simulations, students practice skills useful in their future careers.

Relevance – Cyberlearning activities often use real-world examples to put topics into the correct context.

Access to multiple resources and perspectives – By comparing and contrasting multiple resources, they can achieve more understanding than simply analyzing one resource (see example in top right panel).

Interdisciplinary investigations – Cyberlearning skills can be used in any subject and often bridge many different disciplines.

Adaptability – Many resources can be customized to meet the specific needs of the teacher or class.

Making the learning process visible – Both teachers and students can monitor student work and reflect on what works and what does not.

Leaving a digital legacy – Students’ work is preserved online and can be viewed or expanded in the future.

Examples of cyberlearning resources

DNAi – www.dna.i.org - A part of the Dolan DNA Learning Center (www.dnalc.org) created by the Cold Spring Harbor Laboratory. This website provides a historical perspective for the molecular biology revolution, telling the story of DNA through the scientists and experiments that unraveled its mysteries. The site also includes animations of DNA walkthroughs allowing students to decode the information contained in DNA, use lab techniques to manipulate genetic material, explore genomics, and see real-world applications of DNA science.

NCBI Bookshelf – www.ncbi.nlm.nih.gov/Bookshelf - Provides free access to over 700 texts in life science and healthcare. The website is designed to allow easy browsing, retrieval, and reading of scientific content.

Anupurto – intro.bio.umb.edu/Anupurto - Pronounced “ay poh too,” the name is “Ultopia” reversed. This software, developed by Brian White at the University of Massachusetts-Boston, simulates the genetics, biochemistry, molecular biology, and evolution of organisms in a biologically reasonable and pedagogically relevant way.

References and resources


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