

The Connexions Project – Education for a Networked World

The Connexions Project is a new approach to authoring, organizing, and delivering educational materials that fully exploits modern information technology. Available free of charge to anyone, Connexions offers custom-tailored, current course material, is adaptable to a wide range of learning styles, and encourages students to explore the links among courses and disciplines. In contrast to the traditional process of textbook writing and publishing, Connexions fosters communities of authors, instructors, and students, who together fashion continually updated “modules” from which courses are constructed. Preliminary trials with Rice University faculty and students over the past year have been so successful that our electrical and computer engineering department has resolved to implement a holistic new Connexions-based curriculum. The ideas and philosophy embodied by Connexions have the potential to change the very nature of textbook writing and publishing, producing a dynamic, interconnected educational environment that is pedagogically sound, both time and cost efficient, and fun.

Connexions – A Coherent Solution

While most web-based publishing merely migrates standard textbook material to the web with no adaptation to its unique structure, Connexions exploits the flexible information organization and rapid communication capabilities of the Internet and the World Wide Web. The Connexions environment rests on the unique combination of four fundamental concepts:

- ***Modules of information*** that cover a specific topic within a greater subject and contain hyperlinks pointing to prerequisites, applications, and supplementary material.
- ***Web-based navigational aids*** for students to explore easily the “connexions” between topics currently being taught and those covered in other courses.
- ***Software*** for instructors to weave modules together into customized courses that can be placed on the web, presented in class, and printed as a paper text.
- ***Free, collaborative development*** of modules by a large community of authors under an open-content license (following the way the Linux operating system is developed).

The result is a coherent system for course development, organization, and delivery that mutually benefits students, instructors, and authors.

Benefits of the Connexions Project

Connexions has the potential to set the standard for the development, organization, and delivery of educational materials in the networked age.

- ***Holistic and Diverse.*** By linking concepts across courses and even disciplines, Connexions provides students with a “big picture” vision. Connexions also helps instructors build curricula by bringing into focus the gaps between courses and by making it simple to provide prerequisite knowledge. Further, a great diversity of ideas,

ideologies, and pedagogical methodologies can be easily and quickly introduced through modular course construction.

- ***Flexible and Current.*** Modules can be developed to cover a wide range of learning styles and can be woven together to create an infinite number of courses, accessible either on-line or in print form. Materials can be developed across many fields of study, and they can be easily adapted to, and developed in, a variety of educational environments, including K-12, continuing, distance, and corporate education. Because modules can be easily adapted, added, or removed, their information stays current.
- ***Collaborative and High Quality.*** Connexions fosters the development of a diverse worldwide community of authors who work collaboratively to create, expand, review, and maintain modules and courses. Thanks to a peer-review process and pride-of-authorship (much like the Linux development model), high-quality modules and courses result.
- ***Efficient.*** Breaking course materials into discrete modules drastically reduces the time commitment from an author, who can now write a high-quality module in an evening or weekend. Making all content modules and software freely available leverages the efforts of a worldwide community of scholars and ensures the broadest application of all Connexions tools.

Background, Present, and Future

A team of faculty has been developing and using Connexions at Rice University since 1999 to great success. Several hundred modules now form the basis for three electrical and computer engineering undergraduate courses at Rice as well as the framework for a holistic new information technology curriculum (spanning the departments of electrical and computer engineering, computer science, and applied mathematics). Faculty members at institutions worldwide (including Rice, University of Illinois, University of Michigan, Ohio State University, Georgia Institute of Technology, Polytechnic University, Ecole Normale Supérieure in France, Ecole Polytechnique Fédéral de Lausanne in Switzerland, and Stavanger College in Norway) are forming author and instructor communities to develop thousands more modules.

In parallel with content development, we are creating a suite of software tools for authoring modules, organizing them into courses and curricula, and navigating through them. We encode all modules using the extensible markup language (XML), which allows Connexions to support myriad output formats (from web pages to e-books to printed pages), enables powerful search mechanisms, exhibits links between related modules, and displays and prints clear and attractive mathematics (using MathML).

Going forward, we are developing modules and courses to span our *entire* core electrical and computer engineering curriculum (over fifteen courses) as well as branching into other disciplines in the sciences, specifically bioinformatics. In the future, we would like to expand into humanities as well, making Connexions the standard at Rice for all electronic course materials. We will also involve the nine institutions above in composing modules and nine customized courses on digital signal processing, a key electrical and computer engineering focus area whose rapid development defies traditional textbook treatment and thus is particularly well-suited to the Connexions development model.