

An Open Educational Resource for the Americas

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ABSTRACT

A barrier to development of Latin America, especially of engineers and the high-tech industry, is the lack of sufficient modern educational material in Spanish and Portuguese. This paper describes the success of a pilot project that has initially provided certain electrical engineering material in Spanish and proposes a major effort to broadly provide high-quality technical educational material in Spanish, Portuguese, French, and English, free to the user, via the Connexions curriculum management facility, content repository, and open-source community, using the internet delivery vehicle and targeting all of the western hemisphere.

Keywords: education, Spanish, Connexions, e-learning, e-books, globalization, competitiveness

1. INTRODUCTION

One of the main barriers to development of a vital, vibrant high-tech industry in Latin America is the minimal Science, Engineering, and Mathematic educational material and curriculum written in Spanish and Portuguese. This especially true for material at the college and university level, but also remains a challenge in primary/secondary education, in industrial training, and in continuing education (especially dire, given an aging population). The goal of the Connexions in Latin America project is to provide an easy interface and management platform, an infrastructure for maintaining content, direct technical assistance with implementation and training, and an open-source style community of peers committed to self-help that results in a significant increase in both quality and quantity of engineering and technical educational material available free in Spanish and Portuguese. This will be achieved by using the Connexions system which allows easy translation from English and other world languages to Spanish and Portuguese and, equally important, allows easy generation and educational use of new material in Spanish and Portuguese. This system is part of the global Open Educational Resource (OER) movement.

The traditional method of writing, publication, distribution, and use of text books is very mature and is much too slow and expensive to serve today's educational needs (which now run at 'internet speed'). It also shuts out many potential authors of high quality educational content and creates significant barriers to innovation. Because Connexions is Internet and Web based, its content is freely available world wide and distribution also free and virtually instantaneous. The Connexions framework is flexible, responsive, and easily adaptable to local needs.

Because Connexions content is licensed under the Creative Commons copyright, the material is free to be copied, improved, distributed, and used any way the instructor or student wishes as long as attribution is reserved and given.

A very interesting experiment was conducted last year when some Electrical Engineering material that had been in Connexions in English for some time was translated into Spanish by graduate students at the University of Texas at El Paso. The usage and popularity of this material had a dramatic increase to being at the very top of our usage chart. Almost all of that increase came from use in Latin America. The simple translation of existing technical material into Spanish has the potential to increase the educational material available to a huge number of people in the western hemisphere. But our hope in this project is far greater than simple translation. Once Connexions in Latin America becomes known, the community of contributors will strengthen and much original material from the region will become available, further enhancing standing of Latin American scholars and engaging them in greater global participation (both intellectually and operationally).

In the long run, this flow of technical educational content and ideas is not unidirectional. Connexions also allows the generation of new content in Spanish or Portuguese so that there is flow from south to north as well as north to south. Ultimately, Connexions is about the formation of global communities dedicated to improving education and enhancing the quality of graduates. In engineering, computer science, and other technical disciplines, this is increasingly recognized as fundamental to establishing national competitiveness and maintaining compelling value in today's global marketplace. The road to economic growth is clearly built on technology, so focus on excellence in engineering and technical education is critical in the context of national capability and ability to compete – effective systems of innovation in the knowledge-based economy demands investment in education in general and enabling tools, like Connexions, specifically.

Of extreme importance to the success of this project is the use of a common platform, protocol, and licensing agreement so that we may better share and build on existing material. Connexions supports a full complement of capabilities including from on-line, interactive content management to the printing of high quality, up-to-date inexpensive books. This is key. We must think in terms of enabling the entire ecosystem of knowledge transfer by not only creating access to and contribution of intellectual capital, but by also truly understanding local concerns and ensuring the smooth flow of knowledge from authors to student's minds.

2. CONNEXIONS

Connexions has the overarching goal of making high-quality, open-source educational content available and free to anyone, anywhere, anytime. Established in 1999, Connexions is based on a set of intuitions shared by a remarkably wide range of academics: that knowledge should be free and open to use and reuse; that collaboration should be easier, not harder; that people should get credit and kudos for contributing to research and education; and that ideas are linked in unusual and surprising ways.

Connexions welcomes authors, teachers, and learners to *author, maintain, and use* textbooks, courses, and learning materials from a globally accessible, open-access repository. In Connexions, anyone can create “modules” of information – smallish, Lego block documents that communicate a concept, a procedure, a set of questions. Connect some modules together, and you have a web course or textbook, or build a curriculum entirely of your choosing and easily leveraging the best work of your peers worldwide. All content is open-licensed under the Creative Commons attribution license; all tools are free and open-source.

Over the course of recent history, much has changed with the advent of the internet and the realities of globalization. Education systems, especially at the university level, have not kept pace with change and the accelerated rate of knowledge creation. Old skills are taught and inertia reigns as the internet train relentlessly pushes today's curriculum into irrelevance. Higher Education largely serves the needs of Industry and this inertia, especially in the developed world, risks national competitiveness through the predictable lack of human resources.

Connexions is designed to overcome some of the serious problems associated with the traditional method of transmitting educational information – publishing.

First, Connexions strives to bring *people* back into the educational equation, in particular those people who have been “shut out” of the publishing world, like primary/secondary teachers, scientists and engineers out in industry, and people who do not read and write English. Now these individuals are able to participate not solely as consumers of educational content, but as active contributors to a shared global repository of knowledge. Access to modern curriculum is the start. Connexions is an inclusive strategy and a great deal of energy is spent on ensuring local contributors can quickly and effectively join.

Second, Connexions reduces the *time lag* between producing a textbook and getting it into the hands of students. This is particularly important in fast-moving areas of science, technology, and medicine. Moreover, it allows instructors to rapidly customize and remediate textbooks, course by course, or even week by week. This is key to delivering current, dynamic curriculum modules to classrooms worldwide. Through Connexions, it is easy to see how today’s latest learnings can quickly become available and part of what graduates bring to bear. Innovation demands relevant skills and timely access to information is fundamental.

Third, Connexions brings down the extremely high *cost* of teaching materials, with no compromise in the quality of the presentation or print. For example, thanks to a collaboration with on-demand press QOOP, Inc., a new 300-page, hard-bound textbook sells for \$25 through Connexions, as opposed to \$125 from a traditional publisher. Similar agreements throughout the Americas with other publishers allow custom book creation, publication, and delivery at much reduced prices to the region. Connexions also enables even less expensive options: users can print materials themselves or use them on-line at no charge. This ability will allow us to disintermediate the academic publishing industry – providing authors and information direct access to students.

Today, Connexions is one of the most-used open-education resources on the web, employed in traditional college and K-12 settings, in distance learning, and by lifelong learners around the globe. Demand is surging; currently the Connexions servers handle over 16 million hits per month representing over 600,000 unique visitors from 196 countries. Volunteers are translating modules and courses into a range variety of different languages, including Spanish, Portuguese, Japanese, Chinese, Vietnamese, and Thai; many of these are our most popular.

Connexions content development is grass-roots organized and inter-institutional. Our most active content development areas at present include music, engineering, physics, chemistry, bioinformatics, nanotechnology, and history. For example, a vibrant community of electrical engineering faculty from Stanford, UC Berkeley, University of Illinois, Michigan, Wisconsin, Ohio State, Georgia Tech, Rice, Cambridge, and TU Norway is developing a customizable digital signal processing (DSP) curriculum in Connexions. National Instruments is contributing DSP training materials as well as developing a free “player” version of their popular LabVIEW signal processing tool that will make the materials come alive with sights and sounds, adding much needed interactivity to engineering curricula.

The University of California at Merced is developing their Introduction to Biology and College Algebra courses in Connexions and is committed to using the Connexions platform across its curriculum; recently, they hired a full-time Connexions facilitator. Their mission is clear: “UC Merced will increase educational access and opportunities for Valley students.” Connexions provides an open-access platform to support their close collaboration with community colleges and secondary schools. Indeed, local schools and colleges can use UC Merced-generated content in their classrooms. This ability to “re-contextualize” content is one of Connexions’ greatest strengths.

The National Council of Professors of Educational Administration (NCPEA) is developing a Connexions knowledge base in school leadership and administration that will supersede their current printed materials. NCPEA is also developing a community-based peer review process that involves practicing principals and superintendents to identify and direct readers to high-quality materials that they endorse as an organization. This effort will serve as an example to other professional societies and journals.

With the College of Oceanographic and Atmospheric Sciences (COAS) at Oregon State University, Connexions is exploring dynamically generated content driven by over 17 terabytes of telemetry data per day from real-time

ocean/atmosphere observations and predictions. Dynamic science requires a dynamic medium. Connexions authoring process will be automated so that the materials always have the most current data, analyses, graphics, and imagery.

Connexions is the engine driving the Rice University Press, which will reopen after a decade-long hiatus in early 2007 as an all-digital press. RUP will operate just as a traditional press, up to a point. Manuscripts will be solicited, reviewed, edited, and resubmitted for final approval by an editorial board of prominent scholars. But rather than waiting for months for a printer to make an expensive bound book, RUP's digital files will instead be run through Connexions for automatic formatting, indexing, and population with high-resolution multimedia and web links. Users will be able to view the content online for free or purchase a paper copy of the book. RUP's catalog will never go out of print and will be continuously updated.

In the Connexions Community College Initiative, we are developing the top 10 community college courses, including English composition, college algebra, introduction to psychology, general chemistry, and so on. These courses, with appropriate remedial materials, will be available for free in Connexions and in a low-cost printed form. We are working closely with a number of community college partners to ensure that major state-based curricular requirements are addressed, so that the materials can be used immediately. Our goal is to dramatically affect the economics of textbooks in community colleges by providing high-utility courses in Connexions that can be customized and affordably printed.

Connexions' open-source system software is *Rhaptos* (rhaptos.org), a Plone-based educational content management system, developed in house. All content is encoded in CNXML, a variant of XML, to maximize the use of meta-data and semantic content, thereby facilitating searching and construction of semantic webs. Connexions encourages the use of domain specific markup languages, such as MathML, which embed semantic content. Connexions is working with National Instruments, Inc. to use Labview with Connexions to allow interactive virtual laboratories and demonstrations of technical topics.

Connexions has received support since 2000 from the William and Flora Hewlett Foundation, the US National Science Foundation, and Rice University and its trustees. The Tech Museum of Innovation, one of the country's leading science and technology museums, recently named Connexions a Tech Museum Awards Laureate in its education division.

Having established momentum in the US and developed world, the developing world is of great interest to Connexions and its community. The government of Vietnam has selected Connexions as its platform for higher-education materials development and dissemination for the entire country. Teachers without Borders, which has community teaching and learning centers in 12 countries and teacher training materials in use in 84 countries, is making their materials available in Connexions. Hewlett-Packard sponsored a program at the ASEE's Global Engineering Education conference 2007 in Brazil. Since a significant challenge in delivering content to the developing world is the availability of computer and network resources, Connexions is developing a relationship with the AMD 50x15 project. 50x15 aims provide 50% of the world's population access to computers and the internet by 2015.

In terms of access and impact, Spanish and Portuguese will enable large portions of the world's academics to join the Connexions movement, significantly impacting large numbers of students.

3. CONNEXIONS FOR THE AMERICAS

In the Connexions for the Americas project, we are fostering the creation of a critical mass of high-quality educational materials in Spanish, Portuguese, English, and French for use and re-use by the entire population of the Americas. This has been started by a group at the University of Texas at El Paso translating several Electrical Engineering modules and courses into Spanish. We are now establishing conversations with universities in South and Central America to start grass roots creation of materials in Spanish as well as to translate English modules into Spanish.

This paper is an open invitation to the authors of Latin America to contribute to changing education and the world.

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