Sharing an Open Resource in Medical Education

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Abstract: As the Internet continues to advance new technologies and ideas, we must look for opportunities to collaborate, share and leverage our educational resources in higher education. Sharing educational resources in the form of freely licensed materials, also known as Open Educational Resources (OER), is necessary in order to mutually leverage current advances in learning technologies. Online resources are being used in a variety of contexts to supplement instruction and training in medical schools. As such, The Center for Cardiovascular Research is constantly looking for opportunities to provide educational initiatives that appropriately prepare students and science teachers with skills, techniques, and applications for conducting medical research in a laboratory setting. The objective of this Open Courseware project was to develop a blended learning instructional program to assist users in developing familiarity with laboratory techniques prior to conducting molecular biology research in an authentic laboratory setting. The site experienced significant growth in unique visitors, especially in the period subsequent to its pilot use in a professional development program.

Keywords
open education resources, open courseware, molecular biology, laboratory, training.

Introduction

As the Internet continues to advance new technologies and ideas, we must look for opportunities to collaborate, share and leverage our educational resources in higher education. Sharing educational resources in the form of freely licensed materials, also known as Open Educational Resources (OER), is necessary in order to mutually leverage current advances in learning technologies. Open Educational Resources (OER) are teaching and learning resources that are accessible to the public and sometimes licensed for reuse in alternate settings. Open Courseware refers to sets of OER organized into cohesive educational units, or courses, that frequently utilize videos, simulations, tutorials, and a variety of learning tools that help facilitate an online learning experience (Wiley, 2007). As online resources are being used in a variety of contexts to supplement instruction and training in medical schools, we are constantly looking for opportunities to provide educational initiatives that appropriately prepare students and science teachers with an introduction of skills, techniques, and applications for conducting medical research in a laboratory setting.

The objective of this open source educational project was to develop an effective blended learning instructional program to assist users in developing familiarity with laboratory techniques prior to conducting molecular biology research in an authentic laboratory setting. The project was undertaken by the Center for Cardiovascular Research at the John A. Burns School of Medicine (JABSOM), University of Hawaii – Manoa. Materials are displayed online, allowing interested parties worldwide to freely gain access to the educational opportunities traditionally offered only in limited locations. Further, these web-based instructional materials aim to be self-paced. This project provides the crucial infrastructure to disseminate basic molecular biology training to a vast audience, and enrich the pool of biomedical researchers worldwide.
Background

Open education has followed the same path of development that we have seen in other open systems including open source software, open access, and open archiving. Open education as a movement sits within the broader framework of the history of openness that brings together a number of disciplines and fields that have a direct effect on knowledge and learning (Peters & Britz 2008). Education has always been dependent to some degree on changing information and communication technologies. The Open Education movement has expanded the development of curricula and educational materials as the Internet has changed the way existing content resources are shared and distributed (Wiley & Gurrell 2009).

Building upon the well-accepted practice of laboratory internships, a new blended learning approach was proposed - combining open educational resources (digital and web-based), including virtual laboratories, to augment laboratory training. The participation of health sciences educators in the realm of OER provides the opportunity to shape how information is generated, used, and shared for the benefit of future generations of health-care workers, especially those in developing countries (Lee, Albright et al. 2008). This approach could vastly improve access to high quality instruction and address the needs of many students. Once such resources are created and infrastructure is in place to deliver them, there are no additional costs to share and distribute these commodities. Typically the use of learning objects has been used to support traditional instructional approaches. Blending learning allows developers of distance learning programs to create instruction that is more student centered, as it allows the user to control their own learning experience by adopting the learning style that suits their needs (Ruiz, Mintzer et al. 2006).

In most applications, a blended learning approach combines traditional instruction, distance learning strategies, and the use of multimedia to support learners and their needs (Hoic-Bozic, Mornar et al. 2009. It is important to consider learning objects as instances of learning design when the content is being developed in order to increase the effectiveness of each learning object as it is being reviewed by the user (Boyle 2010). Blended learning, mixing online and face-to-face learning modes, is being utilized with the expectation that it will assist with transfer of knowledge (Lee, 2010). It is important to consider the use of specific OER when planning and designing blended learning scenarios. Blended learning has been a successful strategy as learning materials tend to be dynamic and are geared toward a student-centered approach that allows learners to interact with the resources at their own pace.

The Study

This study examines the use of OER-integrated online instructional modules developed to augment traditional laboratory internships. The online modules (the site) were first used by a JABSOM professional development training program. The training program was implemented with a combination of online training materials supplemented by seven in-class laboratory demonstration days, over a period of four months between February and May 2010. Participants were given access to the online training materials once they had completed their pre-program survey and prior to hands-on laboratory training. Therefore, the teachers were given access to the online instructional modules prior to working in an actual laboratory. After completing online-guided activities, the participants performed work in a laboratory that covered the material they studied online. Usage statistics were monitored during this period, and subsequently, to determine the extent to which the site was accessed as a publicly available open educational resource.

Twenty participants, each advanced biology teachers (including 2 National Board Certified teachers) piloted the molecular biology content and online resources during this program's initial four month period. The average biology teaching experience for the participants was approximately thirteen years. The participants were selected from a pool of secondary biology teachers from the State of Hawaii, including the islands of Maui, Kauai, Oahu, and the Big Island. The Center for Cardiovascular Research chose individuals that had significant experience teaching advanced courses in biology, as they would be exposed to students who were most likely to follow a path leading into biomedical research careers. Additional screening for participants who had demonstrated leadership experience at their respective school sites was important to our study as we were looking for input from the leadership of the science teacher community in the State of Hawaii.

The OER Site

The online training materials are divided into four modules, each consisting of several topics. Each topic is divided into subtopics that contain the learning objectives, content material, animations, and activities.

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<th>Introduction to Molecular Biology</th>
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<th>Objectives</th>
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<td>b. Molecular Biology Laboratory Equipment</td>
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<td>c. Measurements, Solutions, &amp; Calculations</td>
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<td>b. Nucleic Acid Amplification &amp; Sequencing</td>
<td>b. Protein Detection &amp; Analysis</td>
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<td>c. Nucleic Acid Hybridization &amp; Expression Analysis</td>
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<td>d. Molecular Cloning</td>
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<td>e. Preparation, Purification, Quantitation of DNA &amp; RNA</td>
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Table 1: Molecular Biology Online Training Materials.

There are a variety of videos demonstrating Molecular Biology laboratory techniques located in several topics where the particular techniques are explained in the content area. In addition, each module contains video introductions to each topic. The Introduction module takes approximately 2-3 hours to complete. Each additional module takes approximately 6-9 hours to complete, depending on the users’ background knowledge in those respective areas. The content of the instructional modules was assembled through three steps: 1) permission to use materials from a well-developed in-person training at the University of Calgary was obtained, 2) links to publicly available, well-known and highly regarded online resources, such as those of Cold Spring Harbor Laboratory or Howard Hughes Medical Institute were vetted and selected, and 3) a web design was generated based on recommendations from reviewers and the addition navigation, structure and video elements.

**Step 1.** In collaboration with the Director of the Biotechnology Training Centre at the University of Calgary, Dr. Hutchins, a well-developed modular curriculum was modified to efficiently address the lack of access to rigorous training available in Hawaii. The Faculty of Medicine at the University of Calgary had previously developed a series of curricular modules to efficiently increase the technical skills and scientific capabilities of its students. Their modules included the following topics: Nucleic acids, Proteins, Web-based Informatics, Cell Culture and Microscopy basics, Genomics/Proteomics, Integrated Cell Biology, and Genetics and Biochemistry. Dr. Hutchins allowed JABSOM to modify the developed curricular materials for Hawaii’s target learner cohorts. These modules were repackaged for web-based delivery to better accommodate the access issues of Hawaii’s geographically isolated audiences. Table 1 lists the modules and subsets developed.

**Step 2.** The development of the instructional modules incorporated an extensive review of web-based content materials available to the public from various distinguished sources. The modules integrated various animations, simulations, tutorials, virtual labs, videos, and additional web-based content from the sources described following. Reviewed sources included materials developed by the Howard Hughes Medical Institute, the Cold Spring Harbor Laboratory and Dolan DNA Learning Center, the Massachusetts Institute of Technology, The National Human Genome Institute, the National Center for Biotechnology Information, the University of Calgary Biotechnology Training Centre, the Arizona Biology Project, and the University of Maryland Baltimore County’s Applied Molecular Biology Program. These sources provided an array of content materials presented in various formats that include two-dimensional and three-dimensional guided animations, video segments, interactive tutorials and problem-sets, laboratory protocols, and virtual laboratory investigations. These up-to-date, technology-enhanced virtual learning resources enriched the curriculum materials provided through the collaboration with Dr. Hutchins at the University of Calgary. The developed module subsets contained specific learning objectives, content, and learning activities.
Step 3. The website design was completely overhauled by a multimedia specialist whose explicit role was to modernize web design, navigation, and features (refer to Figure 3). The design change was implemented prior to introduction to the 20 advanced biology teachers. The web design changes were based on recommendations from the two National Board Certified teachers, the content experts, and the multimedia design specialist. The instructional modules were expanded to provide videos of laboratory techniques common to the current research investigations taking place in different JABSOM laboratories. The development and integration of new video segments unique to JABSOM have provided a virtual insight into the laboratory facility and allow for demonstrations of specific techniques utilizing authentic research equipment. The video demonstrations incorporated important audio and visual components into the instructional modules to enhance the web-based learning environment.

Data Collection Method

Web usage statistics were collected over a 13 month period starting with the implementation of JABSOM’s pilot professional development training program in February 2010 and ending March 2011. Statistics were gathered using JOOMLA web statistics software to track unique visitors, number of visits, pages visited, hits, and bandwidth used. The results for these statistics are summarized in Figure 3. Each of these site statistics describes site use levels, however the authors focus on unique visitor statistics as the best measure of public consumption of the site.
Results

Figure 3: Web statistics for ccrhawaii.org

A distinct upward trend is evident in all five of the site measurements over the course of the 13 months. During the initial four-month period of JABSOM's professional development training program, unique visitors grew from 106 to 310 per month. The number of unique visitors to ccrhawaii.org continued to build from June, 2010 to March, 2011, with minor exceptions in July and December.

In March, 2011, the site had 1,891 unique visitors – over 6 times more than during the final month of JABSOM's pilot professional development training program. In the subsequent 9 months; June, 2010 to March, 2011; the site has not served as an assigned resource in JABSOM programs. Consequently, additional growth in unique visitor statistics is not attributable to its use in JABSOM programming, but likely reflects interest from a worldwide audience – referred either by human recommendation or by search engine results.

Conclusions

The use of open educational resources, especially when organized into open course-ware has proven to be an attractive model for educational offerings in recent years. The ideal of unrestricted sharing of such resources online has gained attention in all areas of education, publishing, and training. As the open effort continues to grow, its presence in the academic arena will proliferate. This study demonstrates the potential for expanding the reach of resources released as OER. By compiling such resources, both from original contributions and from existing OER, the ccrhawaii.org site proved a compelling resource that attracted an expanding number of users - far greater than the initially intended audience.

Such an expansion in online use could be leveraged in many ways. Institutions might seek to convert open courseware consumers into registered students. Visitors to open education resource sites could generate advertising dollars for the institutions investing in such OER. Teachers and students utilizing open distance
learning could take advantage of OERs, where teachers could disseminate content materials in lieu of textbooks and workbooks to a greater population of students, significantly reducing material costs. And perhaps most importantly, as quality OER are shared and re-mixed by other institutions with similar open ideals; all those involved can mutually leverage the results of the projects – achieving lower development costs for all. It will take a community of educators working in collaboration to take this movement to the next level. OERs are already being utilized to educate populations about healthcare issues. Large scale institutions such as the Howard Hughes Medical Institute and MIT’s OpenCourseWare project are two examples of OER that serve the medical and healthcare populations.

There are limitations of OERs that could hinder their rate of adoption in the academic realm. One concern is high startup costs since it takes a great deal of work to design and develop content materials in any given area of study. Training is another issue to consider when looking at the cost of using free software. Another limitation is faculty tends to be poor adopters of open source materials when they already have access to commercial products and many believe that open source products are not the same quality as the name brand products.

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References


