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Learning Objects in Higher Education

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Overview

Using digital resources to augment course development and enhance student learning is not a new instructional practice. However, extracting units of instruction—learning objects—from the larger course structure has the potential to transform the design and delivery of educational content. Learning objects could enable higher education to capitalize on the promise of e-learning, making it possible to improve the quality of instruction without requiring that every faculty member become an expert in media or technology.

A learning object is "any digital resource that can be reused to mediate learning."[1] These digital resources are housed in a database containing either the objects themselves or metadata describing the objects. Once these digital resources are submitted and stored in a repository, educators and students can search and access them to support learning. Many institutions are currently engaged in developing and centralizing digital collections that will be searchable and accessible to a wide audience. The benefits of creating and using digital repositories of high-quality learning objects are significant.

- An institution can save time and money if labor-intensive and expensive course development can be streamlined by putting together components. Instead of the "Lone Ranger" approach of each faculty designing or revising a course in isolation, institutions can assemble teams to develop modules, courses, and curricula using interactive, digital media. Course redesign efforts can target high-enrollment introductory undergraduate courses, leveraging the value of the original investment.
- Personalized learning can become a reality when a learner's profile, determined by preliminary assessment, is used to structure and sequence the learning components. "We are on the verge of being able to provide learning customized for each specific learner at a specific time, taking into account their learning styles, experience, knowledge, and learning goals."[2]
- At the institutional level, learning objects housed in digital repositories facilitate the sharing and use of valuable collections and services.

This Research Bulletin highlights the issues associated with the use of learning objects in higher education, covering key areas such as the search for operational definitions, the impact on the marketplace, and implications for policies and funding.

Highlights of Learning Objects

A convergence of history, business models, and new educational paradigms has led to the current interest in learning objects.

- Object-oriented programming focuses on code reuse to streamline program design and facilitate efficient software development. Widespread code reuse has

been characterized as the Holy Grail of programming in industries that seek to achieve rapid design and deployment of software.

- Global corporations such as Cisco, Inc. have applied a similar concept to their worldwide training needs. The goal of Cisco's Reusable Learning Objects (RLO) project in 1997 was to develop a streamlined method for the creation and delivery of training throughout the organization.[3] Their white paper, "Reusable Learning Object Strategy," provides a clear description of a standards-based approach for designing reusable information objects. Cisco wanted faster development, the ability to publish to multiple formats, and efficient population of e-learning initiatives with standardized, high-quality learning objects.

- In the same time period, higher education researchers began exploring the nature and origin of learning objects, seeking to define their role in the learning process. The first practical implementations for higher education emerged through the creation of the Multimedia Educational Resource for Learning and Online Teaching (MERLOT) project, an international cooperative for high quality online resources to improve learning and teaching. Funded in part by the National Science Foundation and sustained by higher education members, MERLOT continues to build its collection of more than 7,600 learning objects.

What Is a Learning Object?

The Internet is a vast collection of data, bits, and bytes of information. Therefore, a clear distinction should be made between data, an information object, and a learning object. Data, stored in databases or a data warehouse, is a descriptor about an institutional activity or function, such as an employee's human resource record. An information object is a digital resource that does not include any instructional scaffolding. An example would be a short video clip animating the process of a volcanic eruption. (The information object would be without information about who developed it, how to use it, and so on.) Information objects are usually stored in digital libraries.

Learning objects often are confused with information objects. True learning objects include learning objectives and outcomes, assessments, and other instructional components, as well as the information object itself. If these components are not incorporated within the learning object, they often are co-located or linked to it as a self-standing resource. Most learning object repositories and digital libraries contain a mix of information and learning objects. In fact, in many cases, no clear distinction separates the two.

One of the greatest barriers to the adoption of learning object initiatives is the inability of participating institutions to agree on what constitutes a learning object. Defining the size and scope (granularity) of a learning object may be difficult, but it is critical to creating a usable, scalable database of objects. Learning objects may be text, presentations, quizzes, simulations, video clips, tutorials, animations, photographs, maps, or assessments. For example, an instructor might want to demonstrate what the inside of a volcano looks like when it erupts. The Eruption Model from San Diego University contains an animation, explanatory text, and comparison volcano examples.[4] Conveying

so much material so efficiently qualifies this Web page as a learning object. On the other hand, the Caltech Institute Archives contains a searchable database of images.[5] A researcher can locate a 1779 illustration of a volcanic eruption near Naples, but the image is without instructional context and hence is an information object. These objects can be incorporated into the instructional context of "modules" and "courses," both familiar units of educational experience.

Visual metaphors help to illustrate the relationship between learning objects and the instructional context. Learning theory scholars formerly compared learning objects to the versatile children's toy, LEGO blocks. LEGOs are portable, durable, sharable, and interoperable and can be assembled into imaginative wholes by virtually anyone. David Wiley, a key scholar in the learning object debate, took issue with this popular metaphor.[6] He insisted that the comparison was dangerously simplistic and omitted the significant challenge of creating effective educational experiences with measurable learning outcomes. He proposed the more sophisticated metaphor of the atom. Unlike LEGOs, not every atom is combinable with every other atom. Assembly requires expertise and design strategies for functionality. Corporate universities expanded the definition to include placement and scope. For example, John Cone, former Chief Learning Officer for Dell Computer, talked about "snacking" as a metaphor for "bite-sized pieces" of "on-demand learning," where the larger goal is to enhance employee productivity.[7] Learning objects are used in teaching and learning in a variety of ways. They can complement a traditional, face-to-face course, much like showing a video or film. They can be assigned as homework or as collateral subject matter. An instructor or course developer can select specific learning objects and mix and match them, either with each other or with other course materials and instructional activities for use in online learning environments. Students can integrate them into their digital papers and multimedia presentations.

Learning objects are accessible and searchable through Web-based repositories and "referatories." A repository differs from a referatory in terms of where the learning object is physically stored. In a repository, objects reside within a database on the same server that hosts the Web-enabled gateway to the collection, whereas a referatory contains no objects but only links to objects residing on remote servers. In the repository model, the organization that administers the collection is responsible for updating material and most likely holds some intellectual property rights over the content.

Some developers are researching ways to build federated search engines. By developing standards for submitting queries to multiple search engines simultaneously they hope to invent simple, distributed systems that are capable of retrieving content across multiple collections. These collections may be repositories or referatories, but this distinction will be invisible to the end user.

Regardless of where collections are housed, they fall into two categories: general and discipline-specific. Within these categories collections can be open access or fee-based. Examples of open-access collections are MERLOT (http://www.merlot.org/) and Apple Learning Interchange (http://ali.apple.com/). XanEdu, which advertises itself as "digital and print publishing services" (http://www.xanedu.com/) is a fee-based collection. Corbis

Digital Images (http://shopping.corbis.com/) offers professional photography and fine art from more than 3,000 creative sources. Access to their 2.1 million online images is fee-based. Examples of open-access, discipline-specific collections include the Science, Math, Engineering, and Technology Education (SMETE) Digital Library (http://www.smete.org/) and The Harvey Project for Human Physiology (http://harveyproject.org/). The objects associated with these two collections are free.

To successfully customize and enhance modules, courses, and curricula, learning objects must have several attributes:

- **Portability.** Learning objects work across platforms and course management systems.
- **Accessibility.** Learning objects can be located and delivered to the learner efficiently.
- **Durability.** The core object remains stable and reusable even as operating systems and software packages change.
- **Interoperability.** Learning objects can be exchanged globally among various browsers and course management systems.

To achieve these goals, each object must be tagged with metadata or information about that object. Standards organizations such as the IMS Global Learning Consortium, Inc. (http://www.imsproject.org/) and the Dublin Core Metadata Initiative (http://www.dublincore.org/) have completed basic technical specifications. Another organization, Advanced Distributed Learning (http://www.adlnet.org/) developed the widely used Sharable Content Object Reference Model (SCORM). The Institute of Electrical and Electronics Engineers (IEEE) recently approved the Learning Object Metadata (LOM) standard, which defines a structure for interoperable descriptions of learning objects (http://ltsc.ieee.org/doc/wg12/LOM_1484_12_1_v1_Final_Draft.pdf).

Learning Objects in Higher Education

To report on the current status of learning objects in higher education, we conducted an informal, Web-based, environmental scan during May/June of 2002. Ninety-seven institutions responded. Based on the listservs used in the survey, we assume that the majority of respondents were staff working in instructional technology units or other information technology professionals. Forty-four percent of the respondents were from doctoral/research universities, 20 percent came from master's colleges and universities, and the rest were divided among the Carnegie classifications of baccalaureate, specialized institutions, and associate's colleges. Two-thirds of the respondents were from public colleges and universities, while the remaining one-third were from private institutions. Respondents provided information on general awareness of learning objects on campus, the nature of creators and cataloguers, and support, funding, and incentive issues.

The survey revealed that the production of learning objects is still predominantly the responsibility of faculty, though instructional technologists play important role. Sixty-one

percent of the respondents reported that instructors produce learning objects. However, 50 percent indicated that it was the instructional technology centers and staff members who were tasked with developing learning objects. The use of instructional technologists as developers of academic materials is worth noting. In most cases an instructional technologist partners with the faculty member, who serves as the subject matter expert. This partnership allows faculty to concentrate on what they do best—research, creative activity, teaching, and service—without having to focus heavily on technology. Students also play a role as contributors and users of learning objects. More than a quarter of the respondents confirmed that students are serving as producers of these materials. What they develop is being assimilated into the learning experience and often reused in other teaching venues.

Another shift in traditional roles is that of the information cataloguer. In the past, librarians have fulfilled the role of cataloguer for all published resources. However, in the case of "unpublished" learning objects, that task has yet to be assigned. Metadata tagging standards are just now being approved, and the Web-enabled, tagging applications for automating this process are still in the early stages of development. It is doubtful that faculty will be willing to take on this added chore. "Not applicable" was the top choice of our survey respondents when we asked who tagged objects at their institutions, indicating either that they were not tagging objects or that they had not assigned the task. Over 31 percent selected central IT staff, while 20 percent assigned the duty to librarians. Only 15 percent of our respondents identified instructors as catalogers.

Learning objects are being used in a variety of ways. As expected, instructors are incorporating them in their campus and e-learning courses. Almost 75 percent of respondents agreed that learning objects are being used in instruction to improve the quality of the learning experience. Many instructors like the learning object model because it is efficient—it allows them to reuse materials in more than one course or learning environment. Students are also using the repositories to mine resources that can fulfill their own course assignments.

Corporations that market course management systems (CMSs) to education and learning management systems (LMSs) to industry are developing commercial repository solutions. For example, WebCT's soon-to-be-released enterprise-level CMS product, WebCT Vista*,* is purported to provide functionality to store and share content throughout the institution using a central database. In addition, industry's e-learning content libraries, called learning content management systems (LCMSs), are promoting their products to higher education for learning object collections, training, and authoring tools.

What It Means to Higher Education

Shifting to courses based on learning objects has ramifications at many levels.

- A course, rather than being a single "entity," becomes a composite including components such as text-based material, multimedia-rich learning objects, face-

to-face activities, virtual discussions, interactive assignments, self-paced assessments, and critiques.

- Faculty or students have the option of selecting components. In some instances, faculty might choose the content; in others, the student might customize his or her own learning experience based on learning style, special needs, or level of competency.
- Faculty, along with instructional technologists and librarians, share responsibilities that include the architecting of information.
- Faculty roles shift from instructor to facilitator as students contribute and collaborate in the learning process.

Other, more speculative shifts may occur at some point in the future. For example, registrars may revisit the existing credit structure and assign credits in smaller units to match the modularized learning experience.

Developing Learning Object Systems

The technical aspects of developing and hosting a learning object repository can be expensive and daunting because of the size and complexity of the operation. Like an enterprise-wide data warehouse project, the infrastructure to support a repository is composed of clusters of powerful workstations capable of providing fast network connectivity and high-end database management operations. In addition, institutions will incur development, maintenance, and licensing costs for the repository and database software. To date, there is not an off-the-shelf, end-to-end solution available for the educational market. Most repositories run on homegrown or proprietary applications. For institutions not able or willing to invest in building a system from the ground up, MERLOT offers its consortium members an unsupported version of its Online Community Starter Kit. Many vendors provide pieces of digital asset management retrofitted from the corporate world. The course and learning management industries have promised to incorporate repository functions into their enterprise-level products, but no solution for the academic environment exists today.

Involving Faculty

There are costs above and beyond technical infrastructure expenses. Quality development of learning objects requires involving faculty in significant ways. Many institutions provide faculty with incentives such as training, stipends, release time, or student and/or staff assistance to support learning object development. Close to 45 percent of our survey respondents said that the funding to support this activity came from sources inside the institution, while almost 40 percent funded this activity from external grants. Over 25 percent had no additional funding dedicated to faculty support. Instead of relegating the development responsibility to faculty, many institutions have assigned this task to instructional design support units. In these cases, institutions may need to invest in instructional support teams, who then partner with faculty to unbundle the traditional course and develop modules of e-learning.

Assessing Quality

If learning objects are poorly designed or used inappropriately, learning will suffer. Therefore, two components of quality assurance must be addressed. The first is how the object is used, and the second is quality of the content itself. Critics fear that instructors will string together series of learning objects without pedagogical meaning. However, the situation with learning objects is no different from that of traditional media. Poor instruction is poor instruction, regardless of format. All accredited institutions have checks and balances in place to monitor and assess success in the classroom, whether physical or virtual.

The second component is the quality of the learning object itself. Who and what organization will review and rank objects to guarantee high quality in both content and structure? To address this problem, many repository organizations have review processes in place. Some are selective about submissions and use teams of professional educators to evaluate entries before inclusion. MERLOT has an open submission policy but has developed a standard format and sophisticated system for peer review. Modeled after the review systems used by traditional academic journals, carefully selected and trained faculty discipline teams review and rate learning objects relevant to their areas of expertise.

Rethinking Policies

To deploy a learning object repository on campus requires revising existing policies and drafting new ones. Intellectual property is a key concern. Over 40 percent of the respondents to our survey agreed that fear of compromising their intellectual property inhibited developing and sharing learning objects. Many institutions do not have clear-cut policies detailing who owns the rights to e-learning courses and their components, particularly if college or university resources were used to support development. Faculty tend to be skittish about loading their learning objects onto a central server or, even worse, a server outside of the institution, because of ownership and control concerns.

Digital rights management to protect the unauthorized exploitation of content is a related concern, especially if the learning object has real or perceived monetary value. Setting permissions and authentication levels for access means designing and instituting policies and mechanisms for copyright-cleared learning content. Additional policies will be needed to track and manage intellectual property rights, and perhaps to financially reward the individual or institution for use of learning objects. In addition, learning objects provide an additional reason for institutions to define the value of instructional technology (learning object development) in its promotion, tenure, and merit policies.

Conclusion

One might argue that our academic culture is not ready for this change in course design. However, the use of learning objects is not an all-or-nothing proposition, nor is it a new concept. Instructors are comfortable incorporating audio/visual resources, readings, guest lectures, and other instructional activities into their traditional classes. Learning

objects are the new and improved, digital version of these activities. If designed within a sound pedagogical framework, learning objects can be accessed from anywhere at any time. Instructors can create an engaging experience by using learning objects in an interactive context. Assessment can be in step with learning outcomes, and learners can test themselves to evaluate their own comprehension. With the promise of cost-efficient course development and customized learning, learning objects have given higher education a new lens through which to view its primary mission: education.

Key Questions to Ask

- Does our existing structure allow faculty to share and reuse digital learning objects?
- Do the digital materials constitute information objects, or have we linked them with sufficient instructional components to make them learning objects?
- Would investment in learning objects lead to higher quality and/or lower costs of instruction?
- Does our faculty development process encourage the creation and support the use of learning objects?
- Do we have a mechanism for linking instructional technology staff with faculty to ensure the best use of each group's skills in developing learning objects?
- Who will tag the content and populate and maintain the repositories?
- How will learning objects align with standard course management systems?
- How will the institution invite, support, and fund this activity?

Where to Learn More

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Endnotes

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