

Editor's Note: This project assesses feasibility of working with learning objects and implications for course development. It seeks practical answers to context and research questions such as: How do instructors use learning objects? Are there sufficient learning objects available? Can an instructor create an effective post-secondary course by (re) using learning objects? Despite a shortage of available objects, the three study teams, business, nursing, and literature, were enthusiastic about benefits for instructional design, production, implementation, monitoring student progress, and evaluation. They found value in the graphics, interactivity, and feedback data. They also noted ease of keeping content relevant and up to date.

Feasibility of Course Development Based on Learning Objects: Research Analysis of Three Case Studies

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Introduction

Learning objects offer potential for cost and time savings (Downes, 2000; Hodgins, 2003; Wiley, 2002c). However are these benefits being realized in current practices? This investigation examines the course development implications of a learning object approach to the design and production of online courses. This paper presents three case studies that seek to maximize the use of freely available and reusable learning objects in their course design. The three case studies originated in different university-level disciplines – Nursing, Business and English writing. Using the Internet, each group searched for and selected learning objects to integrate into a specific course. Throughout the course development process, the individuals documented and shared their experiences. They reflected on the availability, benefits and barriers encountered when working with publicly available learning objects. This paper discusses the feasibility, pedagogy, and cost-effectiveness of searching, retrieving and integrating online learning objects into a post-secondary distance education course.

Literature Review

The potential impact of information and communications technologies on all knowledge-based activities is far-reaching. Paradigm shifts have occurred in most disciplines, including education as these tools are applied to production, distribution and knowledge-building activities. In distance education, the use of technologies has transformed mail-based correspondence courses into interactive distance education, often referred to as e-learning. Previously, the greatest impact in distance education was the capacity to sustain communications and interaction in multiple formats [This needs an explanation. I don't understand]. More recently, we see these technologies used to enhance the storage, retrieval and modification of content, providing opportunities for reuse in different contexts

beyond their original purpose. A key factor for facilitating re-usability has been the use of object-oriented designs, in which digital learning content is designed in modular formats. These formats can be recombined, edited and annotated for reuse within and across disciplines. Wiley (2002b) writes that "the fundamental idea behind learning objects is that instructional designers can build small (relative to the size of the entire course) instructional components that can be reused a number of times in different learning contexts" (p. 4).

Numerous authors have offered definitions, characteristics and perspectives regarding the use and reuse of learning objects. Authors who have provided wide-ranging descriptions such as the potential and use of learning objects, theoretical examinations of appropriate size, taxonomies and means of evaluation, etc. include: Campbell (2003); Downes (2000); Gibbons, Nelson, & Richards (2002); Hodgins (2002); Littlejohn (2003); Longmire (2000); Martinez (2002); McGreal (in press); Muzio, Heins & Mundell (2001); Naidu (2002); Olivier & Liber (2003); Orrill (2002); Rogers (2002); Thorpe, Kubiak & Thorpe (2003); Weller, Pegler & Mason (2003); Wiley, Recker & Gibbons (2000a; 2000b); Williams (2002); and Wiley (1999a; 1999b; 2000; 2002a; 2002b; 2002c; 2002d; 2002e; 2002f; 2003).

Three works are particularly noteworthy. Wiley (2002c), Littlejohn (2003), and McGreal (in press) have each edited a book dedicated to online resources or learning objects. The array of subjects, authors' methodologies and case studies provide an excellent knowledge-base relating to learning objects. Weller, Pegler & Mason (2003) also provide an excellent empirical analysis similar in nature to this research undertaking though they focused on the creation, rather than reuse of existing objects. Weller, Pegler & Mason conclude that the use of objects did in fact improve the creation process through increased flexibility in incorporating different author styles, improved communications amongst course team members, increased speed of development and greater potential for reuse of content. However, many of these benefits accrued through use of better communications and distributed work tools among team members that are not necessarily related to a learning object approach to course design.

Despite the plethora of writings, it is challenging to extract a concise and agreed upon definition of learning objects. The widest definition of a learning object may be "any entity, digital or non-digital, that may be used for learning, education or training" (IEEE Learning Technology Standards Committee (LTSC), 2002, p. 6). This definition has been criticized as being too all encompassing to be of little use. Wiley (2002b) limits the definition to "any digital resource that can be reused to support learning" (p. 6). Many educators prefer to differentiate a learning object from information or content. For example, Weller, Pegler & Mason (2003) add that a learning object "addresses a clearly identifiable topic or learning outcome and has the potential to be reused in different contexts."

McGreal (in press) analyses different definitions and places them on a scale contrasting digital to non-digital and learning specific to anything and everything. He proposes a broad yet practical definition "any reusable digital resource that is encapsulated in a lesson or

assemblage of lessons grouped in units, modules, courses, and even programmes.”

Operationalizing this reuse capacity adds characteristics to the definition, such as the necessity for metatags for indexing, storing and retrieving learning objects. Some authors have also added a size or granularity requirement in their definition. For example, the UKeU defines a learning object as “the smallest element within an online course that defines a learning activity” (Darby, 2003). Some authors have defined learning objects in terms of their capacity to revolutionize the creation, storage and distribution of learning content. For example, Tom Barron (2000) has defined learning objects as “a new model for digital learning - one in which learning content is free from proprietary “containers,” can flow among different systems, and can be mixed and reused, and updated continuously.”

Koper (2001) attempts to differentiate between content resources and the learning design that is often developed around that content by formalizing the description of a “unit of study” that can model all of the related concerns of objectives, assessment, differing roles and other educational variables. In summary, the lack of a precise and agreed upon definition of learning objects, besides making any serious study seem fuzzy and ill planned, also limits productive dialogue and theoretical understanding of the application of learning objects in real-world implementations. For the purposes of this paper, we use a rather generic and functional definition of a learning object as a digital resource that is used within a formal course to support individual or group learning.

Learning objects have been created in nearly all formal educational disciplines, in a wide variety of multi-media formats. They have been designed for students at all levels, studying both at a distance and in classroom contexts. Despite this variety, an explicit or implicit methodology is required to effectively integrate learning objects into course design. The object-orientation of learning objects enhances their interoperability and reuse giving rise to a “Lego” block metaphor (Hodgins, 2002) for course construction using learning objects. This rather simplistic idea was criticized by Wiley (1999a) who favors a molecular model, in which only certain atoms (learning objects) can be combined to create stable molecules (units and courses).

Wiley (2000a) noted the inverse relationship between the size of a learning object and its re-usability. As the learning object’s size decreases (lower granularity) its potential for reuse in multiple applications increases. For example, a single image of a tree can be reused in many learning contexts, while a complete unit on tree botany is most likely confined to a limited number of applications unless the language, learning objectives, reception technology, etc. are altered (2000a). Hamel and Ryan-Jones (2002) also believe smaller learning objects better support flexible instructional design. Clark Quinn (2000) argues

First, with smaller granularity, there's greater potential for reuse of objects. ... By keeping objects smaller, they are more likely to be able to be reused in different contexts. Second, there's the opportunity to allow flexibility on the part of the

learner, or even to support intelligent processing. If the objects are small enough, and instructional experiences are composed of these objects, then different learners can have different instructional experiences. (Quinn & Hobbs, 2000)

Note how this use of learning objects assumes that the instructional design is embedded in the learning object. Despite the lack of consensus as to a definition and appropriate building metaphor, there is greater consensus as to the benefits (realized or potential) of course development based on a learning object approach. Longmire (2000) categorizes the arguments in support of learning object course design as:

- **Flexibility:** Learning objects are simple versus aggregate elements, resulting in the ability to contextualize at the time of use.
- **Ease of updates, searches, and content management:** Metadata tags can facilitate filtering, selecting, updating, and managing objects.
- **Customization:** The use of annotation tools and placement of objects within teacher-created web pages allows teachers to customize the object by focusing attention, rewarding certain practices, changing sequences and other ways of contextualizing the learning object content to the needs of a defined class of learners.
- **Interoperability:** The greatest potential strength of learning objects is the ability to be applied in multiple uses as they flow freely between learning systems and a variety of contexts.
- **Facilitation of competency-based learning:** Core competency skills, knowledge, attitudes and measurable outcomes can be achieved.
- **Increased value of content:** The commercial exchange of learning objects is enabled through a learning object economy.

The potential to reuse, rather than recreate, drives much of the discussion of learning objects. Besides the savings in original production costs, the accessibility and search-ability of learning objects provides at least the potential for commercial endeavors. However, as Johnson (2003) and Downes (2003) argue, this may be an illusive vision with many challenges yet to overcome.

An exponential growth in the inventory of learning objects available through the World

Wide Web is creating opportunities for institutions and instructors in their course development and delivery. As this inventory grows, learning institutions are able to profit from having instant access to a vast store of pedagogical content environments, simulations, applications and other learning aids organized into manageable units. Organizations such as CAREO in Alberta, MERLOT in California, and the TeleCampus in New Brunswick are providing accessibility to learning objects by implementing common metadata standards (most often the IEEE LOM).

Classification (and subsequent retrieval) of learning objects in repositories is based on standardized ways to describe or annotate the objects using metadata (data describing data). The process of applying these metatags is much like cataloguing books in a library, with the addition of metadata relating directly to their pedagogical function, ownership, version and access provisions. The implementation of meta-tags is critical for interoperability and accuracy in searching and retrieving learning objects.

Downes (2003) argues that the system for locating and distributing learning objects "is currently poorly constructed, based essentially on what may be called a silo model of distribution." He proposes a distributed model which "would create an open and accessible marketplace for learning objects, in essence, a learning object economy" (Ibid.). The lack of sharing and accessibility is considered to serve as a formidable barrier to developing learning object repositories. "The silo model is dysfunctional because it prevents, in some essential way, the location and sharing of learning resources" (Ibid.). Contributing factors to the existence of "silos" is believed to be proprietary standards, overly strict standards, monolithic software applications (enterprise solutions), closed marketplace through exclusive distribution agreements, disintermediation due to a lack of peer review or other means of independent evaluation, selective semantics attributable to a network application which standardizes an application profile and restricts use, and the issue of digital rights management. To counter these "silo" characteristics, Downes proposes "the development of an architecture for a distributed learning object repository network (DLORN)" (Ibid.). His proposed design has been incorporated by the EduSource development project that is building a distributed network of object repositories. It is characterized by an open-source infrastructure, component-based software, distributed architecture (no single service provider or software developer), open standards for interoperability with various networks, royalty-free standards, multiple data types and metadata classification schemes, integration with the semantic web, open access to prepare and distribute learning objects, open market for content distribution, as well as permission-based and brokered digital rights management (Ibid.). Wiley (2003) similarly (but wishfully) concludes that "when intellectual property issues and concerns disappear, money, effort, and other resources can be allocated to building up a library of free, nonrivalrous educational resources" (p. 7).

Learning objects are granular learning resources which can be used in a multitude of contexts. The inherent flexibility of this approach is appealing to the many course developers seeking to design courses efficiently and effectively. Learning objects are espoused as cost and time efficient by emphasizing search, retrieval and reuse over

individual creation. The ability to create customized courses by offering personalized learning environments for students is considered effective for learning. We conclude this brief review by quoting a rather fervent claim by one of the best known proponents of this new technology. Hodgins (2002) argues that:

Learning objects represent a completely new conceptual model for the mass of content used in the context of learning. They are destined to forever change the shape and form of learning and, in so doing, it is anticipated that they will also usher in an unprecedented efficiency of learning content design, development and delivery. However, the most significant promise of learning objects is to truly increase and improve human learning and performance. (p. 281)

This project strives to assess the feasibility of working with learning objects and the course development implications of the learning object approach against Hodgins' lofty vision.

Context and Research Questions

Athabasca University (AU) is Canada's Open University established in 1970. The mission of AU is a dedication "to the removal of barriers that restrict access to and success in, university-level studies and to increasing equality of educational opportunity for adult learners worldwide." As well, AU is "committed to excellence in teaching, research and scholarship and to being of service to the general public" (Mission Statement, 2002). AU currently serves over 29,000 students predominantly through individualized distance education study. AU currently offers 60 programs (master, bachelor, diploma and certificate levels) and more than 500 courses. In the large undergraduate programs, courses are predominantly offered for individualized study with continuous intake and personal tutor support. Individualized study presents special challenges in course design as it is much more difficult to rely on peer-to-peer interaction or "on the fly" teacher to class interactions to customize and contextualize students learning experiences. "For all courses, optional use of e-mail and attachments, voice mail, and Web access to services has been a major enhancement to "traditional" distance education, which relied on a print course package, fixed telephone office hours for tutors, occasional fax use and the postal service" (Davis, 2001).

The 2002 AU E-Learning Plan (2002) notes that 93% of non-computing program students have access to networked computers. AU strives to include a variety of online support services incorporated in every course by 2005. AU is moving aggressively to a development model in which learning objects are used as the principal methodology in the design, development and deployment of course materials across all subject areas.

Learning objects offer the possibility of re-using content and designs across disciplines and courses. Questions arise however as to the feasibility and cost-effectiveness of accessing generic learning objects from a variety of sources, contextualizing them for use in a particular course context and deploying them in online courses. To date, there has been

little research on the feasibility and cost-effectiveness of such a learning object approach – most of the literature has been focused on developing, storing, tagging and assessing learning objects. Issues to be examined in this investigation include the viability, costing, technical operation, copyright and pedagogical considerations of using a learning object approach in course design.

This research analysis seeks to test the feasibility, benefits and barriers associated with assembling previously constructed learning objects into viable course packages. The principal question to be addressed is “What are the advantages and barriers associated with the development of complete courses of study built from available learning objects?” As well, the research analysis will consider:

- How do instructors use learning objects?
- Are there sufficient learning objects available?
- Can an instructor create an effective post-secondary course by reusing learning objects?

Method

The research generally follows a development research design (Van Den Akker, 1999) in which complex learning content, created to function in complex real-world contexts, require research designs that assess the process as well as the outcome of the intervention. Development research is particularly applicable to learning objects as it “is often initiated for complex, innovative tasks for which only very few validated principles are available to structure and support the design and development activities. ... The aim is not to elaborate and implement complete interventions, but to come to (successive) prototypes that increasingly meet the innovative aspirations and requirements” (Ibid., p. 9). The research design entails preliminary investigation, theoretical articulation, empirical testing of the intervention followed by analysis and documentation of the research findings (Ibid.).

In this study, we used a *laissez faire* development methodology in which we asked three experienced distance education faculty members and course designers to create (or do a major revision) of one of their courses with the objective of reusing as many publicly available learning objects as possible. The three courses developers are subject matter experts in their discipline. The courses are all in different subject areas at the undergraduate post-secondary level. These include business writing, nursing studies and professional writing.

The business team course developers sought to revise an entry-level undergraduate

course. The goal envisioned by the developers was a course structure that would help students plan, write and edit simple informative texts (e.g., memos, e-mails, faxes, etc.) and more complex informative and argumentative texts (e.g., letters, reports, etc.). The student enrollment is forecast at 600 students annually. The skills-based course includes very little issues-based content. The developer states "students need to acquire conceptual knowledge (rule-based) about writing and practical knowledge as well." The focus on skill development will remain following revision, but the developers are seeking to increase the component of system-led student assessment (automated quizzes) following revision. The developers were originally optimistic that the learning object approach would provide a means for student evaluation.

The nursing team course developers sought to develop an entry-level course and revise an advanced-level course. The entry-level course offers an introductory survey-based learning for students with assessment led by an instructor. The advanced-level course deals with analysis of current nursing trends and issues with assessment led by student peers. The forecast number of student enrollment is relatively low at approximately 25 students annually for the entry-level course and 50-75 students annually for the advanced-level course.

The literature team course developers sought to develop a professional writing course. "Writing for Performance" is an advanced-level undergraduate course focusing on creative writing. The course focuses on writing for film, radio, screen and theatre productions. The course is seen to draw from numerous examples for students to consider, critique and discuss. The goal of the course is to encourage the creation of material that is of high artistic merit, but also demonstrates awareness of current marketing environment.

The three teams of course developers participated in an initial training session. The session introduced the concept of learning objects and provided an introductory document (Bartz, Paille, & Norman, 2003). The document includes various repository sources and discusses methods of evaluation for learning objects.

Following the initial group session, the individuals and their research assistants proceeded to creating or revising a course by using as many freely available learning objects as possible. Monthly surveys were conducted by email and telephone to discuss the following questions:

1. What sources and methods are being utilized for the selection of learning objects?
2. What assessment activities are being undertaken and tools utilized (website ratings etc.)?
3. What issues have been encountered (e.g., copyright)?
4. What benefits have been derived (ease of access, relevance, quality,

costs, time, etc.)?)

5. What barriers have been encountered (ease of access, relevance, quality, cost, time, etc.)?)
6. What is your perception of the feasibility of assembling learning objects into a viable course package?

As well, telephone and in person interviews were conducted with the course designers to conclude the research process.

This laissez faire development methodology differs significantly from the methodology followed by other instructional designers. For example, Muzio, Heins and Mundell (2001) use a more traditional approach to course development with a team being led by instructional designers. In our study, we wanted to see how AU faculty members could use learning objects. We purposely did not impose any new instructional designs on the course developers, but rather used the study to investigate how the new paradigm of learning objects could fit within their existing practice. From Rogers' (1995) classic theory of innovation adoption, we know that innovations must be compatible, offer relative advantage, be trialable and also compatible. Both the academic and the training trade presses are replete with articles expounding upon the benefits of developing learning activities by reusing learning objects, resulting in cost effective reuse of expensive content. This research project sought to determine if this utopian vision is the reality for three course developers at AU.

Results

Learning Objects - Availability and Selection

The availability of learning objects is a crucial consideration in determining the feasibility of using this approach in course design. The course developers were asked "what sources and methods are being utilized for the selection of learning objects?"

The lead individual in the business team initially browsed learning object repositories, but focused efforts on searching for 'boxes' rather than learning objects. He sought to construct a structure which would be filled in with learning objects that demonstrated the process under study, such as writing a memo. The research assistant focused on searching for learning objects, examining existing learning object classification systems and developing a unique classification system. However, it soon became apparent that the classification system being developed would transform the Internet search task into an endless and time-consuming cataloguing task. The team switched from classifying to selecting learning objects based on a sequence of course units and lessons. A system of folders was devised for collecting material relevant to each lesson.

The course developers in the nursing team set out with a goal of finding learning objects relevant to the variety of content included in their issues-based course. The nursing team used the MERLOT repository and general search engines (notably Google) as sources for finding and selecting learning objects. The web site provided the team with general information to consider purpose, authority, accuracy, objectivity and suggestions for further reading. The search method entailed determining search terms and critically evaluating sources for bias.

The course developers in the literature team sought to find learning objects which illustrated various approaches to writing scripts for public performance. Efforts were focused on finding model scripts and discourse at a suitable level. An abundance of web sites were found with learning objects of possible value. The team's search method entailed visiting various drama, film, television, and radio web sites. The web sites included personal sites of individual writers, broadcasters' sites and educational sites.

Learning Objects - Assessment

The course developers responded to the question "What assessment activities are being undertaken and tools utilized (website ratings etc.)?"

The selection of learning objects by the business team was based on their instructional merit and applicability to a lesson. The goal was to find enough learning objects to plan a typical lesson around predictable instructional/learning features such as examples, readings, writing rules, instructions and practical exercises. Various commercial software applications were considered such as Adapweb and the Electric Learning Kit.

The nursing team undertook a continuous assessment process to select appropriate learning objects. The process entailed describing the web site in a word-processing document under the heading of the issue concept under study. The descriptive statement described the fit, acceptability and ideas of how the web site might be best utilized.

The literature team also undertook evaluation on a continuous basis in combination with the selection process. Each course developer evaluated the various web sites according to their professional writing education and experience. Model scripts were evaluated to determine the degree to which they would meet the objectives of the course. Each model script was evaluated using personal judgment of the course developers as writers, directors, critics and teachers.

Learning Objects - Contextual Issues

The three course development teams were questioned as to how they contextualized learning objects. AU makes extensive use of study guides to assist students in the course learning process. The three teams were questioned as to the role of textbooks, reading lists

and study guides.

The business team found the issue of context as critical. The weakness of an incompatible context, when following a learning object approach, proved to be an insurmountable barrier. The team concluded that "students need learning objects designed in a highly cohesive and effective learning environment." Their frustration with the wide variety, level and approach of various publicly available objects caused them to look at available commercial products that were designed as an integrated whole. They found an online and interactive textbook consisting of a printed text with a supporting web site containing various interactive exercises directly linked to the text. They believed this approach was better able to "provide a rich environment that enables students to learn via a variety of 'learning paths'."

Both the nursing and literature teams wrote a context narrative to envelope the learning objects. The nursing team drew on past experience of extensive reading file materials to support course learning. The reading file of 20 to 30 print articles has now changed to a web site resource with five links. The literature team also determined that they would continue to use a reading file of published articles and also incorporate interactive learning objects.

Learning Objects - Issues Encountered

The course developers responded to the question "What issues have been encountered through this process?" The issues of search strategy and copyright were discussed with the course developers.

The business team found the search for learning objects to be difficult with inconsistent results. The team perceived online learning material as more suitable for designing a preparatory on-line writing course, than for a specialized second-year writing course. Learning object repositories and Internet web sites provided the team with very few learning objects. Those found were deemed to be of questionable relevance. The goal for the skill-based course being developed was to find high quality learning objects with strong content. Context emerged as a major issue as the writing style between web sites and learning objects varies greatly, as does the interface environments in which the learning material is located. Context emerged as a major issue with a "patchwork result" in the course development process a cause for concern. The issue of copyright was seriously considered and served as a deterrent to employing learning objects. The team considered contacting publishers to negotiate copyright. However, only a portion of the publisher's web site or online material was needed for inserting as the learning object into the course. The onerous copyright process was not considered time or cost effective and thus not pursued.

The main issue encountered by the nursing team was determining when to conclude the search process. The abundance of learning objects, they found, required administrative discipline to maintain an order to the search and selection process. While searching, the

team undertook assessment of the material, therefore requiring a record to be kept of web sites visited and which may also work well in other courses. Copyright did not emerge as a major issue. The nursing team sought to revise the course without having to seek copyright. Free use web sites, such as the Canadian Nursing Association (CNA) and Health Canada, allow for free use with acknowledgement. Copyright clearance was not sought as the team believed the fair dealing exemption would be applicable. The web site sources were not hosted, but rather merely linked to. All sources were referenced appropriately and web site information regarding copyright was abided by.

The literature team was more concerned with copyright than the nursing team. The nature of the learning objects required special attention to copyright clearance. An email was sent to several web sites to seek copyright clearance for possible learning material. The literature team focused on permission to transfer learning objects to Athabasca University's server. The team wanted to host learning objects on the server at Athabasca University to ensure the availability of online resources for students. Partial access to core material is unacceptable, resulting in the team pursuing system requirements for hosting.

Learning Objects - Benefits

The question "what benefits have been derived (ease of access, relevance, quality, costs, time, etc.)?" was posed to each of the three course development teams.

The business team considered the learning object approach as pioneering instructional design. The approach "permitted designers to respond to students' learning needs and learning styles not addressed in a 'book-based' learning experience." The use of readings and instructions from on-line journals (cleared for copyright) through the AU library's subscription to e-journals and various journal syndication services was seen to enhance the course lessons. The learning object approach diminished instructor control, but improved graphics content, interactive capabilities and the opportunity to institute online student assessment with automated quizzes.

The nursing team considered the learning object approach as timely. Web sites provide timely content, which is likely to be revised sooner and more easily than comparable print resources. As well, the nursing team favoured the use of interactive media available through learning objects.

The literature team, like the nursing team, considered the learning object approach as timely. Timeliness of online content is preferred to textbooks which are considered to be quickly out of date. They believed a likely benefit will be relevance, as very current discussions and writing models can be found online. The learning object approach is perceived to allow for spontaneity, creativity, diversity and variety in learning resources.

Learning Objects - Barriers

The question "what barriers have been encountered (ease of access, relevance, quality, costs, time, etc.)?" was posed to each of the three course development teams.

The business team struggled with four barriers. The first barrier was difficult deadlines attached to the six month course development project. The deadline was perceived as short and resulting in the need to seek rapid solutions when faced with obstacles. The second barrier was the perceived scarcity of course-relevant learning objects. Learning objects collected were found difficult to incorporate into a course structure. The lead developer states "gathering and assessing objects is tedious and very time consuming – it must be guided by a clear vision of what objects are required to form a lesson rather than a lesson being designed around objects." The scarcity of lesson content requires that course material be created by the team. The third barrier was the perceived lack of quality in learning objects available. While some web sites were considered to contain excellent content many were considered inappropriate for use in the course due to web-based formatting problems, differences in presentation style and a generally "low-quality look." The fourth and critical barrier to the use of learning objects is the issue of context. Lesson content and writing style varies greatly from website to website. A lack of coherence in website content is of particular concern for students studying writing. The team was faced with having to "patch together" lesson material from a variety of web sites. The lead developer strived to achieve a solid concept to envelope the learning objects in order to draw in students. The team decided to use an interactive textbook supplemented with additional learning objects linked to on a course web site.

The nursing team struggled with a perceived abundance of web sites. The developers tended to visit a large number of web sites of questionable relevance. The quality of the web sites was extremely varied, requiring continual assessment and tracking. Some difficulty was encountered in finding content geared specifically to nursing. The issue of context emerged for this team as well with resolution through a written narrative.

The literature team struggled with technology issues. Information system difficulties were encountered while downloading learning objects to the AU server. The team was concerned with the cost implications in providing a supporting platform. As well, the cost for the learning object itself may serve as a barrier when copyright permission or royalty fees are accounted for. The size of learning objects also presented a barrier. Learning objects are seen as effective for reading short pieces, but more difficult with larger components (such as a book).

Learning Objects - Feasibility

The question "what is your perception of the feasibility of assembling learning objects into a viable course package?" was posed to each of the three course development teams.

The business team struggled with finding relevant learning and freely available learning

objects. The outcome of the learning object approach is perceived to be incomplete, very poor in content, and not academically sound. Rather than focusing on freely available learning objects, the team turned their attention to commercial learning resources and on-line journals.

The nursing team perceived that assembling learning objects into a viable course package as quite feasible. Question arose relating to the level of academic rigour, which is a critical driver in developing any university level course, but was resolved by the creation of commentaries, exercise and discussions forums around the objects.

The literature team perceived assembling learning objects into a viable course package as highly feasible. The content, level of study and student-base of their course makes the learning objects approach appealing. Regarding the student-base, the computer literacy of the students must be considered in determining feasibility of a learning objects' course design. The student-base for the course is believed to be orientated to using the computer, online resources and asynchronous communications. A dialogue forum will form a portion of the students' course requirements with students being required to review and critique the work of others online.

Course Development - Instructional Design

The influence of instructional design was discussed with the developers. The teams were queried as to how they would describe the instructional design of the course being developed and if an instructional designer or specialist was consulted. We attempted to determine if an initial template or model was followed and revised during the development process.

The business team determined that finding high quality learning objects required too much effort and was not time efficient. The result of this search and course development process was a "patchwork learning environment" which was considered "not learning effective." The lead developer states "given available learning objects, the design of lessons, learning activities, and ultimately, the design of a course were severely restricted."

The nursing and literature teams fared better in their course development. The nursing team sought to incorporate reflective and critical thinking components into the course design. The design process followed was deemed successful and relevant to the learning object approach. The design process followed entails: preparing (determining the level of knowledge), practice (exercises) and reflecting (critical thinking). The literature team also considered their design process successful. The learning object approach allowed for interactive design supporting student dialogue via asynchronous communications.

Course Development - Production Process

The three teams used various approaches to the course production process. A course designer was not drawn into the production process. The three groups set out to develop the course based on their subject matter and teaching expertise.

The business team conducted a skills-based needs assessment as well as a pedagogical needs assessment. The skills-based needs analysis determined that students require more practical writing skills. The pedagogical needs analysis determined that students require more feedback during the course. The team stated they would value students' assessment of the learning object approach, particularly to address the instructional design issues such as a lack of context that they encountered.

Both the nursing and literature teams provided an enveloping context through a written narrative for the learning objects. Both teams also found that learning objects inspired course content. The nursing team determined an overall course design and then set out on a search for learning objects. The required readings are supplemented with numerous web sites located and referenced. The literature team searched for learning objects after the course design was determined. The course structure entailed four large areas for development. The team envisioned five or six learning objects for each of the four instructional areas resulting in 20 to 25 learning objects in total for the course.

Course Development - Production Issues

The three teams were questioned as to the tools and techniques used to incorporate learning objects into the course. During the interview, the possibility of modifying existing learning objects and creating new learning objects for contribution to a repository was discussed.

The business team was concerned about the large size of learning objects. The lack of success in finding suitable learning objects led the team to prefer a website that includes learning objects as a supplement to the course content. The perceived contextual weakness of the learning object approach resulted in an interactive text being selected. "The interactive text concept allowed us to co-opt technical help to design "small" learning objects rather than large ones that our team could not have produced."

The nursing and literature teams found an abundance of learning objects. Both teams did not consider creating learning objects, as ample supply was considered to exist. The nursing team found it difficult to stop searching for a "better" learning object. The literature team anticipates creating learning objects to enhance the course content.

Course Development - Production Time and Cost Efficiencies

The course development teams were asked if the focus on learning objects altered the speed and/or cost of producing the course.

The business team was concerned with tight deadlines and the perceived heavy time commitment required for creating learning objects. They concluded that the learning object approach "was too costly and time consuming." As well, they concluded that "gathering and assembling objects to create a course on one's own was not cost effective...it was cheaper to design a course around an existing online learning environment and curriculum designed by a publisher than to create one's own course."

The nursing team considered past experience with traditional (print format) course development with extensive time being required for editing and printing. The learning object approach is believed to be considerably faster, if the course production process is kept in the online format and not taken to paper format and then back to online format. They concluded that online courses following the learning object approach eases course editing and speed for revision.

The literature team did not perceive a fundamental change attributable to the learning object approach. Cost efficiencies are seen with the lack of a textbook being required, however web site administration will add to the course cost. Course cost was not considered a driving factor for this team.

Discussion

The course developers were challenged to use learning objects in their course design process. As discussed, selection of appropriate learning objects was challenging with accessibility, context and quality emerging as issues. The abundance of available material is helpful in selecting learning objects. However, great care must be taken in planning the search strategy and method of compiling results. A unified system of repositories and classification methods would assist course developers in their search, selection and retrieval of learning objects. Use of a general search engine may thwart the search process by rendering information overload. In the business course, the divergence and incompatibility of freely available objects was judged to be so severe that a commercial solution (a paper text book, supplemented with a variety of related and web-based customized multimedia objects) was deemed to be a more effective way to use networked resources.

All developers spent considerable time searching for relevant objects using tools that were not optimized for educational use. The development of more effective learning object repositories would have assisted all of the teams in focusing their search strategy and narrowing their search results. Repositories, with their classification and evaluation processes, may have provided improved search results by providing higher-quality learning objects. For instance, MERLOT offers learning objects which have undergone a peer review process. In addition to peer reviews, MERLOT offers quality ratings, assignments and access to discipline communities.

The issue of creating new learning objects (especially those incorporating multi-media) was dismissed by the course developers as being too difficult and expensive. However, it is important to consider the possibility of modifying existing learning objects. The adaptive nature of autonomous learning objects provides a foundation to build upon. The learning object approach depends on interoperability and adaptation. This adaptation process is termed "content repurposing" and "allows learning objects to become customizable and thereby promotes their reuse. Designing and developing educational material in a manner that allows the customization, editing and adaptability to learner needs is the key to providing cost effective, sustainable, and high quality educational materials" (Belle Project at <http://belle.netera.ca>).

Information technologies provide an enhanced ability to tailor content to meet particular needs. This is evident in the use of "cookies" in e-retailing where individual preferences are stored for later customization of the user interface. E-learning can also benefit from this ability of information systems to customize content to personalize content to meet an individual's unique learning needs. Facilitating variety in study patterns is an important benefit of the learning object approach. Students can choose to engage in particular learning experiences to a greater or lesser extent. Their active participation in the learning process is a distinct advantage of the learning object approach. Learners can be provided with an active environment with autonomy in choosing to follow various learning paths. "Each of the pieces of evidence contributes to an overall argument they are constructing, and thus the wider the pool of evidence they have to draw upon, then the richer their final assessment will be" (Weller, Pegler & Mason, 2003).

The role of course developers also changes as the learning object approach "means that there is far less requirement on the course team to write all of the material and to occupy student study time solely in reading course-authored text. The emphasis is instead on writing good introductory and framing material, structuring activities and locating engaging resources" (Ibid.).

The issue of context emerged as an insurmountable barrier for the business team. As a result of their dismay with the "patchwork result" derived from the learning object approach, the team decided to incorporate a preformatted interactive textbook. The value of context raises a multitude of pedagogical issues and debates. The decision of reverting to a textbook can be debated; it should not be assumed that the provision of a main learning resource for students is a superior means of learning. The ability to personalize the learning approach and customize learning materials to a particular learning style must be considered. Courses developed according to the learning objects approach do have a different contextual environment. Though:

it remains to be seen whether the removal of explicit connections may render the material more meaningful for students, since it places the responsibility for making such connections with the student. The integration between materials is thus an activity the student must engage with, rather than simply being spoon-fed. It is also

in keeping with more constructivist sympathies, that there is not one set of connections to be made between concepts, i.e. those of the educator, but rather a multitude and every individual will create their own meaningful overarching narrative. (Weller, Pegler & Mason, 2003)

Course developers must balance the value of a variety of learning resources, with different approaches to a subject and viewpoint being offered for consideration, against the need to provide coherence in the course materials. Variety may be beneficial to the learning process, but it does require students to alter their learning process as they approach the various materials. Weller, Pegler & Mason (Ibid.) state "a course that continually seems to shift dramatically in pedagogy, level or style would carry an overhead for students as they make the cognitive shift between objects and styles."

The variety of learning materials can be contextualized by the writing of narrative elements which provide cohesiveness in the course. Another approach is to include online dialogue such as in a computer conferencing system. The dialogue can provide a narrative thread through the provision of tutor and peer support. Students can be encouraged to make cognitive and contextual connections between the learning objects provided (Ibid.).

It is obvious from the different approaches adopted in these three case studies that there is no single best method for implementing learning objects in course design at the current time. Continuing changes in the storage, search and retrieval capacity; the ease and cost of acquiring rights for use; and the increasing capacity and ease of use of content creation tools will individually, and in aggregate continue to change the factors that inhibit and support course construction based on learning objects. In Figure 1 below, we illustrate the generic process of course creation based on objects as practiced in these case studies.

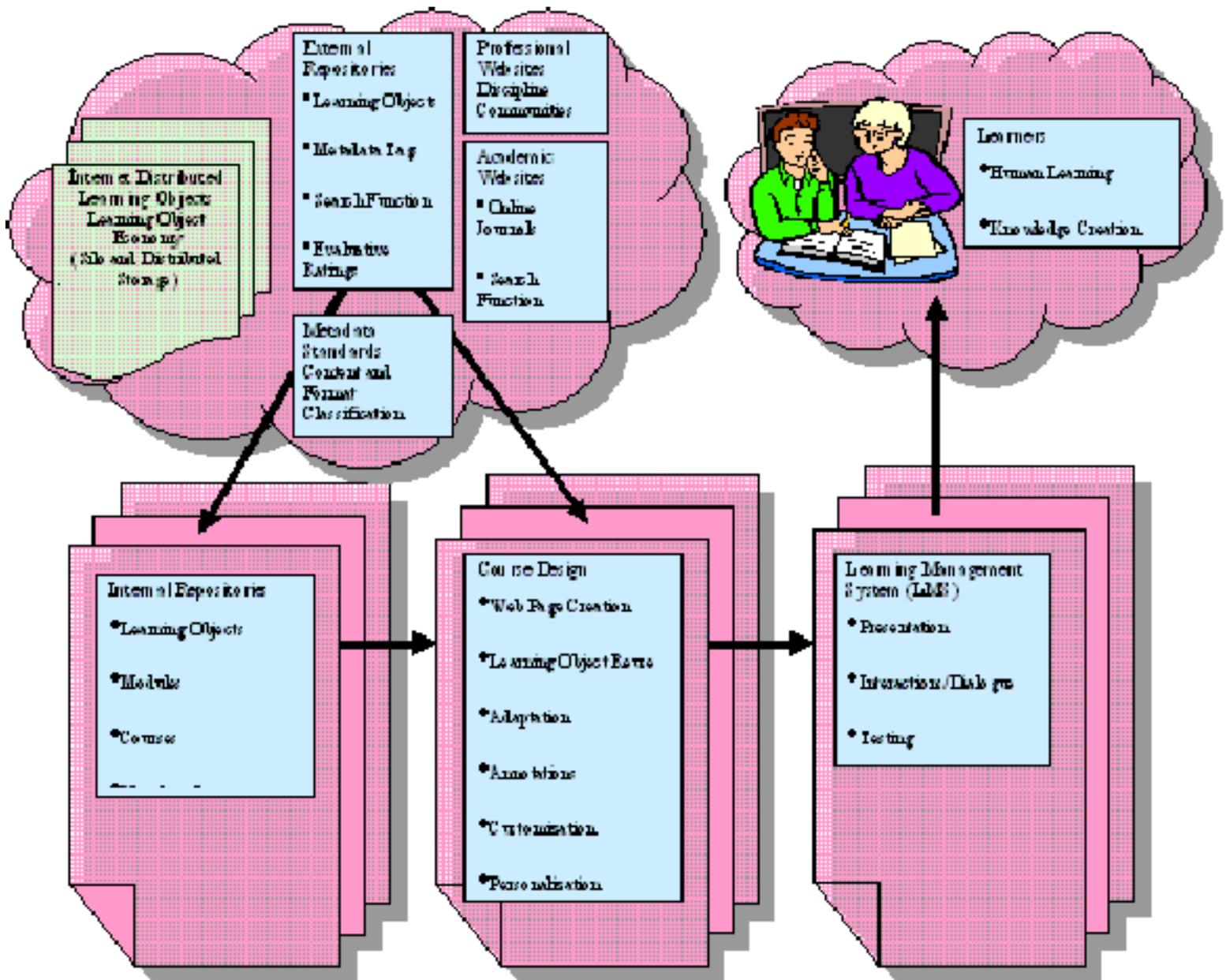


Figure 1. A generic model of course creation and delivery using learning objects.

In this model developers begin the course development process in the learning design phase. Here they design the course through formal and informal needs analysis, articulation of learning outcomes, design of experiences, assessments and learning activities. Unlike in times past, this process is from beginning to end enriched by excursions into both internal and external networks. Here developers extract knowledge and content related to similar courses offered internally and by competitors, addressing learner needs, aspirations and expectations, searching and retrieving content formatted in a variety of media. This content is annotated, customized for local learner needs, personalized by the developers own experiences and incorporated into a variety of learning activities and assessments. Finally, the course content is ported to a Learning Management System (LMS) where it is presented to learners – again in a variety of formats and structures. The LMS also provides interaction environments (conferencing, chats and audio/

video conferencing), testing tools, and a variety of scheduling and tracking tools.

Conclusion

Athabasca University, Canada's Open University, has been developing course materials for independent study through a variety of course designs since 1974. The university is now committing to the development of learning objects as the principal methodology in the design, development and deployment of course materials across all subject areas. Learning objects present challenges to course developers, such as finding and contextualizing the resources. The playfulness of merely plugging Lego blocks together to form a structure is misleading when applied to the course development process. Instructional design using learning objects demands skillful construction by course designers. The issues encountered by the course developers in this research project have proven to be formidable. However, the barriers can be countered and the results arguably warrant the effort.

The results of this case study analysis shows promise for future course design with learning objects. The nursing and literature course developers were pleased with the learning object approach. The business team's difficulties demonstrate the weaknesses in learning object availability and context. The distributed model envisioned by Downes (2003) is not yet a reality. Issues relating to repository silos constrain the learning object economy and the free sharing of resources. The barriers to the learning object approach may also be cognitive barriers by faculty members in falling back into well trodden paths. The learning object approach is innovative and demanding to implement with search and retrieval issues being followed by a need for contextualization. These costs must be evaluated against the benefits of interoperability, multi-media learning resources, personalization in learning style, ease of course revisions and diversity in content. This case study seems to align with the conclusions reached by Acker, Pearl and Rissing (2003) who state

The promise remains too tenuous, the risk-reward ratio too high, and the sense of urgency too low for the majority of faculty to change their current practices. Nonetheless, learning objects – right-sized content that may be re-used, recontextualized, and re-purposed – bring with them small seeds of change that likely will grow vigorously in the future. (Ibid., p. 83)

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[go top](#)

[March 2004 Index](#)

[Home Page](#)