Practical Guidelines for Learning Object Granularity from One Higher Education Setting

Kelvin Thompson and Francisca Yonekura
University of Central Florida, Orlando, FL, USA

kthompso@mail.ucf.edu fyonekur@mail.ucf.edu

Abstract

In considering the granularity of learning objects, one might be reminded of the cliché of the student who approaches her professor with the question, "How long does my paper have to be?" and the professor's response of, "Long enough to cover the topic and short enough to be concise." While learning object granularity has implications for both reusability and the development, specific decisions related to granularity are governed by the organizational context in which the learning objects are developed. It is a widespread hope that learning objects created in one organizational context will be routinely incorporated into different contexts. At present, it is the immediate organizational context of a learning object initiative that holds the most promise for addressing specific granularity issues such as the proportion of content relative to practice and assessment, the specific size limits of content, practice, and assessment, and heuristics for comparing time length of text with time length of various other media types (e.g., video, audio, and interactive media) in the implementation of content, practice, and assessment sections.

Keywords: Learning objects, granularity, learning object structure, organizational context

Introduction

In this paper, we articulate how guidelines for learning object granularity at one university arose from the unique organizational context of the institution. We will summarize briefly the history of online learning at the University of Central Florida. Then we will explain the institutional, faculty, and student needs that learning objects are intended to address. Our learning object structure, the underlying system architecture, the development process, and the adoption process will be reviewed. Finally, the granularity guidelines for learning objects at the University of Central Florida will be explained.

History of Online Initiative/Organizational Structure

Founded in 1963, the University of Central Florida (UCF) is one of eleven institutions in the State University System of Florida. UCF currently enrolls over 45,000 students and is accredited by the Southern Association of Colleges and Schools as a Doctoral/Research University-Intensive institution. Over the past seven years, UCF has developed a distributed learning initiative that today includes

nine online degree programs, six online graduate certificate programs, and hundreds of hybrid and Web-enhanced courses (nearly 2,000 online courses overall) that account for approximately twelve percent of the university's annual student credit hour production. Online learning at UCF serves institutional goals for increased access and improved student learning.

From the first online courses offered during the summer of 1996, the online initiative has grown through the efforts of three organizations. UCF's Center for Distributed Learning (CDL) and Course Development and Web Services (CDWS) departments were formed in 1996 specifically to coordinate UCF's online programs and to support faculty and course development for UCF's online learning initiative, respectively. Created in 1999 out of UCF's acclaimed Distributed Learning Impact Evaluation to provide research support for all of UCF's instructional modes, the Research Initiative for Teaching Effectiveness (RITE) has collaborated in authoring scores of research studies focused on UCF's online initiative and other teaching/learning environments.

All three UCF organizations collaborate to offer a nationally recognized faculty development course, IDL6543, through which UCF faculty are prepared to teach online (Truman-Davis, Futch, Thompson & Yonekura, 2000)**.** Emphasis is placed upon supporting individual faculty course goals within the context of an array of systematic design and production processes. Instructional design and production staff collaborate with participating faculty to produce online courses aligned with established course development, instructional, assessment and student support models. Hartman (2002) notes that the existence of these "models of practice" (p.46) has contributed to the university's success in transforming the teaching/learning process and distinguishes UCF's online learning initiative from the majority of institutions lacking such models.

Needs: Institution, Faculty, Students

At UCF there are institutional, faculty, and student needs that are addressed through implementation of a learning objects initiative. For each of these areas, we will identify specific issues and provide a detailed discussion below.

Institution

UCF has a number of administrative or institutional challenges that are addressed by implementation of a learning objects initiative. First, there is a need for an updated instructional model for online courses. Second, a higher degree of confidence in the instructional quality of online courses is necessary. Third, it is increasingly important to provide support to faculty through a more automated production process for online course materials. Fourth, there are ongoing non-academic course needs for professional development and performance support that can be met more efficiently through a learning objects approach. Fifth, learning object implementation at UCF addresses the reusability concerns that are widely touted as the primary benefit of learning objects.

As with many universities, UCF's predominant instructional model for online courses is based in the tradition of computer-mediated communication (CMC). Asynchronous discussion boards supplemented to varying degrees with online quizzing, assignment submissions, and content modules account for the structure of most UCF online courses. Content has been de-emphasized while interactions between and among students and faculty have been promoted. To date, online courses/programs at UCF are predominantly in disciplines *other* than the so-called hard sciences and technical fields (e.g., chemistry, physics, engineering, accounting, etc.). As an example, during the past five years, only 5% of the faculty successfully completing the IDL6543 faculty development course were from the hard sciences or technical disciplines. These fields are commonly known as being "content heavy" (especially as represented in the courses offered as a part

of the General Education Program) and lend themselves to student-content interaction with guidance from a knowledgeable subject matter expert/instructor (Sheppard & Jenison, 1997). There is little perceived value among faculty in these disciplines for an instructional model that requires discussion board postings. Instead, a model that presents rich content supported appropriately by multi-media with opportunity for practice and feedback is more useful.

In UCF's predominant instructional model for online courses, the association between instructional objectives, content, activities and assessment is varied. It is not uncommon for a module on a given topic to contain several instructional objectives, multiple pages of textual content on a variety of sub-topics, one or more learning activities, and one quiz. That is, there may be stated objectives without a clear connection to either content or activities or assessment. In practice, the components that are given grades are the ones that receive most student attention despite the intentions of the instructor to emphasize the value of certain ungraded topics. Given such a context, it is difficult to speak authoritatively about the quality of student learning or of the instructional integrity of UCF online courses throughout the institution. In contrast, the learning object framework of objective-content-practice/feedback-assessment supported by a wizard-driven interface affords better assurance of instructional quality in learning objects than in current UCF online course modules. The focus on only one instructional objective in a given learning object provides a rationale for including some content while reserving other content for separate learning objects. Similarly, for each objective and content piece, students have an opportunity to practice and receive feedback on their mastery of the objective (at whatever level of sophistication, whether recall, comprehension, application, etc.) prior to completing the associated assessment. Further, tracking statistics can reveal other qualitative distinctives; for instance, whether greater time with content or in practice results in higher achievement.

Historically, UCF has been known for the robust level of support given to online faculty. Instructional designers are available to advise faculty on suitable online instructional strategies and resources, and production staff are called upon to create content modules, graphics, and associated resources under the project management/supervision of the instructional designers. Despite an emphasis upon standardized workflow practices, in the face of continued online program development, the instructional design and production staff resources are becoming overwhelmed. As UCF faculty have the opportunity to design online courses based in large part on learning objects created through a standard, wizard-driven interface, much of the demand on production staff and the need for instructional designer project management should diminish. Instructional designers will be able to focus on their core role of providing instructional consultations to online faculty without having to manage an elaborate workflow process, and production staff will be able to focus on the creation of more specialized instructional resources rather than being called upon to develop each module in every online course.

One UCF college has recently identified a need for an automated remediation application that can address certain core concepts for students (apart from individual courses). If individual faculty had created learning objects for their courses, it would be relatively simple to re-purpose these objects to meet the college's need for a remediation system. (Modules from existing online courses were considered too diverse to assemble into a cohesive whole with many necessary concepts left unaddressed.) In fact, the same principle applies for performance support and professional development for university faculty and staff as well. As learning objects are created that address specific employee needs, these learning objects can easily be combined to provide a personalized professional development course or just-in-time performance support resource.

As large numbers of learning objects are created, housed in UCF's learning objects repository, and made shareable by their creators, UCF faculty will have a growing repository of reusable resources to incorporate into their existing courses or to use as the basis for their new online courses. As the number of available learning objects in specific disciplines increases, the time to

create online courses should decrease somewhat. It should be noted that an online course will undoubtedly continue to be more than an accumulation of learning objects.

UCF has been recognized as a leader in the area of online learning. However, the institution's instructional model and associated course development processes, while still successful, have become limited in that they serve only some disciplines and are demanding increasing amounts of staff time. Implementation of the proposed learning objects initiative on an enterprise-level will serve to diversify the instructional model, affording access to discipline areas with little previous involvement while revitalizing the underlying production processes and maximizing staff time. As a result, it is expected that this implementation will assist UCF in retaining a prominent role among higher education institutions committed to excellence in distributed learning.

Faculty

UCF faculty have needs distinct from those of the institution, that learning objects address. First, faculty are calling for more control over the development process for instructional materials in online courses. Second, there is a growing faculty demand for the inclusion of more multimedia elements in online courses. Third, in content-heavy disciplines, providing rich, rapid feedback to individual students in a timely manner while ensuring that curriculum goals of content coverage are met is a daunting challenge for many faculty. Fourth, UCF's emphasis on the scholarship of teaching and learning currently is without a publishing venue for identifying and recognizing instructional contributions of UCF faculty.

Although UCF's collaborative approach of providing robust instructional design and production support to faculty teaching online has enabled many faculty without web development skills to participate successfully in UCF's online initiative, there is an increasing faculty demand both for a production process over which individual faculty have control and for quicker turnaround time from CDWS staff.

Faculty who have acclimated successfully to the online environment, incorporating online pedagogical principles from IDL6543, routinely ask for a way to "go beyond" the basics. This typically involves a desire to include custom multimedia elements into their courses. This is particularly true of faculty with an innovative inclination. Multimedia production staff from CDWS' New Media team have assisted many faculty in developing such elements but this is not a scalable approach. The New Media team has started developing instructor-customizable templates for multimedia elements. The number of template types available in the past has not been varied enough to meet the needs of UCF's diverse and growing online course faculty, nor has there been a systematic process for integrating these multimedia templates with the existing Web page content modules in an instructionally sound manner.

Currently, the only automated data related to student performance that UCF online faculty have at their disposal is the tracking data provided by WebCT (e.g., automatically scored quizzes, history of content page visited, length of time each content page was accessed, time stamps of student interactions within WebCT). The system architecture underlying UCF's learning objects initiative affords greater information on student performance (e.g., log-in/log-out times, time on task for each learning object component, individual and aggregate assessment scoring) which allows faculty to identify relationships between formative and summative progress and performance measures and intercede, if necessary, when students are in need of assistance. Additionally, the provision of a practice element within UCF's learning objects structure and the ability to incorporate automated feedback into this practice element allows UCF faculty to focus on guiding students through their subject matter (especially in content-heavy disciplines) while ensuring that individual student misconceptions are identified and corrected early.

UCF is cultivating a culture that promotes the scholarship of teaching and learning. As designed, UCF's learning objects initiative provides a vehicle for individual instructional elements to be created and "published" (if desired) to the whole UCF academic community. A peer review process can easily be implemented within the existing process for submitting learning objects to the learning object repository. If supported by university administration, this will enable peer-reviewed publishing credit for contributions to UCF's teaching activity (rather than only being available for research activity).

Students

From the student perspective, learning objects offer possible solutions to several of their instructional needs. First, students need help identifying relevant course content from the growing level of extraneous information available to them. In the Information Age when we are overwhelmed with the amount and ease with which we can access information, our students are often lost and frustrated, not knowing where to start in their learning process. Although students need to develop their information literacy skills, the time to do so is not necessarily during their coursework; especially if that coursework involves the traditionally "feared" courses from the hard sciences. There are more appropriate opportunities for them to develop the ability to critically distinguish valuable from insignificant information. Hopefully, these abilities and skills are developed sooner rather than later.

Second, research has shown that students require timely feedback about their performance (Cross, 1987). Regardless of the institution and discipline, one of the most common comments left by students at *ratemyprofessors.com*, a popular Web site through which students from 1,700 colleges grade their professors, is that students desire to be able to practice what they have learned, receive feedback about their performance from their professor and be able to talk to their professor. However, students are finding that these needs are next to impossible to fulfill as they find themselves fighting for the same opportunities among hundreds of fellow students. Conversely, from the perspective of faculty teaching this type of content-centric course, providing ample opportunity to practice the concepts students need to learn and ensuring individualized feedback to each student is somewhat unrealistic and difficult for one instructor to handle. Students need to master the numerous concepts and principles of the subject matter, but motivation to do so might be hindered as students face uncertainty about how they are performing in mastering the concepts due to the lack of immediate feedback.

Third, students need guidance in how to manage their time and reduce anxiety levels when engaged in learning a subject perceived as difficult. Amidst the negative aura surrounding technical and hard science courses in general and General Education Program (GEP) courses in particular, learning objects could be a vehicle to reduce students' anxiety levels and the negative perception of these types of courses. For learning objects to be effective, they must be organized and prescribed to guide the learning process through timed and targeted content, practice and assessment specific to the learning objective at hand. Consequently, we create an experience in which the student can concentrate on true learning related to the subject matter they are to learn. Because learning objects are designed so that the learning objective, content, practice and assessment are interconnected, students benefit from a final product that is instructionally "composed" rather than improvised where materials and assignments are put together ad hoc. Otherwise, students get confused trying to understand the rationale behind the intended teaching goals of the faculty or instructor. Moreover, students taking the same course at different times from the same professor have found inconsistencies in what they have learned. As a consequence, students are left with a feeling of missing out on what they should have learned. Also, the experience of practicing concepts and principles within the same environment provides consistency in what students are taught.

We must understand that along the continuum of becoming experts, students are novices. They are far removed from being experts; therefore, the role of the faculty is to help novices master the subject matter through progressive, guided instruction. Rather than having students sift through unmanageable amounts of information and not knowing where to start, learning objects contextualized through lessons or modules guide students in learning and practicing the basics while steering them towards more intricate skills and knowledge with the ultimate goal of achieving higher order thinking skills and problem solving abilities. Furthermore, if learning objects are organized well by the instructor, learners will be able to understand where the part fits in the whole. Likewise, learning objects offer the possibility (if designed appropriately) to be adaptive given the needs and preferences of each student. In other words, faculty and teaching assistants can select the most appropriate learning object suitable for the individual learner's needs, e.g., adapting to learner needs, abilities and preferences.

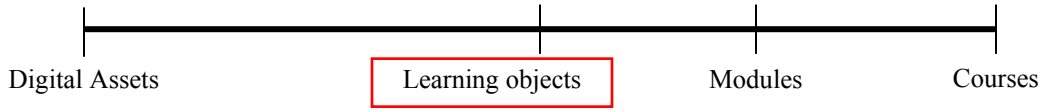
Another difficulty faced by students is that they often struggle when searching and putting together different points on a topic presented to them through a variety of venues where there is little explanation about the relationship between these venues (content, practice and assessment spread among different lessons, modules, books and software.) Their effort is spent trying to decode the intention of the instructor putting these teaching components together rather than on learning the subject matter. Learning objects facilitated and contextualized in modules or lessons provide a solution to the difficulties students face. In other words, learning objects provide a centralized, single point of reference concerning a specific topic. Also, learning objects provide an increased number of opportunities to practice and assess learning while getting immediate feedback and opportunities to get better grades.

By the nature of being chunks or smaller pieces, learning objects provide a convenience factor as students can focus their attention on that smaller unit of learning. As a student expressed to us, knowing the length of time, it would take to learn the topic addressed in a learning object allows him to gauge time and schedule his activity accordingly. Also, the fact that his assessment is based on the content on which he is instructed, i.e., instruction and assessment are linked, confirms whether he understood and achieved the intended learning objective or not.

Lastly, technical and hard sciences, especially in lower-division coursework, require a content-centric approach to teaching and learning in which is laid a solid foundation of domain-specific factual knowledge. Students need all the help they can get to understand many of the abstract concepts in these disciplines. Producing learning objects to convey abstract concepts through rich instructional content that goes beyond text and includes animation, video, audio, diagrams, games or simulations could prove very useful.

Learning Object Structure

Learning object practitioners know that there is no one, standard learning object structure. The presented form of learning objects ranges from animation and video segments all the way to complete modules or lessons. However, taking into consideration Hodgins' (2004a, 2004b) Content Object Model, the animation and video segments do not necessarily fall under the category of learning objects; neither do the lessons or modules. It is helpful to view these various items on a continuum. On one end of the continuum, animation, text, illustration, video and audio segments represent the most granular elements under consideration (i.e., digital assets) while on the other end of the continuum, courses, a broad collection of instructional materials, are the least granular items. Learning objects are situated between these extremes and may be composed of digital assets while the learning objects are incorporated into modules which, in turn, are incorporated into courses.



Course Development & Web Services at the University of Central Florida has adopted a structure for the development of learning objects with the goal of producing instructionally sound and reusable learning objects that go beyond the compilation of ad hoc content and unrelated assessments. This structural model is similar to CISCO's reusable information objects, more commonly known as RIOs. Essentially, the underlying principle behind the creation of a learning object according to our model is to keep it simple. UCF's learning objects model consists of useful and reusable digital components that: 1) state a learning objective, 2) present content, 3) provide opportunity for practice and 4) assess achievement of the objective. According to our model, all four elements must be present for a component to be considered a learning object. Each of these elements is further influenced by highly recommended instructional guidelines addressing granularity, pedagogical, usability and universal design needs that any author of learning objects at our institution must take into consideration.

1. **Learning objective –** Each learning object can address only one learning objective. Such learning objective must state the following to the learner:
    a. Task: What will the learner perform or complete?
    b. Conditions: Under which conditions should the learner complete the objective?
    c. Criteria: To what degree should the learner achieve this objective?

    Examples:

    - Upon completion, you will be able to demonstrate an understanding of what a preferred stock is and calculate its value with 100% accuracy.
    - At the end of this session, you will be able to accurately calculate taxes according to the latest corporate tax laws.

2. **Content**- these are some of the considerations regarding content:

    - Content in a learning object should be succinct and direct; to the point.
    - Content may be in the form of text, audio, video, interactive media or a combination of any of these.
    - Organize and chunk your content in one screen sections (maximum 250 words per screen) to facilitate reading and interaction with the content.
    - Content should include no more than five minutes of any one media type at a time.
    - Establish a ***high-to-low level of importance*** for how you want to organize the content and maintain this approach throughout the design of the learning object.
    - Be ***consistent*** in how the information is organized throughout the learning object.
    - ***Text, video, audio, images or interactive media*** that convey the ***facts, concepts, processes, procedures and/or principles*** of the subject matter should be included.
    - Although writing style differs from person to person, a ***conversational tone*** is appropriate in the design of learning objects to maximize learner engagement and time on task.

- Consider the inclusion of outlines with main or key concepts and principles; however, bulleted items as used in PowerPoint presentations are not enough. Remember, students will be accessing these learning objects on their own. You will not be there to expand on the bulleted items.
- Some methods of organizing your content are: ***overviews, vocabulary, descriptions demonstrations, diagrams, flowcharts, concept maps, and examples*** (good and/or bad).

3. **Practice** – A learning object provides opportunities for learners to review facts, key concepts and principles through exercises, instructional games, simulations, problem solving and guided reflections. UCF provides a few customizable instructional games and applications that could be incorporated into the practice section of learning objects. Alternatively, practice may be provided through quiz-type self-tests (i.e., multiple choice, true-or-false, etc.)
4. **Assessment** – A learning object should assess whether the learner has achieved the stated learning objective. Learning object authors have the choice of using traditional assessment methods such as quizzes (i.e., multiple choice, true-or-false, etc.) or non-traditional methods such as games and simulations.

System Architecture

To successfully implement the learning objects infrastructure at our institution, modularity for integration with existing and concurrent development of other applications and processes is crucial. Although the actual integration is much more intricate, the desired outcome is for the infrastructure to be comparable to the "plug-and-play" nature of computer hardware; very similar to plugging-in digital cameras, data storage devices, digital audio recorders and other devices to our computers.

Our systemic model ties storage, wizardry, viewing and reporting capabilities within their own individual environment but as components of a much larger system. The main learning objects infrastructure consists of four components: the wizard to create/edit learning objects, the learning object viewer, administrative interface to compile data and generate reports and the repository to house the learning objects.

Wizard Interface

This component of our learning objects architecture consists of the editor to create or modify learning objects based on our instructional model. The wizard uses a PHP script to load an existing learning object for editing. If no existing learning object is specified, a blank slate is loaded to guide faculty or designer through the creation of a new learning object. After the user is done creating the learning object, the system separates the learning object data from the screen layout (shell) data and saves the information to the database for the retrieval of the finalized learning object.

Learning Object Viewer (LOV)

The learning object viewer is a graphical user interface designed to deliver learning objects in a rich and organized fashion through common mediums such as Flash and HTML. The LOV represents the player through which students will interact with the object. The learning object viewer

uses a PHP script to retrieve the learning object data and the screen layout templates from the database, which then combines the two into one XML structure. This XML structure is then sent to the LOV, any video, pictures, or sounds included in the learning object creation process are loaded from the corresponding servers housing these assets, and the learning object is displayed for the user.

Reporting Interface

Data such as usage statistics and quiz scores are recorded in the system and organized for faculty to retrieve students' progress and evidence of mastery. The statistics are presented to the faculty upon login to the system. These data can be formatted for download and upload in other systems, such as WebCT, for grade reporting. In subsequent versions, the transfer of this information will be completed directly from one application or system to another.

LO Repository

Learning objects are housed in a centralized place on the network. Faculty have the ability to 1) access their own learning objects, 2) search and view learning objects available for implementation into lessons or modules, or 3) prescribe appropriate learning objects to match the individual needs of students.

How Does It Work?

1. The content is created through a "wizard" interface.
2. This content is requested by the LOV when the user loads the application.
3. The server then provides the XML file to the LOV. (See Figure 1)

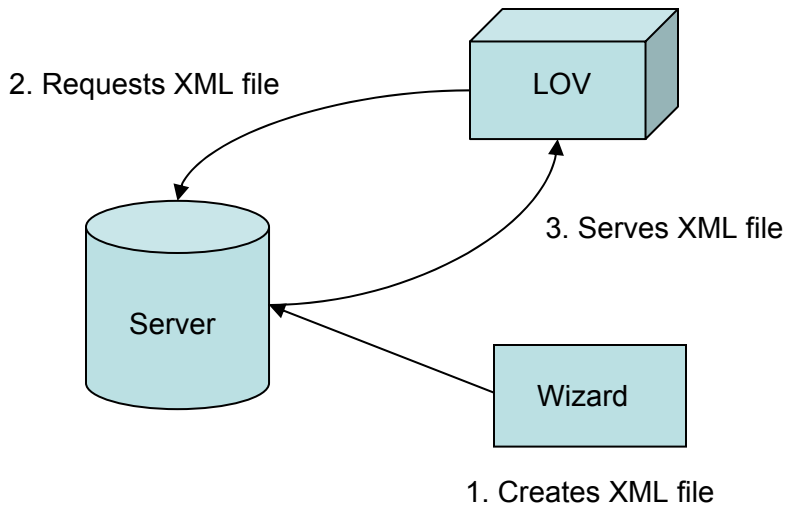


Figure 1: How LO Repository Works

Lastly, in our infrastructure, the learning objects system is integrated with other major components critical to the institutional systemic model for distributed learning. These components are WebCT, the institutional course management system and GameServ, our home-grown games and

simulations server that houses various game engines and simulations to be incorporated into learning objects. (See Figure 2)

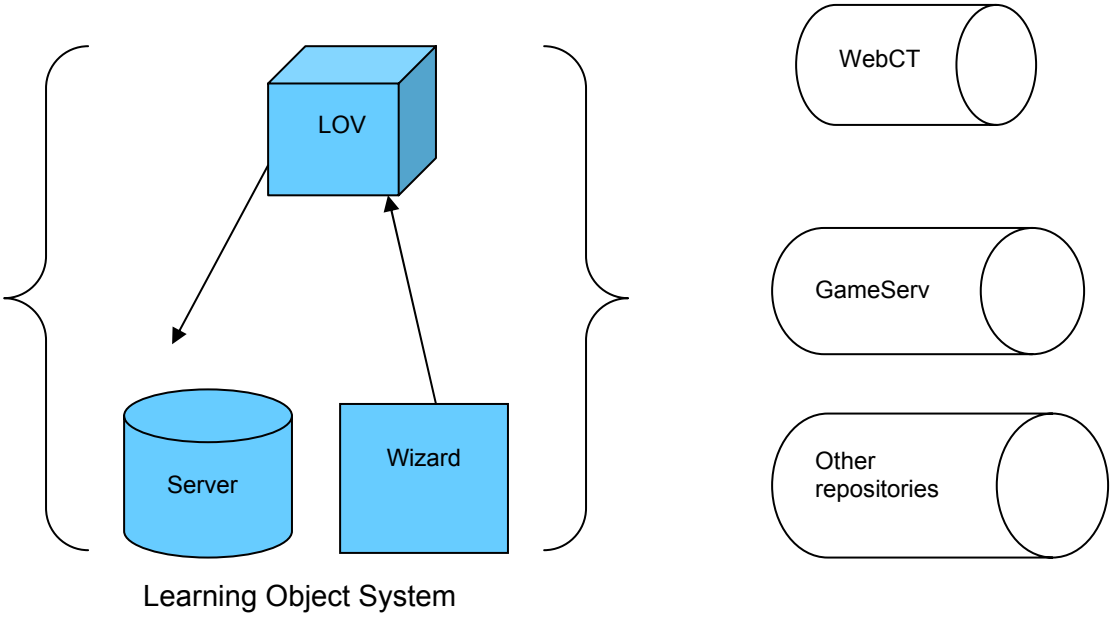


Figure 2: The Infrastructure

Adoption Process

With apologies to the motion picture *Field of Dreams*, it is *not* our expectation that "if we build it, they will come." It is not sufficient to design a learning object structure and implement a system architecture that addresses institutional, faculty, and student needs. Attention must also be given to facilitating the process of adoption by faculty and administrators. The adoption process pursued at the University of Central Florida consists of three sub-processes: (1) the learning object development process, (2) the approval process for including learning objects in UCF's repository, and (3) the institutional implementation process.

Development Process

At UCF, faculty designers wanting to create learning objects log-in to an online editor in the form of a wizard that walks them through the steps of creating a learning object while providing instructional and media design recommendations. While the faculty designer of the learning object makes the final decisions regarding the design of the learning object, for the first-time online faculty member, an instructional designer provides a series of instructional consultations during the IDL6543 faculty development course to assist in these decisions. The use of the wizard is detailed below.

Upon logging-in to the learning object system, the development process starts with the faculty designer selecting whether to create a new learning object or edit an existing one. If the faculty member opts to edit an existing learning object, she selects the specific object and edits any of the areas she so desires. If, on the other hand, the selection is to create a new learning object, the fac-

ulty designer is asked to define a specific learning objective which states the desired outcome or competency; that is, the conditions and the degree of accuracy students are expected to achieve. In the process of writing the learning objective, the faculty member is given tips and suggestions for articulating such objectives. For instance, a drop-down menu with common operating verbs is available to the learning object designer. The goal of this feature is to facilitate the process of writing a sound learning objective. The next step consists of organizing the content. The learning object designer has the options of creating textual content or importing existing media such as video, audio, graphics and animations. Then, the author incorporates practice opportunities for students to apply the content presented to them. In this stage, the learning object designer has the option of creating practice exercises similar to traditional self-tests and quizzes or importing interactive, media based exercises, games or simulations. The same options are available in the design of the assessment section of the learning object. In both practice and assessment, the faculty member is able to use commercial quiz-preparation tools (e.g., Respondus) or formatted flat files to upload data in batches. The major difference between the practice and assessment sections is, in the practice section students are able to apply what they are learning in a safe environment with trial and error while performance scores and comments are provided as a feedback mechanism. In the assessment section, however, a formal performance measure is submitted as evidence of mastery of the learning objective.

Once the faculty designer is pleased with the completed version of the learning object, he has the option to package and save the learning object "as is" for use within his individual courses. However, if his desire is to *share* it with others, the learning object is submitted for peer review as described later in this paper. In the packaging process, a manifest is created by automatically filling in known information such as author's name, and contact information as well as information authors are asked to provide such as keywords and descriptions.

Finally, the development process does not end with the creation of the learning object. Instead, at UCF faculty are highly encouraged to contextualize learning objects presented in online courses by incorporating them into lessons or modules. This contextualization is left to the faculty designer who can collaborate with an instructional designer to devise specific instructional strategies.

Approval Process

To be shared for reusability through UCF's learning objects repository, individual learning objects must first be approved for inclusion. In addition to the practical needs met by this approval process, we believe that with repositories, as with many other contexts, heightened selectivity often leads to increased interest in being included. There are two types of approval necessary. First, the quality of learning objects must be approved through a peer review process by subject matter experts. Second, the learning objects must meet production-related standards that facilitate their reuse. (Please note that learning objects not intended for reuse, may be included in the learning object repository without undergoing this approval process, but if the learning object author later desires to share the learning object, it must be submitted for approval at that time.)

Peer review

As noted above, UCF's institutional emphasis on the scholarship of teaching and learning provides a favorable climate for the implementation of a peer review process for materials produced to support teaching and learning. The learning object structure outlined above provides a consistent means through which such instructional materials may be realized. Additionally, this structure allows the emphasis to be placed on the subject matter knowledge of teaching faculty rather than on instructional methods since, by definition, the learning object structure specifies a con-

tent-centric instructional approach, supported by practice and assessment. This subject expertise emphasis defines "peer" as a university faculty member with subject matter expertise in a given discipline. This is in contrast to Thompson's (2005) placement of online faculty, online program administrators, and instructional designers in a peer relationship as practitioners equipped by their experience with online instructional environments to offer equally perceptive criticisms of online courses. The emphasis in such online course criticisms is on instructional methods, not on subject matter. At the online course level, a more contextualized concern with learners, instructors, and the instructional and institutional contexts is appropriate. At the less contextualized/more reusable level of learning object, however, subject matter expertise is required. In addition, using peer reviewers with subject matter expertise rather than instructional expertise allows the peer review process for learning objects to more closely approximate the process used by discipline-specific scholarly journals. The function of peer reviewers is explicated below through discussions of their focus, feedback, and selection.

The particular interest of the peer reviewers engaged in approving learning objects is quality as manifested in four dimensions: accuracy, usefulness, potential reusability, and originality. First, reviewers must be concerned with accuracy of content and of practice/assessment items included in submitted learning objects. Inaccurate learning objects, no matter how well implemented, cannot be shared through the repository. If practice or assessment sections make use of non-traditional formats (e.g., simulation or modeling) rather than quiz items, these must be evaluated for their accuracy in representation as well. Second, reviewers must identify whether the proposed learning object is useful. That is, does the learning object's learning objective have purposefulness? Is there enough context to give meaning to the object? If the focus of the learning object is too narrow, it is not likely to be useful. Third, reviewers must concern themselves with the potential reusability of the learning object beyond one specific course. There must not be so much contextualization that the learning object cannot be reused. Learning objects might be reused in multiple sections of the same course or in courses that are quite different from one another. The scope of the content should be examined to ensure that it is not too broad. If it is, possibly the learning object should be divided into several more focused learning objects with different learning objectives associated with each. (Usefulness and reusability are counterpoised dimensions.) Finally, reviewers must ensure that the proposed learning object represents original work and does not include any material that might constitute plagiarism. Again, subject matter experts within specific disciplines are expected to know their fields and to recognize unoriginal material.

The purpose of the peer review process is to ensure quality, not to reject learning object submissions. To this end, substantive feedback must be presented to learning object authors in such a way as to encourage the improvement and re-submission of the learning objects rather than to castigate the authors. To avoid any potential interpersonal conflicts; however, anonymity of authors and reviewers must be maintained.

Since reviewers must have subject matter expertise, they must at a minimum represent each UCF college. Preferably each specific domain within a college should have at least one reviewer. (For instance, UCF's College of Arts and Sciences includes disciplines as diverse as physics and theatre.) While every effort should be made to ensure anonymity of learning object authors and reviewers, this may be difficult within disciplines having relatively few faculty. In such cases, it may be necessary to recruit reviewers from other institutions to assist in the review.

Production-related review

Along with the peer-review process, production related reviews are necessary to ensure the technical reusability and instructional consistency of learning objects. In our case, we incorporate, in

the design of our learning object editor, wizard-like features and job aids that address production related matters in the areas of instructional design, meta-tagging, intellectual property, copyright, accessibility and universal design. Our decision to do so is based on our desire to empower faculty to create, edit and manage learning objects on their own while addressing bigger scheme matters such as universal design, accessibility and meta-tagging.

Instructional design review

The rapport the instructional designers form in IDL6543 with faculty who teach online at UCF facilitates the curricular and procedural implementation of how to create and implement learning objects to enhance online courses offered by the University. The review and approval process starts with the implementation of mechanisms that facilitate the creation of learning objects based on the adopted instructional model of what the learning object should be (described throughout in this paper). Sprinkled through the steps of creating a learning object are features and prompts that provide hints and tips on chunking the content, links to existing resources to incorporate opportunities for practice and/or assessment among other instructional design principles. These innate features of the learning object wizard are enhanced by the established institutional channels mentioned above in which faculty with the help of instructional designers, determine the appropriateness of the learning objective scope, whether the practice and assessment pieces address the identified learning objective, and the contextualization of the learning object in the corresponding online module, among other things.

Metadata checking

Data about data is certainly one of the most challenging aspects of implementing learning objects. The numerous standards such as Dublin Core, IMS Learning Resource meta-data and SCORM makes the task of compliance checking very daunting. As architects of the learning objects endeavor at our institution, we wrestle with some of the philosophical, theoretical and practical matters addressed by learning object experts such as Norm Friessen (In McGreal, 2004), who in his article entitled “Three Objections to Learning Objects” has provided a great reason for why the military foundation of SCORM does not work in higher education. However, we value the underlying principle for why the military created SCORM and see a potential for implementing a modified or personalized (if you will) version of standards for the purpose of meta-data checking. Also, other emerging concepts such as community based tagging pose an intriguing solution to the matter. However, for a manageable system facilitating the administration and searchability of learning objects, we identified the following few metadata tags as a minimum requirement to address content, context and structure of the learning objects:

- Unique Identifier
- Title
- Language - ISO 639 abbreviation
- Version
- Description
- Author(s)
- Date created
- Date modified
- Discipline
- Keywords
- Status (draft or published)
- Copyright
- Intellectual Property

Intellectual property/copyright checking

Ideally, in the spirit of open societies, we would love to adopt the Creative Commons licensing tenants. However, intricacies of established copyright and intellectual properties that have been in use for centuries makes it difficult to implement the Creative Commons agreement in a higher education institution. Therefore, in our model, intellectual property and copyright matters are handled based on the institutions' existing UCF Distributed Learning Scope and Policies document which delineates that the author(s) of the learning object and the University co-own the rights to the learning object. In accordance with the document, while the subject matter knowledge contained in the learning object is the intellectual property of the faculty, the actual material produced with University resources during University time grants the University the right to co-own the learning objects. Should an external use or commercial venture to implement the use of a learning object flourish, both parties (the author(s) and UCF) must mutually agree before anything can be done to distribute or grant permission for its use.

Accessibility/universal design checking

The key in this matter is to develop for universal design. Institutionally, we abide by the Section 508 guidelines (Section 508 of the Rehabilitation Act, 1998). Also, traditionally, we have an established strong relationship with our institutional Student Disability Services unit to be able to address the needs of our students. At a minimum, we make sure to provide keyboard accessibility, transcripts for audio and video segments and implement message and media design guidelines addressing visual and cognitive disabilities by providing consistency, ease of navigation, as well as clear and simple language.

Implementation Process

In addition to the processes for learning object development and for approval of learning objects, institutional adoption is also dependent on how learning objects will be implemented with faculty and administrators. To some extent, the implementation process is incorporated into many of the areas previously discussed. However, there are also aspects of the process that exist apart from these other areas. Both aspects of the implementation process will be discussed below.

The implementation process begins with the identification of perceived needs of the institution, faculty, and students described above. This "targeting of needs" helps to facilitate buy in by various stakeholders throughout the institution. Parallel to this targeting of needs is the existence of UCF's institutionalized faculty development program for online course development. Working within the established program ensures that the learning objects initiative is incorporated into the online learning infrastructure as new faculty prepare to teach online.

The required subject matter expertise of peer reviewers and the resulting recruitment of reviewers from disciplines in all colleges assist in establishing early proponents of the learning objects initiative throughout the institution.

In addition to these embedded implementation decisions, the process continues with a series of discrete steps. First, potential faculty adopters are identified from two groups: (1) experienced online faculty who are interested in innovation and (2) influential faculty from disciplines that are currently not engaged in online learning (e.g., the hard sciences and technical disciplines). Second, administrators (e.g., program coordinators, department chairs, deans, etc.) associated with the faculty are informed about the learning object approach and their support is solicited. Third, the targeted faculty produce at least one learning object each as a "proof of concept" in their discipline. Fourth, in coordination with the administrators, prototype learning objects in each discipline are showcased to other faculty along with information on how to use the learning object wizard. Fifth, plans are made with the administrators to either develop online courses (through the

established faculty and course development program discussed above) or to encourage learning object development for face-to-face or web-enhanced courses.

Practical Granularity Guidelines

As Hodgins (2004a, 2004b) has suggested, optimally, learning objects are situated at the intersection of contextualization and reusability. That is, learning objects have to be sufficiently broad in scope to be meaningful to students and useful to faculty while being granular enough to be reused in various contexts. This principle anchors all our guidelines for learning object granularity. (It should be noted, though, that what follow are *guidelines* or "rules of thumb" rather than absolute requirements. Further research is needed to substantiate these claims; they are, however, a starting point.) We will provide a broad overview followed by a more detailed explanation of the guidelines.

The targeted maximum time for learning object completion by students is 30 minutes, but this overall timeframe has implications for the design of each substantive component (i.e., objective, content, practice, and assessment). Based on prior knowledge or other learner-specific variables, students may choose to interact with the learning object components in various sequences, or they may choose to ignore some components altogether. Since the only *required* component is the learning object assessment and since content is emphasized in learning objects, these two components receive the most specific focus in the granularity guidelines. (While the learning objective is critical, when considered alongside the other components it does not represent any granularity issues beyond the limitation to one clearly stated objective. Similarly, since practice is required for inclusion in order to benefit students rather than to penalize them for taking too much or not enough time, there are no time limitations provided for this component.)

Our intent is for students to be able to complete their interaction with a learning object in one sitting. Thirty minutes is our target for the maximum length of such a session. Without a maximum timeframe, we foresee the creation of learning objects that would require an inordinate amount of time for students to complete. The focal point of learning object design tends to be content. This component, in particular, impacts the overall size of the learning object. Our guidelines specify content granularity in terms of a minimum and maximum time length. Content should be no less than five minutes in length and should not exceed 15 minutes. It is unlikely that a learning object containing less than five minutes of content will have enough contextualization to prove instructionally useful. Conversely, too much contextualization can occur when content time exceeds 15 minutes. While audio or video content is easily timed, a heuristic is needed for gauging the "time" of textual content. At UCF, an average reading speed of 200-250 words per minute is used as the basis for converting text into time as authors design their learning objects. (Although the actual time taken by peer reviewers to complete the learning object will determine their judgment of compliance with these guidelines, the reviewers are also expected to bear in mind a reading speed of 200-250 words per minute as their own reading speed may exceed this.) The assessment component determines a student's "completion" of the learning object and indicates whether the learning objective has been met. It is the only truly "required" element. As discussed above, the matching of learning objective to assessment is ensured in the instructional design review. However, the size of the assessment is specified relative to the length of content in the learning object. As with content, a minimum and maximum timeframe are provided. A student's assessment attempt should take no more time to complete than the content component and no less than half the time of the content length (e.g., a 10 minute content should have an associated assessment of no less than five minutes and no more than 10 minutes). As with content, the determination of compliance with these guidelines is left to the peer reviewers. While individual faculty may choose to allow more than one assessment attempt (drawing on a larger bank of assessment items if using a traditional quiz-type assessment), the default setting is for one assessment attempt.

By specifying granularity, in terms of estimated time lengths, while keeping in mind the necessary balance between contextualization and reusability, it is our intent that students will benefit from learning objects that are focused in purpose and manageable to complete. Meanwhile, the faculty authors of learning objects are provided with concrete guidance in making decisions about what and how much to include in individual learning objects. Such learning objects are well-situated to provide a content-centric alternative to an online course initiative that has historically relied almost exclusively on computer-mediated communication.

Conclusion

Our institutional learning objects initiative holds great promise for a segment of our population that we have not been able to support due to the dichotomy between our current distributed learning initiative and the needs of the hard sciences and technical disciplines. We are cognizant that this learning objects approach will continue to evolve as faculty and students use the system. Also, as the learning objects community of practice conducts more research on the use and effectiveness of learning objects our guidelines will probably have to be adjusted accordingly.

As depicted throughout this paper, the implementation of an institutional model of learning objects is not an easy task. Our philosophy has been a balance between the extensive theoretical and philosophical discussion around what learning objects look like, and the practicality of actually developing and implementing learning objects that could prove useful for our learners. We would like our readers to walk away with the understanding that ours is one approach that could hopefully serve as an example for other institutions. It is not necessarily "the" approach. We look forward to seeing how other institutions react to our approach through emulation, modification, or rejection of the concepts presented here. We expect that our own learning objects initiative will benefit from the work of others.

References

Cross, K. P. (1987). Teaching for learning. *AAHE Bulletin, 39*(8), 3-7.

Hartman, J. (2002). *Models of Practice in Distributed Learning: A Catalyst for Institutional Transformation.* Unpublished doctoral dissertation. University of Central Florida: Orlando, FL.

Hodgins, W. (2004a). Into the future of learning objects. Paper presented at the *Partnership in Global Learning Conference*, June 3, 2004, Orlando, FL.

Hodgins, W. (2004b). The future of learning objects. *Proceedings of the ECI Conference on e-Technologies in Engineering Education: Learning Outcomes Providing Future Possibilities*. Retrieved April 14, 2005 from http://services.bepress.com/eci/etechnologies/11

McGreal, R. (Ed.). 2004. *Online education using learning objects* (pp. 59-70). London: Routledge.

Section 508 of the Rehabilitation Act (29 U.S.C. 794d). (1998). Retrieved June 5, 2005 from http://www.section508.gov/

Sheppard, S. & Jenison, R. (1997). Examples of freshman design education. *International Journal of Engineering Education, 13*(4), 248-261. Retrieved September 29, 2005 from http://best.me.berkeley.edu/~aagogino/papers/freshman_IJEE.pdf

Thompson, K. (2005). *Constructing Educational Criticism of Online Courses: A Model for Implementation by Practitioners*. Unpublished doctoral dissertation. University of Central Florida: Orlando, FL.

Truman-Davis, B., Futch, L., Thompson, K., & Yonekura, F. (2000). Support for online teaching and learning. *Educause Quarterly*, *23*(2), 44-51.

Biographies

Kelvin Thompson is an assistant director for Course Development and Web Services and research coordinator for the Partnership for the Advancement of Distributed Learning at the University of Central Florida (UCF). Kelvin has assisted with the design of hundreds of online courses and holds an Ed.D. in Curriculum and Instruction from UCF.

Francisca Yonekura is the New Media lead for Course Development and Web Services at the University of Central Florida. Francisca has been involved in numerous instructional and promotional projects developed for a variety of media types including Web, CD-ROM, CD-I, and print in higher education, the hospitality industry and the military. She has facilitated and collaborated in the design and development of many online courses with UCF faculty. Francisca is currently completing her doctoral dissertation on specific instructional characteristics of learning objects.