

# **"Sharable Content Objects (SCORM): Whole Course Design and Implementation Issues,"**

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## **Abstract**

The Sharable Content Object Reference Model has been designed to allow for maximum reusability and platform (LMS) interoperability of electronic learning objects. As a part of the Academic Co-Lab of The Advanced Distributed Learning Initiative (we) have been involved in both the testing of practical applications of SCORM specifications, and research on issues that may affect the usability of the model in higher education. To date most practical academic research has taken a "bottom-up" approach, developing minimal Sharable Content Objects and using these primarily to test LMS implementation and interoperability. At Northern our approach has been "top-down," designing the whole course, breaking it down into reusable, independent SCOs, and attempting to implement this as an online course offering. This approach has brought to light a number of issues that the primary bottom-up research program has yet to encounter. These include issues of the redundancy inherent in stand-alone SCOs, the need for external references to support material such as glossaries and updates, assessment relevant to the course (but

not the individual component), and the sequencing of SCOs to create a cohesive course, preferably one that allows for divergent learning styles.

#### Contributors

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## **"Sharable Content Objects (SCORM): Whole Course Design and Implementation Issues,"**

### **Background**

The Sharable Content Object Reference Model (SCORM) has been designed to promote maximum reusability and platform (LMS) interoperability of electronic learning objects. At Northern State University, a partner institution of the Academic Co-Lab of The Advanced Distributed Learning Initiative (ADL) I have been involved in both the testing of practical applications of SCORM specifications, and research on issues that may affect the usability of the model in higher education. To date most practical academic research has taken a "bottom-up" approach, developing minimal Sharable Content Objects (SCOs) and using these primarily to test LMS implementation and interoperability. My approach has been "top-down," designing first the whole course, breaking that down into reusable, independent SCOs, and attempting to implement this as an online course offering. This approach has brought to light a number of issues that the primary bottom-up research program has yet to encounter. These include issues of the redundancy inherent in stand-alone SCOs, the need for external references and support material such as glossaries and updates, assessment relevant to the course (but not the individual components), and the sequencing of SCOs to create a cohesive course, preferably one that allows for divergent learning styles.

Three major issues developed: the need for a course "envelope" or context package, the issue of redundancy in utilizing multiple SCOs, and the use of external resources, illegal within SCOs, but often necessary within a SCO built course.

More complete background information on the ADL, SCORM, and my project can be found in Appendix A.

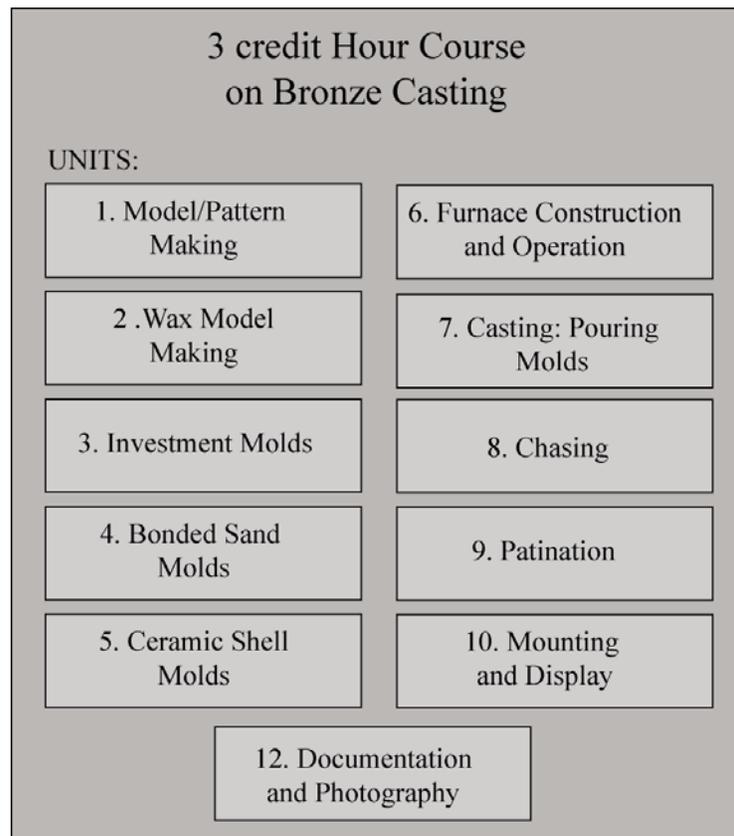
**Part One:** *“Contextually Specific Envelope for the Delivery of Whole Courses Built Primarily From Shareable Content Objects (SCOs): Solutions developed for the obstacles encountered in the integration of stand-alone SCOs into an asynchronous user guided distance delivered course.”*

The development of reusable, sharable learning objects is key to ADL’s long-term vision. [O]nce sharable learning objects exist and are commonly available, they can be assembled in real time, on demand and then delivered to learners as needed. Thus the ADL initiative is focused on the design of sharable learning content objects and the development of an instructional object economy.

( SCORM\_1.2\_Overview Section 3 Page 12, [www.adlnet.org](http://www.adlnet.org))

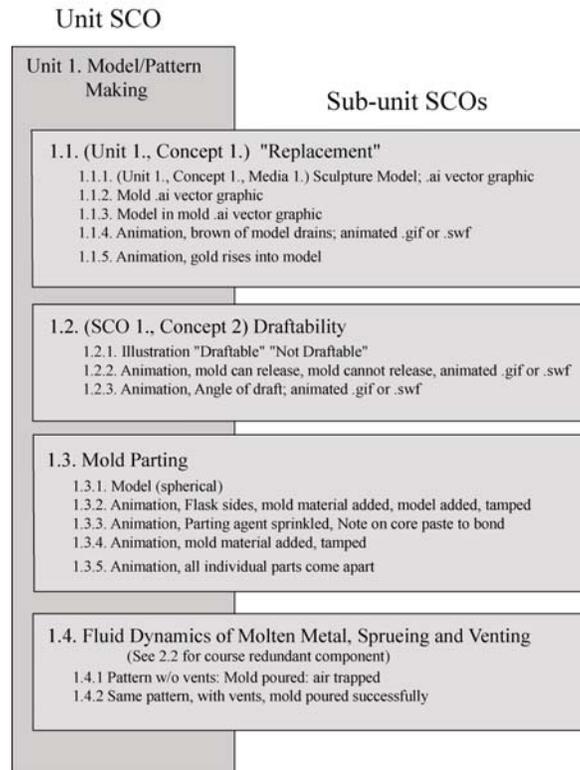
By definition, Sharable Content Objects (SCOs) must be self-contained; SCOs cannot reference material external to the SCO itself, this includes material within other SCOs. A designer creates a series of SCOs for a specific course, one for each major topic needed,. Later, another designer also uses some of those SCOs in a new course, perhaps in ways that the original designer had not envisioned. In order to maximize flexibility in the sequencing and crafting of SCOs into an educational whole, some kind of delivery and access control “envelope” or package is needed. Individual SCOs do not need this

container, and even short serial sets of SCOs managed by a Learning Management System (LMS) do not, only the combination SCOs that would make up a robust multi-SCO lesson, or a whole course will. This may be more relevant in education than in military or corporate training where simple, single concept SCOs are presented in a set sequence presented over time.



This “Envelope” holds all of the course’s SCOs but it also holds additional information. Any additional material not found within the specific SCOs used in the course will have to be contained in, or accessed through, the envelope. A course specific introduction, for example, could be included. One outlining course prerequisites and explaining student expectations. This information could not be included into any of the component SCOs as

it would limit the reusability of the SCO in applications other than this specific course. Any other course specific components would require an envelope, including glossaries, pre-test, links to external resources, an updated bibliography, and course depth assessments.



To take advantage of a selection of SCOs to build a course the designer still needs to provide context to this collection of stand alone learning objects. The course as a whole needs not only contexts, but also is likely to need instructions, sequencing, navigational information or control, assessments, and other course specific material that is not relevant to individual SCOs.

The author was interested in the implications, in a higher education setting, to the design, use, and reuse of Shareable Content Objects. This project, somewhat like the designing of

a textbook, involved breaking a course into chapters, and then breaking these chapters down further into topics and procedures. Each chapter is a single SCO, designed to be a self-sufficient resource, but each topic is designed to be a SCO also, but on a smaller level of aggregation. This sub-chapter level of SCOs became necessary initially to deal with components that were required in several different SCOs in order to make them each self-sufficient, but were redundant to the whole course when inserted into several SCOs. It quickly became evident that the reusability of these sub-chapter SCOs was critical as some were used repeatedly.

For example, the course built was on Bronze Art Casting, although for general research purposes the course subject is unimportant. The course contained eleven chapter-level SCOs. One of these was on foundry furnace usage, others were on types of mold making, still another on pattern and model making. All fall under the umbrella of Art Foundry Practice, but each could be used in other applications too. The SCO on furnace construction and operation requires an understanding of foundry safety equipment, so does the SCO on metal casting. Neither unit can reference material on safety equipment that sits within another SCO therefore both must contain all of the information. Since both require basically the same material it made sense to create a topical SCO on safety equipment and include it in each of the chapter SCOs.

Educators often want to pretest incoming students. This can allow the experienced students to advance quickly, perhaps even test out of parts of the course that they are already quite familiar with, but also to identify students who might need extra help or additional background in order to keep up with the course. This could be taken a step

farther and a learning style assessment might be built that could actually organize the structure of the course, allowing or restricting access to specific SCOs and other materials until the student was prepared for them.

For this project a standard browser (HTML) interface was used for the envelope. This was done because the ADL has presumed a web delivery, among other reasons. The widespread use of Internet browsers, and the reasonable expectation that users are already familiar with the basic interface, the graphical metaphors, and the common tools, allowed a focus on content and organization rather than the clarity of the interface itself.



The standard browser (HTML) interface allows users to work within a SCO yet maintain an external connection that allows access to other external media too (additional web sites, glossaries, etc.) at all times during the course. The use of JavaScript allows for situation-dependant instructions or information to be displayed. It seems to me that some

kind of “package” will need to be presumed by SCO designers, and, since the ADL mission encompasses web delivery as the primary delivery method, it seems safe to assume, at least for now, that JavaScript will be an acceptable way for a SCO to trigger an envelope, and for the envelope to control access to both outside information, but also to additional SCOs in any of a series of possible orders.

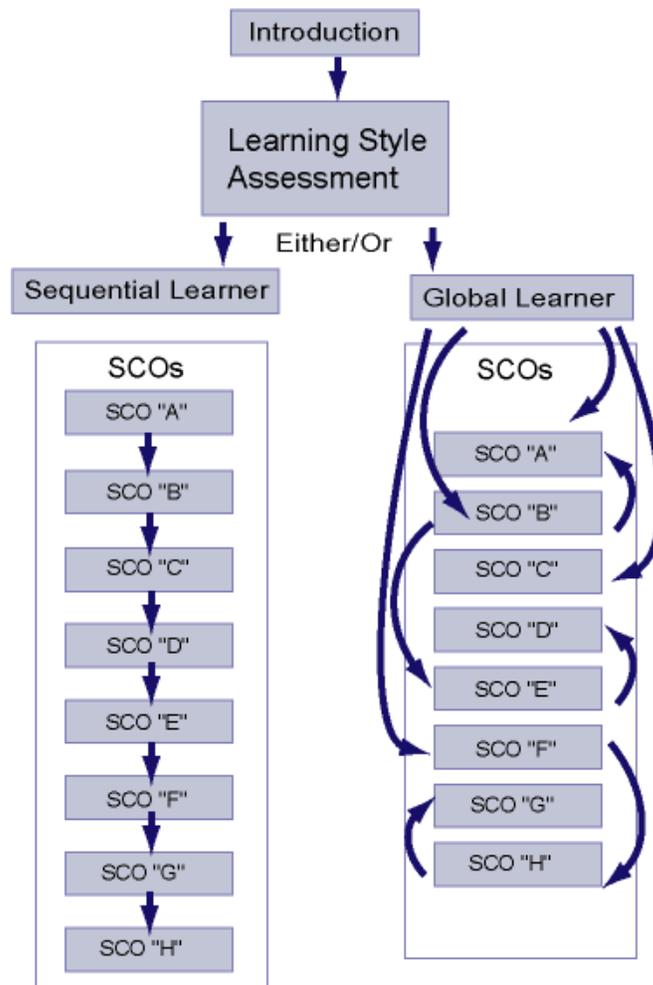
When utilizing the SCOs created by a number of designers, issues will arise concerning the “look and feel” of SCOs as well as potential differences in navigational schemes within the individual SCOs. The envelope can provide relevant explanatory content to aid users in working through the different components. The author’s HTML interface uses framesets to achieve constant user access to both the current SCO and the envelope content. This is, however, just one of many ways this might be accomplished.

On a related note, Elliot Masie has suggested that the interface may someday be a “tagged” entity that can be displayed in a way designed by the course builder rather than, or in addition to, the SCO designer. In this way SCOs built by a variety of designers for a variety of initial applications could be both re-purposed and reformatted visually. I find this to be a very intriguing idea.

### The Envelope as a Sequencing Tool

A designer’s attention to diverse learning styles can have a large impact on user learning. Some people respond well to textual explanations, others learn better with visuals, still others learn best by doing. The envelope, with the addition of a learning styles

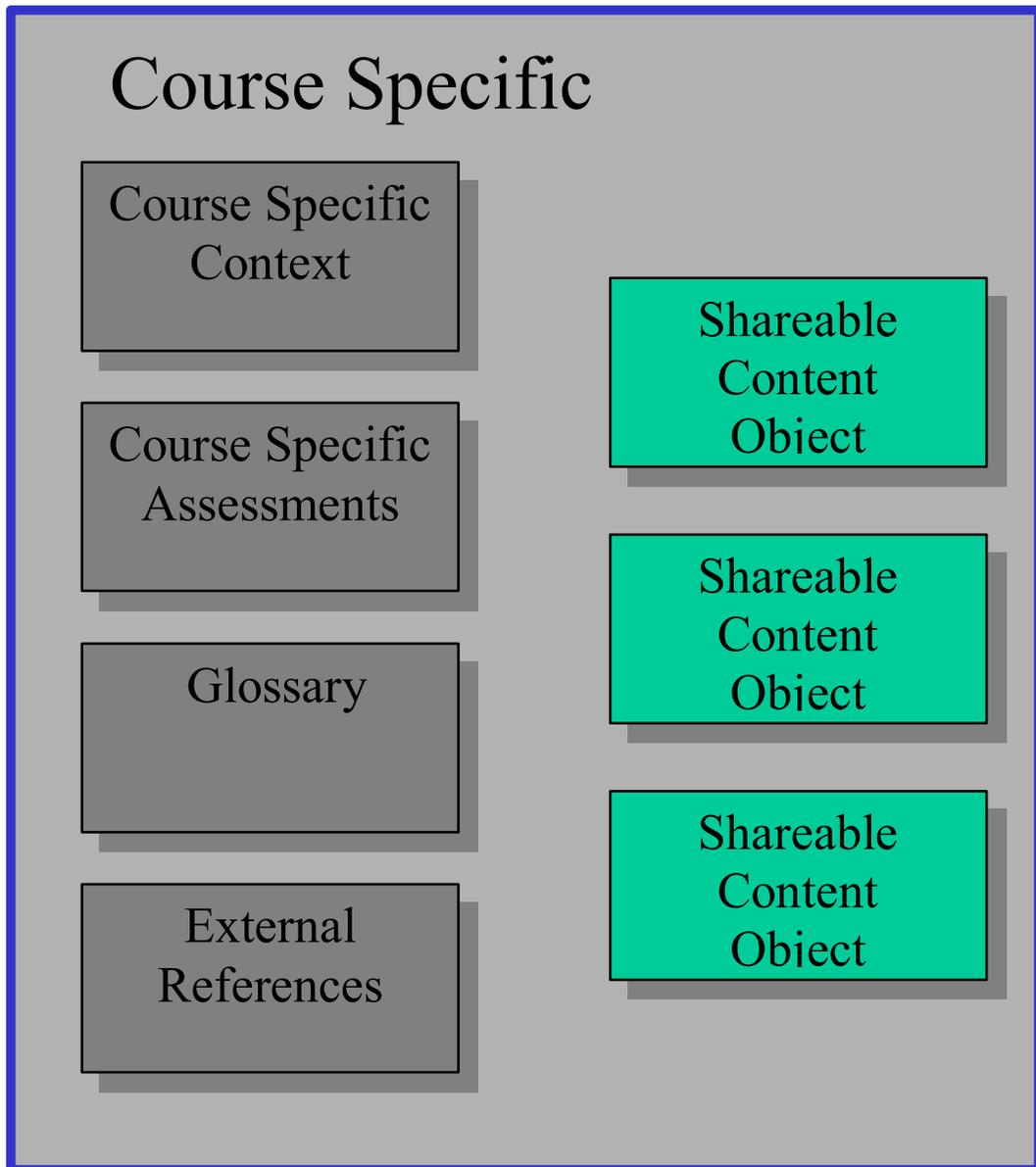
assessment, could serve to actually arrange or order the component SCOs (as well as other material included within the envelope) based on the outcome of the learning style assessment. While the author's specific course did not take advantage of this possibility, research is continuing and this is an important component. We hope to be able to not only order SCOs in sequential steps, the order being determined by a pre-test, but also to determine when a totally global approach is appropriate.



Footnote Disclaimers: Many of the components designed and built for this project may not “test” as SCORM compliant. The author's focus was not on the details of SCORM compliancy per se, but on the theory behind it. This project did not use an LMS (Learning Management System). At this stage it did not

seem relevant to the primary research, and many others in the field are working on SCO to LMS communication.

The project “envelope” is not to be confused with the ADL’s “content packaging,” which refers to the metadata tagging “shell” or package that must be included with any SCO to make it SCORM compliant and provide for text based searchability.



**Part Two:** *“Redundancy in Shareable Content Objects (SCOs) When Combined Into Complete Courses”*

Redundant Content

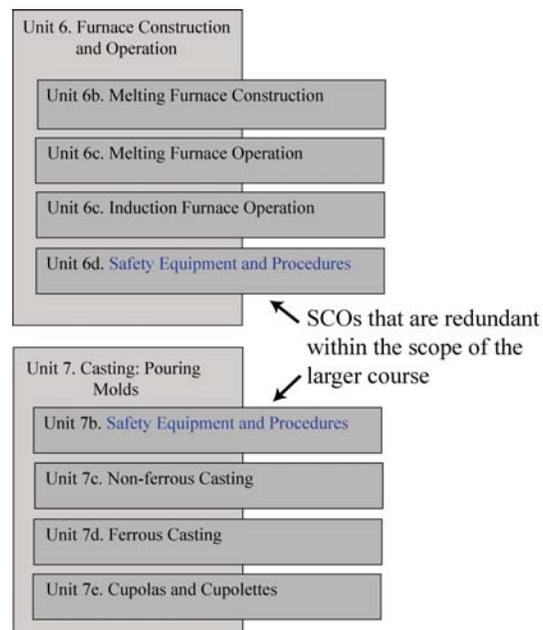
Since to maximize reusability each SCO must be able to stand alone, then much material that is secondary to the primary concept or process, but critical to the user's understanding of said concept or process, must be included.

An example from the test course would be the secondary issue of personal safety equipment. For this particular project, two separate SCOs, one on metal casting, one on furnace operation, both require the same basic information on personal safety clothing. In a traditional textbook or classroom setting, this material could be covered once and then referenced when relevant in later sections. Since a SCO cannot reference material covered in another SCO, this information must be offered twice (to offer it as a separate SCO would require external reference from the SCOs on practices and is therefore not an option). Since the proper safety equipment is so fundamental to the safe operation of the furnace it would not be acceptable to leave out this information.

Equivalency of Content

For this project the format and construction of the SCOs were much alike. In the future designers will want to be able to use SCOs from a wide variety of sources and these will presumably vary tremendously in look, navigation, and in internal assessment style and

quality. Redundancy will be an issue again, and one potentially much more confusing to the user.



Redundancy in assessment is likely to be a large issue. In a recent SCO building workshop held by the ADL Academic Co-lab, each team independently assumed the need for internal assessment to establish the level of the users understanding of the material presented. This observation seems so reasonable that it is easy to expect the idea of internal assessment will become common. In the group the author was working with the scored assessment was treated as a separate SCO and this allowed for the easy removal of the assessment component, but this practice may not always be the case. In situations where the original designer has included an assessment within the SCO, the course designer must deal with the difference between the needs of the initial product and its assessment, and the assessment needs of the new course.

If the SCO can be easily (and legally) deconstructed the course designer might simply remove the assessment component. Or, the envelope, if responsible for sequencing, might be designed to intercept and re-purpose the LMS value returned from the assessment. The LMS might be used to re-purpose the values returned. But if the course's designer needs their own, different type of assessment, or if no LMS is being used, something would have to be done to remove or neutralize the original quiz. It may well become a "best practice" to include assessments, quizzes and tests as easily removable components, or even separate SCOs.

Some designers of sequential learning objects use the successful completion of some type of assessment as a prerequisite for continuing on within the SCO. Assume a designer wants to use several SCOs in a course, but the SCOs have each been designed by different authors, and for different purposes. If the designer is including one of these SCOs because it contains information that is of interest, but is not critical, to the course, then might be unreasonable to expect the new students to take and pass the quizzes within that specific SCO.

## Conclusion

Redundancy of content in SCOs is to be expected, indeed, redundant material will often be required. The course designer will need a way to deal with the issues of duplicated content, duplicated assessments, and irrelevant assessments. Future "best practices" may suggest limiting in-SCO assessment (other than non-scoring practice quizzes) and find a way to "short cut" material duplicated across multiple SCOs within the same course.

**Part Three:** *“External Resources for Whole Courses Built Primarily From Shareable Content Objects (SCOs)”*

The Reusability vs. Context-rich Learning Object Paradox

For a learning object to be “off the shelf” ready it must be a completely stand alone object. Since references to external material would involve connections to (and responsibility to provide) said material. The presumption is that the complexity of such a reference system would get quickly out of hand, so objects conforming to the SCORM must be self contained. While a course designer may like the efficiency of “off the shelf” content objects they also recognize the need to rework courses from semester to semester, and one way to do this is to provide links to current, relevant external information. Additionally, often the self-contained units, while excellent as far as their designers envisioned them, may fail to provide material that is relevant to the course as a whole but was not relevant to the individual SCOs. This will become more and more important as course designers find more creative ways to take advantage of SCOs.

The Case for External Resources

The necessary restriction that SCOs each be self-contained entities creates a serious problem for the teacher in education. The inclusion of recent relevant content is a standard “upgrade” that teachers commonly perform on repeat courses. Continued research of subjects, and the inclusion of new, relevant material (often in the form of hyperlinks to recently published work) is usually expected of faculty.

The very “stand alone” nature of the SCOs will tend to require the addition of additional contextual material within the course, material that is beyond the scope of the self-limiting SCO but relevant to the course as a whole. The very fact of self-sufficiency will necessarily limit the size and complexity of the content. It is impractical to put an encyclopedia in each SCO.

Ellen Wagner, speaking to the ADL Academic Co-Lab gathering in Madison, Wisconsin, June 23, 2003, pointed out that reusability and context often behave as opposites on a single continuum. For a learning object or asset to be reusable it must be as flexible as possible. For a learning object to teach effectively it must provide context for its assets. For example, an image of the White House by itself is nearly context free and can serve in a wide variety of learning objectives. When a designer builds a SCO that contains the image they add information, or context. This might be historical information if the SCO is about American Civics, or engineering details if the SCO is about period architecture. Engineering details are worthless to the political historian however, so the addition of context limits the flexibility (the range of options for reuse) of the asset within another SCO. This tradeoff is fundamental to the concept of reusable learning objects.

An issue this paradox brings up is that of external reference. Computer learners have become accustomed to hypertext in research, the addition of links to information peripheral to the subject being directly addressed. Most have also become somewhat accustomed to “broken” links and 404 “Not Found” messages. To link to a source outside

of the SCO obviously reduces the reliable reusability of the SCO. Yet, course designers will need to update material each time a course is taught. Further, they may need to offer peripheral materials and additional resources for interested and motivated students. Somehow, they need to be able to allow students to access material not relevant to any individual SCO as it stands alone.

A prime example of a relevant, external resource would be a bibliography. Papers and books on subjects “beyond the scope” of any component SCO could be very relevant to the synthesis that is the goal of the entire course.

In the example course, the SCOs each contain a glossary of terms. By in large these are foundry technical terms, not sculptural or art terms. None of the SCOs cover art history as this is peripheral to the intent and content of the processes being covered. Yet, for the overall course, there are terms that the student need have access to, terms about forms and space, terms describing an artistic perspective. The glossary for the whole course then, needs material not covered within any of the individual SCOs. Additionally, it may not be reasonable to expect all SCOs to contain glossaries, especially small SCOs and lower level aggregates.

So within the envelope we find a need for any introductory material, basic instructions for the user, and any or all of the following: sequencing information or controls, glossary, appendices, indexes, course assessments, practice tools, assessments of synthesis of multi-SCO components, resources (links and/or lists),

For a higher education asynchronous web delivered course, a dynamic web site, easily and quickly updateable, could serve to maintain the currency of the data yet utilize SCOs as functional learning objects too.

## APPENDIX A: BACKGROUND

In 1997 the DoD established the Advanced Distributed Learning (ADL) initiative. ADL and its Co-Labs (the author's university is an Academic Co-Lab Partner) have created specifications for SCORM (Sharable Content Object Reference Model), which sets guidelines for SCOs developed for any Government use. Many vendors are currently working on SCORM compliant metadata tagging programs, and the Academic Co-Lab headquarters in Madison, Wisconsin, is working with programs that test SCOs for SCORM compliance. Several interested parties have built small, simple, and minimally tagged SCOs in order to test their SCORM compliancy software.

The project referred to in this paper involved taking a 3 credit hour college course on Art Bronze Casting Practices and reconstructing it in SCOs with the basic ideas behind the SCORM fully in mind. It was the author's intention to try to discover how the overall SCO-built course worked within the higher education setting.

In September 2002 the author began planning a course that would contain SCOs and discovered that some kind of shell, or "envelope" would be required in order to deliver any lesson, course, or program that contained more than one SCO. The project entailed building a course in order to develop a working model of a "shell" or "envelope" for developers, designers, and vendors to use when constructing SCORM compliant lessons, courses, and programs.

The course is built out of eleven SCOs that cover the various “lessons” or “chapters” that comprise the course. Since each SCO must be completely self-contained to allow total reusability, no course specific data can be included, nor can the designer use any references that are not included in the individual SCO. Each SCO covers between four and twelve key concepts that relate to the SCO specific lesson.

It was important that this working model cover as many options as possible so the SCOs contain text, images, illustrations, animations, quizzes and audio, but some also contain video and interactive simulations. The “envelope” contains course specific information, subject introductions, navigation instructions and options, and a resource section.

"The Department of Defense (DoD) established the Advanced Distributed Learning (ADL) initiative in 1997 to develop a DoD-wide strategy for using learning and information technologies to modernize education and training and to promote cooperation between government, academia and business to develop e-learning standardization. The ADL initiative has defined high-level requirements ("-ilities") for learning content, such as content reusability, accessibility, durability and interoperability to leverage existing practices, promote the use of technology-based learning and provide a sound economic basis for investment."

(SCORM\_1.2\_Overview Section 3 Page 3, [www.adlnet.org](http://www.adlnet.org))