Context and the Role of Standards in Increasing the Value of Learning Objects

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Abstract

A benefit promised from learning objects (LOs) is the ability to reuse and repurpose them, thereby saving time and money when producing learning content. Yet anecdotal evidence and informed opinions indicate that relatively little reuse is taking place as of yet. Thinking of information as data put into context, it is hypothesized that the higher contextual component of learning objects and the associated cost of contextualization is inhibiting reuse and repurposing in the education and training arenas. Standards and specifications such as LO Metadata (LOM) and the Sharable Content Object Reference Model (SCORM) serve to reduce that cost and thereby promote reuse. They permit the creation of learning objects that have both pedagogic impact and reusability, and are therefore of more value in many situations.
Learning objects (LOs) promise to take learning to new levels of personalization and relevancy. They promise to offer an environment for individualized learning that is easily accessible and enabled by the use of reusable components over networks of components over networks (Shepherd, 2001). Yet anecdotal evidence and informed opinions indicate that relatively little reuse is taking place as of yet. If one believes informed opinion, much less of the promised reuse and repurposing is taking place than is desired (Hartnett, 2002; Dodani, 2002).

This causes us to ask whether there is something inherent LOs that makes them more expensive or less feasible to reuse and repurpose than it does, for example, to reuse and repurpose news reports, Web site components and other similar content that also derives its value from its ability to bring about a sustained change in memory, behavior or effect. It is hypothesized that high contextual content and an associated high cost of contextualization is what is inhibiting reuse and repurposing of LOs.

At a basic level, LOs contain information. T. Wilson (1984) defines information as data plus context. This might also be expressed as data put into a context. How one quantifies context is not clear, but it is clear that the size of the data is not only thing that matters when determining the value of an LO. In terms of bytes, the entire text in the Encyclopedia Britannica is comparable in size to a fifteen minute film clip of a professional wrestling match, but the encyclopedia contains far more informational value, unless you are interested specifically in professional wrestling. Context plays a very important role in the value of information!

The Cost of Context

When analyzing the economies and advantages of creating content using LOs, we must take into account all possible cost and quality factors, including the preservation of context. If
information-based content is to be reused and if the creation and processing of informational content is to be carried out by people playing different roles in different places, then the content must be transported from place to place and person to person as it goes through the production process. This has a cost, analogous to the cost of transporting goods for industrial processes. Cairncross (2001) argues that the cost of transporting information has become negligible and insensitive to distance. This is true in as much as broadcast media, telephony, and the Internet allow huge quantities of data to be transmitted with little or no loss and at little or no cost. But, information depends on context to maximize its meaning, and context may not be explicitly represented in a data stream. A message out of context may be completely meaningless even if all of the data is faithfully preserved.

Losing context not only impacts the quality of an LO but can also introduce costs required for contextualization. For example, not much is to be gained by re-using an instructional module describing a product if the designer must update all the terminology to conform to new marketing approaches while also re-writing the set of recommended practices to take advantage of new functionality. The context may well have changed sufficiently to make the cost of contextualization too high.

As another example, suppose that several authors are asked to contribute to an educational Web site. If they can simply add their text to a template, then there is almost no cost to distributing the writing effort. If an editor is required to harmonize the authors' writing styles, then a larger cost is incurred. If an editor is required to merge the author's writing and in the process must go back and forth with the authors about what they meant and what common terminology to use, then the cost becomes significant. If the authors' perspectives are too
contradictory and if the assumptions made about the readers are too diverse, then contextual incompatibilities may make it impractical to proceed.

Context also affects reusability. Dependence on context diminishes opportunities for reuse, which acts as a disincentive to produce reusable objects in the first place. The degree of this diminution is a function of both the depth of dependence on context and narrowness of the context. An exercise in the back of a computer science graduate textbook on data structures will have less opportunity for reuse than a news report on earthquake in China or footage of the winning goal in a World Cup Football match. If the data structures exercise is in addition based on a series of four preceding exercises and explicitly references examples and notation from the book, the chances of reuse are even smaller, and repurposing the exercise for use in a class or on a test requires the additional work of building up the context in which it makes sense. A LO that only makes sense in a narrow context has less potential market size.

As indicated by examples like the ones above, it is reasonable to hypothesize that there are inherent differences in the contextual complexity of general content and the contextual complexity of LOs. LOs typically have deeper dependence on more restrictive contexts. This is why news reports are more easily and widely reused and repurposed than LOs.

The Value of Context

The conclusion to be drawn is that much observed behavior, including the lack of widespread reuse and repurposing of LOs, is a reaction to the highly contextualized nature of information used for education and training. The cost of preserving this context, which is an integral part of an information object, is simply too high.

On the other hand, there is a great value to context. The value of an LO is measured by its effect on users, and that depends in part on contextual phenomena. Much learning literature is
devoted to learning styles, "teachable moments", role models and other issues of a contextual nature. The better the contextual match between a LO and the learner, the more effective it is likely to be.

It is therefore important not to simply give up on the notion of reuse and repurposing LOs. Instead, it makes sense to find ways to preserve context, thereby lowering the cost of contextualization and preserving value at the same time.

LO Metadata

Other chapters in this book have discussed the mechanics and format of LO metadata. Metadata applies to information objects in general, and is often portrayed as a way of describing the properties of objects. A more accurate view may be that its role is to capture context. Thus, when a LO is defined as a resource plus metadata, it could equally well be defined as data plus context.

Some examples can illustrate how metadata enables contextualization, in other words, how metadata can make it easier to introduce a LO into a larger framework such as a course or training module. As a first example, consider (as we did above) an exercise from a graduate school text that is based on a series of preceding exercises and that explicitly references examples and notation from the text. A LO metadata record can log the level of difficulty of the exercise, the subject matter of the exercise and its relationship to other exercises and the text. This allows the exercise to be properly cataloged and to be accessed by metadata-enabled search engines. If an instructor finds the exercise using such an engine, then the instructor will know that the exercise matches the level, language, subject area, format and other essential criteria that must be met in order to effectively use the exercise. The search results can display additional information (for example the relationship to other exercises) that might nonetheless make it clear
that the exercise cannot be used or that might provide the bonus of revealing further useful resources. If the exercise depends on other exercises, a good system can automatically provide links to them or, as we will see below, make them available as part of the package. These capabilities may still be a long way from automating the process of discovering and reusing highly specialized educational content, but they may save enough time to make reuse not only feasible but desirable.

**SCORM**

In the production of learning content, it is important that as much context be captured as is possible. Although the IEEE LOM metadata standard addresses some aspects of the context of a LO, it does not address all of them. When LOs are assembled, one needs to include or reference all of the other objects (for example, multimedia files) on which a given object depends. It is also important to know the order in which components are (or should be) delivered to the learner and how their presentation might be affected by elements such as the technical capabilities of the delivery device and the profile of the learner. Interactions between the learner and LOs need to be managed and recorded. All of these factors belong to the context associated with a LO, and all of these are addressed by specifications and standards that are now part of the *Sharable Content Object Reference Model* (SCORM, 2003) that is being disseminated by the Advanced Distributed Learning initiative.

SCORM is not a single standard. (Technically, it isn’t a standard at all.) SCORM is a collection of specifications and standards collaboratively developed by organizations including the IEEE Learning Technology Standards Committee, the Aviation Industry CBT Consortium, and the IMS Global Learning Consortium (Masie, 2002; Robson, 2001). SCORM lives as a collection of related documents, each of which addresses a specific kind of functionality. As time
goes on, the number of documents in the collection are projected to grow, but as of this writing
SCORM includes three basic pieces with a fourth about to be added.

The first part of SCORM features LO metadata. As previously noted, LO metadata
provides objective and subjective descriptors that identify and differentiate information objects
from each other. Every type and granularity of content object within SCORM can carry
metadata.

The second part of SCORM describes a method that learning platforms can use to
communicate with Web-based content. The information that can be exchanged includes but is
not limited to the student's name, the time a student has spent interacting with content, the results
of individual quiz questions, overall scores, and pass/fail information on both the content as a
whole and on individual learning objectives.

The third part of SCORM presents a packaging format (also called an aggregation model)
that supports the assembly, transport and disassembly of collections of digital LOs and learning
resources. A SCORM package includes control data called a manifest whose primary function is
simply to name what is in the package and attach metadata to the components. But the manifest
also contains information about how the contents of a SCORM package can be organized into a
coherent learning experience.

The fourth part of SCORM, which as of this writing is still in the process of development,
is a specification that tells a delivery platform how and in what order to deliver the content
within a SCORM package. The order can depend on what previous content a student has
completed, on how many times a student has interacted with a LO, and on what learning
objectives have been met.
Using SCORM, smaller LOs can be assembled into modules and courses, imported into a learning platform and delivered in a moderately adaptive fashion. Or, to put it another way, SCORM allows the creation of LOs, large and small, that carry the contextual information needed to make them a meaningful part of a digital learning experience.

SCORM has given a tangible meaning to the notion of a LO. In SCORM, there are units called *sharable content objects*, or simply SCOs, which must meet well-defined technological criteria, as well as smaller objects called *assets* and larger objects called *packages* that were just described. In practice these are the objects that can be produced by authoring environments and delivered by learning systems and therefore are LOs from a down-to-earth operational perspective. SCORM can already be reasonably called a de facto standard, and having attained that status, it paves the way for reuse, disaggregation of roles, and distribution of labor. By offering a consistent, commonly agreed upon framework within which LOs can be assembled, context and all, SCORM enables genuine gains by creating repositories of LOs for reuse and repurposing.

Is an "educational object economy" based on SCORM growing where others have failed to take root? Organizations involved in learning content development are gearing up to produce SCORM content because of its "write once run anywhere" characteristics (Jacobsen, 2001). Large government projects are banking on SCORM (Hill, 2002; ITSC, 2002). Consortia are investing in SCORM (COLIS, 2002; EduSpecs, 2003; OASIS, 2003) and various projects are experimenting with metadata-enabled repositories of SCORM content (OASIS, 2003).

Perhaps even more significant is a trend towards distributed SCORM content production. In this process the development of training content is carried out by organizations completely separate from those responsible for designing the content. This indicates that the cost of
contextualization is lower than the savings that can be realized from disaggregating and distributing the production process for learning content.

The Value of LOs

Having discussed the costs of creating LOs we must also consider the benefits. What determines the value of an LO? It is reasonable to posit that the value of an LO is determined by the number of times it can be (re)used and the impact it has in each use. Although it is illogical to imagine that an information object has the same impact every time it is used, a rough estimate of its potential impact can be given by its contextual content. In other words, if we think of information as "data plus context," then it is the contextual component that determines its potency.

To illustrate this, suppose your task is to design an interactive online course. If you are lucky enough to find an existing two hour module that you can drop into your course "as is," you have saved yourself a lot of effort. The same amount of effort might also be saved by finding a Java applet that can be dropped into your course and provides a simulated computing environment and an entire series of relevant exercises. From the perspective of the task at hand, they have the same value. However, if the Java applet is constructed so that it can generate exercises appropriate for other courses, then it can be reused more often, and its overall value is higher, at least to someone such as a publisher who is selling the applet or to a librarian who is creating an institutional repository of LOs with the intent of saving time and money by avoiding duplication.

In practice, LOs with lower contextual value can be reused more. This has led a number of authors to observe that there is an inverse relationship between the "size" of a LO and its potential for reuse (Duval and Hodgins, 2003; Elliott, 2002; Hodgins, 2002; Wagner, 2002;
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Wiley; Wilson, 2003). This applies to any information-based content. For example, a stock photo can be used in many editions of many newspapers, a single story can be used in a single edition of many newspapers, and an entire edition of a newspaper can be use in its entirety exactly once. But it is not "size" that matters. The real issue is context. Information objects with larger contextual components are generally less reusable.

The Value Curve

There is a tension between reusability and context, but both contribute positively to the value of an object. Figure 1 represents a coordinate system with context as the x-axis and reuse as the y-axis. This is meant to be a heuristic based on a conceptual representation; we don't

FIGURE 1: THE RELATIONSHIP AMONG REUSE, CONTEXT AND VALUE
claim to have reasonable quantitative measures of context or reuse at the current time, although anecdotal evidence suggests the value of further exploration. To each point in the x-y-plane we can assign the value of an information (or learning) object with that degree of reuse and context. This means that the classes of objects with the highest worth are those represented by points in the fourth quadrant of Figure 1.

The curve on Figure 1 represents the inverse relationship between reuse and context. Again, we have no real idea of the shape of these curves, and the diagram is meant to be heuristic only. However, we believe them to be passable representations of the situation in which we find ourselves.

Under appropriate conditions, an interesting consequence of the existence of an inverse relationship between reuse and context, plus the positive dependence of value on both variables, is that there are points along any one of the curves where maximum value can be obtained. The curve labeled ‘Without Metadata’ on Figure 1 does not pass through the area of the x-y-plane where value is highest. This, we feel, represents the situation in the absence of metadata. LOs without sufficient metadata are sufficiently expensive to contextualize that even the optimal value that can be derived from a LO is less than desirable. The ones that are rich in context are too hard to reuse and the ones that are easy to reuse do not carry enough context to make them truly valuable.

The addition of metadata and SCORM to LOs does not alter the relationship between reuse and context but changes the shape of the value curve. This pushes it up a bit, moving the maximum closer to the high value area. The right type of technology can push the curve even higher, as diagrammed in Figure 1. This is what we see being done by some learning content management systems that integrate learner profiles and roles directly into the structure of LOs.
Conclusion

At the start of this chapter it was suggested that LOs may not be as reusable as one would hope for. Context has been identified as being the culprit. The highly contextual nature of LOs adds significant cost to reuse. In this chapter we point out that standards like LO metadata and specifications like those found in SCORM have the effect of preserving the context of a LO as it is handed off from person to person and system to system. This makes reuse more feasible. By looking at heuristic value curves, we can imagine that standards and emerging technologies can make it possible to reuse objects with higher contextual components than has hitherto been possible. This makes reuse even more attractive and at the same time increases the inherent value of LOs. With standards in place, along with appropriate practice built around the standards, predictions of educational object economies as in (EOE, 2003) and other similar visions may well end up being correct.
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