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Use and Abuse of Reusable Learning Objects

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Abstract

The term *Learning Object*, first popularized by Wayne Hodgins in 1994 when he named the CedMA working group "Learning Architectures, APIs and Learning Objects", has become the Holy Grail of content creation and aggregation in the computer-mediated learning field. The terms *Learning Objects* (LOs) and *Reusable Learning Objects* are frequently employed in uncritical ways, thereby reducing them to mere slogans. The serious lack of conceptual clarity and reflection is evident in the multitude of definitions and uses of LOs. The objectives of this paper are to assess current definitions of the term *Learning Object*, to articulate the foundational principles for developing a concept of LOs, and to provide a methodology and broad set of guidelines for creating LOs.

1 Movements in the Learning Object Economy

In the past 5-7 years there have been considerable efforts in the computer-mediated learning field towards standardization of metadata elements to facilitate a common method for identifying, searching and retrieving Learning Objects (LOs). Recently, a consensus has emerged among the various bodies spearheading these efforts - including the IEEE Learning Technology Standards Committee (LTSC) Learning Object Metadata Working Group, the IMS Global Learning Consortium, Inc., and the Dublin Core Metadata Initiative - on what these common metadata elements might be.

Similar efforts to develop a common conceptual definition of LOs have yet to emerge. There is a broad understanding among the members of the LO community about the functional

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requirements of LOs:

- *Accessibility*: the LO should be tagged with metadata so that it can be stored and referenced in a database
- *Reusability*: once created, a LO should function in different instructional contexts
- *Interoperability*: the LO should be independent of both the delivery media and knowledge management systems

The functional requirements of LOs are similar to the benefits derived from the object characteristics in object-oriented programming.

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1.1 Practices of Learning Objects

Existing content repositories arbitrarily classify and categorize digital content as *Reusable Learning Objects* (RLOs). For example, the Center for International Education at the University of Wisconsin at Milwaukee (<http://www.uw-igs.org/search/index.asp>) classifies interactive maps, lectures, a population clock, course modules, and other objects, all under the category of *Global Studies Learning Objects*. The Campus Alberta Repository of Educational Objects (<http://www.careo.org/>) lists a video clip of a person lifting weights with voice-over narration, an oriental porcelain statue, and the Final Declaration of Participants in a seminar on land mines, as *Educational Objects*. Comparable inconsistency is reflected in the Educational Object Economy's (<http://www.eoe.org/>) Learning Objects: Java Applets Library, in which the only criterion for classifying a digital resource as a LO is that the object be a Java applet.

1.2 Multiple Definitions of Learning Objects

Currently, there are as many definitions of LOs as there are users. Here is a small sample:

1. "For this standard (*Draft Standard for Learning Object Metadata v6.1*), a Learning Object is defined as any entity, digital or non-digital, that may be used for learning, education or training" ([IEEE Learning Technology Standards Committee 2001](#))
2. "...a Learning Object... [is] 'any digital resource that can be reused to support learning.' This definition includes anything that can be delivered across the network on demand, be it large or small. Examples of smaller reusable digital resources include digital images or photos, live data feeds (like stock tickers), live or prerecorded video or audio snippets, small bits of text, animations, and smaller web-delivered applications, like a Java calculator. Examples of larger reusable digital resources include entire web pages that combine text, images and other media or applications to deliver complete experiences, such as a complete instructional event" ([Wiley 2002](#))
3. "Learning Objects are a new way of thinking about learning content. Traditionally, content comes in a several hour chunk. Learning Objects are much smaller units of learning, typically ranging from 2 minutes to 15 minutes." (Wisconsin Online Resource Center <http://www.wisc-online.com/Info/FIPSE%20-%20What%20is%20a%20Learning%20Object.htm>)
4. "[A Learning Object] is defined as the smallest independent structural experience that contains an objective, a learning activity and an assessment." ([L'Allier 1997](#))
 1. Objective: an element of a Learning Object structural component that is a statement describing the intended criterion-based result of a learning activity.

2. Learning Activity: an element of a Learning Object structural component that teaches to an objective.
3. Assessment: an element of a Learning Object structural component that determines if an objective has been met.

The definition of a LO in *Learning Object Metadata v6.1* is not only overarching but also impractical, in part because non-digital objects such as computer hardware and digital objects like images enjoy the same conceptual status, thereby making it impossible to use the term Learning Object in a meaningful way. In fact, *Learning Object Metadata v4* went so far as to classify people, organizations and events involved in computer-aided education as LOs: "Examples of Learning Objects include multimedia content, instructional content, instructional software and software tools that are referenced during technology supported learning. In a wider sense, Learning Objects could include Learning Objectives, persons, organizations, or events".

Equally broad is Wiley's characterization of the LO. Wiley's contribution to this debate is limited to excluding non-digital objects from the definition offered by Learning Object Metadata. If small media assets such as images and video clips and large elements like Web pages and instructional contexts can be called LOs, then why should these be called LOs instead of *images, video clips and Web pages*? Wiley's definition appears to be a simple case of uncritical nomenclature without conceptual clarification. As a result, classifying every digital asset as a LO nullifies the basic features of modularity, separation of content and context, and reusability borrowed from object-oriented programming.

For a concept to function as such, it should be a general principle, and the concept should be valid in all contexts irrespective of the empirical object it is applied to. Therefore a concept cannot be based on subjective considerations. For example, the Wisconsin Online Resource Center's definition includes the arbitrary imposition of time. But the time required to learn the content of a LO cannot be a measure or means of defining a LO generally, since the time needed to explore a LO varies from learner to learner, depending on the individual's learning characteristics.

L'Allier's definition of the LO is the most clearly articulated of the four. However, any definition that stipulates the intended use, method and measuring mechanism of a LO beforehand restricts the LO's reusability because the methodology, the intention and the assessment are determined by the instructional situation and not the LO itself.

2 Towards a Concept of the Reusable Learning Object

A conceptual definition should clearly lay out the principles of its foundation, in this case learning and reusability, two fundamental predicates of the LO.

2.1 Learning

For any digital object or media asset to acquire the status of a LO it should be wrapped in a *Learning Intention*, which has two aspects: form and relation.

2.1.1 Form

Form is the framework in which a digital object is embedded, and it is the *form* that sets a media

asset on the path to becoming a LO. Take as an example a digital image of Picasso's famous painting Guernica executed during the Spanish Civil War (1936-39). The image displayed on a viewer's computer screen or on a museum wall can evoke a multitude of emotions and reactions: horror, awe, surprise, intrigue, rejection. These effects are based on the sensibility of the viewers. It is through sensibility that we intuit objects, in this case Guernica. If the same image is presented in an art history course, however, the object acquires a different status and becomes a LO because the art history course as *form* - the setting, context and environment for viewing the image - changes Guernica from an object of intuition into an object of understanding. The participants of this course are expected, in addition to simply intuiting the object, to understand it, i.e. to turn Guernica into an object of thought. In this way, *form* not only changes a digital resource into a LO but also transforms viewers into learners.

2.1.2 Relation

The understanding through which an object becomes an object of knowledge cannot be arbitrary nor can it be founded solely on immediate reactions based on sensibility; instead it should come through a reasoned reorganization of sensibility. For learners to acquire a sound understanding of Guernica, they should be guided towards that aim through exposition or discourse. A discourse is a rational set of statements about an object. Although the term 'discourse' refers to language, it could be a textual, visual, aural or interactive construct. A more appropriate term would be 'interface', since the type of discourse envisioned here is a way of relating to the LO analogous to the computer interface that establishes a relation between the user and the bits of information stored in the computer memory banks.

A media asset or a digital object can become a LO only when it is incorporated into a *form* and provides a *relation* to itself as LO in order to facilitate the understanding of that object. Therefore a LO is a totality that combines its digital element and an exposition.

2.2 Reusability

Reusability is the second principle that serves as the foundation for defining a LO. While *form* and *relation* provide a mechanism for the internal constitution of a LO, reusability accords value to it. A LO can avail itself of the flexibility, scalability and adaptability offered by information technology only when the object in itself is predisposed for reuse by multiple developers in various instructional contexts. To achieve genuine reusability the development and operation of LOs should be considered mutually exclusive processes. The separation between creation and deployment will require that LOs do not favor one or other instructional methodology. One of the major problems that give rise to confusion regarding LOs is the excessive influence of instructional design theories. As the terminology and practice of instructional design suggest, it is concerned with generating effective instructional frameworks for achieving overall learning goals. Therefore instructional design theories, which can offer a major contribution to LOs, cannot be the point of departure for the development process.

A clear understanding of the need to separate the object development and instructional usage of LOs can be seen if we consider the former as a strategy and the latter as tactics. Strategy is a ground plan for achieving an overall objective, in this case learning for knowledge exploration. Tactics on the other hand are concrete actions or a series of moves by participants that are required and aid in accomplishing the strategic goals. Given this perspective of strategy and tactics, LOs are strategic assets that are deployed and redeployed in carefully designed and specifically executed instructional situations to facilitate effective learning.

Form and *relation* shape a cohesive internal composition of a LO, and the reusability achieved through separation of object creation and its use facilitates free exchange of LO assets among developers, organizations and institutions. It is through exchangeability articulated here as reusability that the LOs acquire value; without value they remain simple digital images or Web pages.

Now that the foundational principles for the concept formation of a LO have been delineated, the LO can be defined as:

A Learning Object is an independent and self-standing unit of learning content that is predisposed to reuse in multiple instructional contexts.

3 Creating Learning Objects

Content developers have traditionally conceived content from the point of its use. Since use is context and instruction specific, content intended for one particular use is generally invalid for other purposes. The reusable LO - organized content for pedagogical purposes - is a new way of thinking about content creation and its instructional use. The success of this strategy rests on the rigorous separation of the LO and its use for instructional purposes, however. Although sound pedagogical principles should inform the creation of a LO, it should not be coded by any specific teaching methodology or instructional theory. Genuine reusability and optimum functionality of a LO can be achieved only when the LO attains a high level of abstraction. Abstraction provides the LO independence from use and strong performative ability, enabling it to join other LOs for instructional intentions.

Viennese philosopher Ludwig Wittgenstein's idea about the meaning of words and language-games can help clarify the separation between the abstract LO and its concrete use I am insisting on. According to [Wittgenstein \(2001\)](#), the meaning of a word in a language is neither inherent to it nor is it derived from an object it stands for. Instead, the word becomes meaningful in its rule-governed use in a language. Varied uses of words and sentences are called language-games. Like games, language too is a rule-bound activity. The rules of a game as well as language do not decide what move/usage will provide success, but instead what is permissible and what is correct. As a position has significance only in a game it belongs to, a word acquires its meaning only when used in a particular language-game according to the rules. Therefore a preposition is a move or a function in a language-game and it is meaningless without the whole system that supports it. The utterances in a language-game, like moves in a game, unfold as the game progresses and depends on the position of other players.

The LO should be thought of as a word or preposition, and the usages of LOs as language-games. Like a word, a LO is abstract, but can be understood and shared among users. Similarly, as individual words cannot independently produce meaning, the LOs - self-standing and self-referential - in themselves are insufficient to generate significant instruction. Therefore, several LOs have to be brought together in order to create an instructional situation. How many LOs, how they are related, and for what purposes will be determined by the instructor's objectives, pedagogical methodology and instructional design theories. However, I would like to underscore the point once again that the efficacy of a LO and its status as organized and sharable content depends on the degree of abstraction achieved through separation of content and its intended use.

Creating LOs that conform to the conceptual definition advanced here requires that the structure of the LO reflect the two basic foundational principles, learning intent and reusability. This can

be achieved by determining the granularity, or the size, of a LO and its composition.

3.1 Granularity

The size of a LO is crucial to achieving success in its reusability. The current determinations based on learning time (Wisconsin Online Resource Center) and any digital or non-digital asset are subjective and arbitrary. For an effective and functionally sound determination we should revert to a concept or idea that forms the basic building block of rational knowledge. A LO, ideally, should include only one or few related ideas. The rule to be applied is: how many ideas about a topic can stand on their own and can be reused in different contexts? If a LO consists of more than one idea, one of these should be the main idea and the others should be derived from it or be dependent on it. If we take the concept or idea for determining the size of the LO, we free it from subjective considerations such as time and an individual's instructional choices and chosen methodologies.

3.2 Composition

While the concept/idea determines the size of a LO, fulfilling the reusability principle, the composition of a LO puts into practice the *Learning Intention* principle. The formal composition of a LO is the arrangement of elements. An element could be text, image, video, animation, glossary, assessment, multimedia, etc. Preferably a LO should be a combination of multiple elements. The multiplicity not only reinforces the concept communicated, but it also opens up multiple avenues to foster a richer understanding of the idea(s) represented, facilitating learning based on learners' choices and learning characteristics. Furthermore, the same content can be served for learners with disabilities without requiring additional developmental considerations.

4 Developing Learning Objects

The success of the LO strategy depends on a development process that is carefully thought out and methodically executed. The planning and production rests on two processes: conceptualization and collaborative development.

4.1 Conceptualization

Conceptualization is a key phase that lays the basis for success of the LO strategy. LO modeling requires a double vision: on the one hand, a global understanding of curricula to conceive a content object as part of larger whole, and on the other, a micro vision to create content as standalone information for it to function as a reusable object ([Longmire 2000](#)). With this comprehensive visualization we will be able to achieve a maximum rate of reusability.

Experts in the implementation of this content framework should proceed in three steps:

1. Select a topic or theme in a discipline or one that spans different disciplines.
2. Identify different levels and depths the topic is treated at in the discipline. This will provide an intensity map where ranges of depths, from the lowest to the highest level of complexity, are mapped.
3. Design LOs in such a fashion that a combination of them can be used for each level of instruction.

4.2 Collaborative development

The information space opened up by the recent technological developments is the site of production, circulation and consumption of knowledge modules: the reusable LOs. The space of the information age is located in the interconnected global network of computers. The programmers who write the code for the operation and interconnection of these computers create the information space; the graphic designers design and develop interfaces to facilitate the management, input and manipulation of information located in the space; and the subject experts provide the ideas/concepts stored as information bits. Since the role of experts from all three fields is crucial for the successful development and use of LOs, the creation should be a cooperative and closely aligned process wherein the experts use each other's knowledge to create ideas, make them visually compelling and store them in databases for access and manipulation. Furthermore, as the nature and functional requirements of knowledge are ever-changing in the knowledge economy, no single academic or subject expert can generate a total knowledge adequate to the tasks. Therefore knowledge experts should develop only 'events' of knowledge that can combine with other 'events' to develop into a 'program' on demand. This 'events' approach should be seen as strength instead of weakness, since it is a contribution to a collective knowledge that is flexible, functional and adaptable.

5 Standards and Specifications for Developing Learning Objects

As LO development is a collective enterprise among the programmers, graphic designers and subject experts, a standardized approach can accelerate and establish efficiency in the LO strategy. It is important that the developers agree to a set of specifications for development of LOs covering such areas as technology, editorial requirements, and stylistic considerations. A commonly agreed on standard will enable genuinely sharable and reusable content objects, without which we will revert back to current iterations: static Web pages.

5.1 Technical Standards

The technical specifications should address the interoperability of LOs and the physical structure to facilitate easy manipulation of the elements. Success depends on the flawless execution of LOs in all operating systems and delivery media. What is crucial for achieving interoperability is the selection of language for producing LOs. The language should be chosen with the future in view, that is, we should not attempt to make objects compatible with all earlier generation technologies, but instead we should focus on the next generation technology. XML is ideal for achieving both purposes since it is being endorsed as the standard for all future applications. Additionally, separation of structure, content and presentation, which is the fundamental logic of XML, will allow the flexibility required for deploying and manipulating LOs.

5.2 Editorial Requirements

Every discipline has its own discourse and rules of construction for its discourse. Subject experts in a discipline should agree beforehand on editorial standards to ensure the consistency of language across the LOs. Similarly, a common terminology should be created for referring to concepts in a discipline. To accommodate the requirements of LO strategy and individual stylistic preferences, a LO can have a glossary that explains the terminology used in the LO and which cross-references other terms used in the discipline to refer to similar concepts.

5.3 Stylistic Considerations

Appearance and style are extremely important for an effective presentation of LOs. Developers should draw up specifications for use of color, fonts, and layout of images and text. These structural elements should be consistent across LOs so that they can be easily combined for instruction. Since XML separates content, structure and appearance, stylistic considerations can be excluded from the domain of subject experts. Due to the flexibility of XML, the same style sheets can be used for different contents without additional development, and each can be modified without affecting the other. An ideal situation would be to develop several interface and stylistic environments that are user-controlled, which would enable the user to choose the most suitable form of interacting with and exploring the knowledge.

6 Learning Objects and Electronic Books

Any discussion of electronic books has to take into consideration humanity's long experience with the written word in general and the book in particular. Equally important are the reading practices that were shaped by the typography of the printed book over several centuries. Such a reflection cannot be simply a question of technology; it requires a historical, sociological and philosophical perspective. Within the scope of this article it is not possible to undertake a detailed inquiry into these issues, but I would like to touch on some of the important elements to highlight the crucial differences between e-books and material books, and the role of LOs in the construction of e-books.

By designating the digital representation of written text as an e-book, we have already posited a tension between the e-book and the material book. Nevertheless, this confrontation cannot be avoided since our long experience with the book has necessarily placed it as a measure and an impediment for design, production and acceptance of e-books. In positioning e-books vis-à-vis material books the analysis should address three levels of the book's existence: concept, object and metaphor.

Conceptually a book is a compendium of printed pages of text (written in case of manuscripts), organized as sections/chapters with navigational aids such as titles, table of contents, indexes, page numbers, etc. This concept of *book* is a product of mechanics circumscribed by the copyists, artisans, composers, printers and publishers. Although *book* became synonymous with organized discourse, authors do not write books, they only compose text that is offered to readers either orally or visually. Hence the book in its material form is a mediation between the writers and his/her readers; a *mise en scène* that facilitates as well as conditions the writers' compositions and the readers' experiences.

The concept of *book* begins to unravel once it is transferred from the mechanical domain to the field of information technology. An e-book is potentially a limitless interconnected textual grouping whose beginnings and ends cannot be determined. Similarly, the navigational aids that facilitate readings are not conditioned by physical contiguity and spatial relations, but by logical connections and database access. For example, the electronic text is not organized as folios and pages that a reader turns as he or she progresses, but like *volumen* (a papyrus roll) through which one scrolls. These differences require new forms of approaching, reading and treating written texts.

The experience of book is not simply exhausted in the visual representation of text it presents us.

Book as a three-dimensional object offers us a plurality of sensual experiences. Our body can feel its texture, we can hold it between one or two hands, it can sit in a lap, the pages can be turned and folded, it can be carried or kept on a shelf. The tactile sensation of a book and its capacity to engage our whole body and mind while interacting with it is what binds us to it so closely. The e-book essentially belongs to a single domain: the visual. Recent experiments in presenting e-books like material books is an attempt to recreate, through a hierarchical organization of visual content, the tactile experience of a book. The e-book as a visual mode of presentation, however rich it may be, is limited since it does not offer the same sensual experience as the material book. As a result all attempts to simulate material books will yield at best partial results.

Our long relation with *book* has turned it into a rich metaphor, giving rise to representations of *book* as destiny of life, and our conceptions of world and nature as books that can be read. It will be a long time before e-books and e-texts can find their place in our metaphorical universe. Even when they do claim their rightful place they cannot be identical to the role *book* plays in our imagination because e-books and material books belong to radically different realms. We can metaphorically represent life as a book since both, life and book, unfold in space and time as a succession of events. E-books, on the other hand, belong to the information sphere - the space of globally interconnected computers - revealed on computer screens as interfaces. The information space is temporal wherein the moments in time, measured as global real time, create differentiated time-bound spaces. As a result the narrative continuity is fragmented into independent movements in real time.

The recent reversal in the fortunes of e-book manufacturers seems to suggest that the e-book is doomed to failure from the beginning because of a radical divergence between the book and e-book as objects and on the conceptual and metaphorical levels. However, I believe this fundamental differentiation with the book should become the foundation for building the e-book. Such an effort should start by abandoning all attempts to imitate the material book in electronic format and instead concentrate on generating new and different experiences for the reader. In this regard we should realize that the material book is essentially print-centric; the written word is central to the existence of *book*. In last 50 years audio-visual media, especially film, television, video and audio have been competing for readers' attention and have evolved their own unique language offering equally compelling experiences to audiences as the book provides to its readers. Computers have a decisive advantage over other media since they can combine textual, visual and aural elements into a single package that can be experienced simultaneously. Furthermore, multimedia elements provide interaction that is absent from books as well as other media. E-books should embrace this advantage and create a unique form of new and different experiences for its audience, generating its own idiom and diction for communicating these experiences. The success of this strategy requires a community of users who are educated in new reading/viewing/interacting practices. In this context e-books should emphasize communal or collective readings, in opposition to material books, which are essentially directed towards individualized self-experiences.

LOs that are appropriately conceived and constructed will be the first building blocks for rapidly and efficiently constructing targeted reader experiences. LOs can play an important role, especially in e-textbooks and learning materials since knowledge organized into reusable LOs can be easily combined to produce educational materials. However, I would like to emphasize that we should strive to move beyond the text-centric approach and concentrate on designing participatory environments that engender memorable experiences in readers and audiences.

7 Conclusion

It is evident that LOs are the most meaningful and effective way of creating content for e-learning. Unfortunately, the current definitions and practices of LOs are confusing and arbitrary. Consequently, they will never be able to avail themselves of the flexibility, scalability and speed offered by information technology. To break from this impasse, a commonly accepted, accurate and functionally effective definition of a LO is an immediate necessity. The first step in this direction, articulated in this paper, is to establish a concept of the LO that clearly lays out the principle basis on which it is founded. Similarly, as I have suggested, there is a need to reengineer the design and development process of LOs. In this regard the developers - programmers, academics, graphic designers, and multimedia experts - should embrace a multidisciplinary and cooperative model of development to create knowledge that is appropriate for the emergent network society.

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