Learning Objects: the question of "to be or not to be?"

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Abstract: What are *learning objects (LO)* and how are they defined? These are the questions we discuss in this paper, from a didactical point-of-view, in contrast to the technical aspects that dominate the field of Learning Objects. Our review shows that a technical definition of a *learning object* is not sufficient for creating and utilizing *reusable LOs* for didactical purposes. Our conclusion points to an alternative definition of LOs, as well as the need for further research efforts in this domain.

Keywords: learning objects, information, instruction, knowledge, didactics, meta-data, reusability

Introduction

Learning Objects (LO's) have been widely utilized in the domains of E-learning, whilst E-learning has developed through other names and terms such as: open distance learning, web based training (WBT), computer based training (CBT), computer aided training (CAD), technology based training, and online learning. A definition of E-learning is "The delivery of formal and informal learning and training activities, processes, communities and events via the use of all electronic media like Internet, intranet, extranet, CD-ROM, video tape, DVD, TV, cell phones, personal organizers etc" (E-learning-site, 2003).

In our research, we have encountered the abundance of existing variation on the theme: definition, concept, utilization and applications of a learning object. Therefore we concentrate our research efforts on the conceptual aspects of LO's. A learning object can be defined as "A reusable, media-independent chunk of information used as a modular building block for e-learning content. Learning objects are most effective when organized by a meta-data classification system and stored in a data repository such as an LCMS." (Learningcircuits, 2003).

In relation to LO's we ask the question of "to be or not to be" in reference to the confusion that has spread regarding the terminology in use, especially in order to differentiate the definitions of a LO in the context of learning and teaching in a digital environment. With this paper we want to create awareness about the aspects of existing definitions of LO's thus by questioning it's "to be or not to be?", we are aspiring for better definitions that would support the creation of LO's for didactical use. These aspirations concern especially the LO definitions in the existing use of meta-data and standards that define the use and application of LO's.

The conceptual understanding of learning objects brings together traditional E-learning and the more technical related domains concerned with Knowledge management (KM) and learning content management systems (LCMS). KM has been defined as "The process of capturing, organising, and storing information and experiences of workers and groups within an organisation and making it available to others. […]" (Learningcircuits, 2003). A LCMS is defined as "A software application that allows trainers and training directors to manage both the administrative and content-related functions of training. […]" (Learningcircuits, 2003).

The problem with existing LO definitions, is the fact that they point LOs to the technical domain (e.g. by means of the definition and handling of meta-data, LCMS, KM, etc.), in which the handling, locating, transforming and creating qualities are dealt with from an utterly computerized-point of view.

The Learning Object concept is accredited to Wayne Hodgins back to 1992. Since it's arrival, LOs have manifested in various fields of instructional theories towards LCMS. From this aspect it seems like the designer of LOs gradually changed their skills as well. From educators and instructional designers, into technical specialists with skills in database, system architecture, programming and content management.

The question we would like to target is, what, by definition, is a LO in a didactical setting, as opposed to the utilization from the technical aspects? We find that the current available associations or connotations do not appeal to our claims. By proposing this question, we will shed light on the troublesome concept of "learning object". This paper describes concepts that are important for understanding LOs, from the didactical perspective: information, instruction, knowledge and learning/teaching; from the technical perspective of: meta-data, reusability, and composition of LO's.

We will present how to define and utilize LOs in the context of E-learning, and target the problems in such a definition. The paper will outline what a "learning object" should be for the utilization and development of E-learning platforms, content and courses (connotations to domains/terms presented in the beginning) in a didactical setting.

1.1 Definitions of Learning Objects

The Institute of Electrical and Electronics Engineers (IEEE), which is the leading authority in technical areas has defined learning objects as "[…] as any entity, digital or non-digital, that may be used for learning, education or training." (IEEE, 2002). This definition is an official technical definition, which has been referred to concerning a *learning object*.

Advanced Distributed Learning (ADL), has defined a model called the Shareable Content Object Reference Model (SCORM), which is a well-established "standard" for meta-data for LCMS, but also for defining and creating LOs. SCORM sets guidelines and technical specifications for Web-based learning content. SCORM defines term such as: Accessibility, Interoperability, Durability, and Reusability (ADL, 2001). These terms function in the management of "content objects" in a Learning Management System (LMS).

LOs have also been ascribed and associated with terms such as: instructional object, educational object, knowledge object, intelligent object, data object (Wiley, 2000). A common definition by a field expert , regards a *learning object* as "any

digital resource that can be reused to support learning" (Wiley, 2000).

Wiley (2000) has described the taxonomy and characteristics of learning objects, and presented systematic definitions of learning objects consisting of detailed description.

1.2 Learning Objects in Business Praxis

We looked at the definitions and terminology from the utilization in the business context (Cisco, 1999). The terminology from Cisco Systems for LOs is that Reusable Learning objects (RLO) consist of a group of combined Reusable Information Objects (RIO). The group of combined RIOs is a collection of seven plus or minus two RIOs. For completing the learning experience/lesson, an Overview, Summary and Assessment are added to the package. The package's task is assembled around the single learning objective. The Reusable Information objects (RIOs) are further divided into three components, which are: content items, practice items and assessment. These items act like a self-contained chunk of information, which is built around a single learning objective. The RIOs are classified into five type formats: Concept, Fact, Procedure, Principle and Process. These information types were, in fact, defined by Merrill as early as 1983 for the purpose of understanding the cognitive aspects for teaching a singular idea or information chunk (Merrill, 1983).

Hence, the CISCO approach is different in comparison to the more technical oriented approach of ADL and IEEE, regarding their view of creating, assembling, classifying and identifying "information objects" and " reusable learning objects".

1.3 Knowledge Components

From a didactical point-of-view, David Merrill has largely influenced the early body-of-work for E-learning. In his research Merrill defined a terminology that can be compared to that of a "learning object". Merrill defines and names these components as "knowledge components" which, in his later publications has been adapted compared to the earlier definitions: facts, concepts, steps (procedures) and principles (Merrill, 2002). These terms have been borrowed in the RIO and RLO structure of Cisco.

Merrill worked on a theory called the Component Display Theory (1983) (later re-named to the Instructional Transaction Theory), where he defines knowledge [information] with the components of a Knowledge [information] Object (KO) (Merrill, 2000). These KO's are composed of a set of defined containers of information, thus they are carriers of information. The theory suggests that

subject matter content can be represented in the following properties of these components which are (quoted from Merrill, 2000):

- The knowledge components of an *entity* name, describe, or illustrate the entity.
- The knowledge components of a *part* name, describe, or illustrate a part of an entity,
- The knowledge components of a *property* name, describe, identify a value, and identify a portrayal corresponding to this value for the property.
- The knowledge components of an *action* name and describe the action and identify the process(es) triggered by the action.
- The knowledge components of a *process* name and describe the process and identify the conditions (values of properties) and consequences (property values changed) of the execution of the process and any other process (-es) triggered by the process.
- The knowledge components of a *kind* name, describe, and define via a list of property values a class of entities, activities, or processes.

Merrill's components correspond to a structure that matches well to that of a learning/teaching environment's didactical needs. Learning objects are in both the didactical and the technical perspective thought of in connotation to knowledge. In SCORM, it is mentioned that a research aim is targeted towards "creating learning 'knowledge' repositories" (ADL, 2001). We look forward to the development of the SCORM and ponder on the creation of "learning repositories" in which knowledge would be utilized as a technical term. This development should be grounded in the didactical need of learning and teaching.

1.4 The Concept of Learning and Teaching

Learning is "The process of gaining knowledge or information; ascertaining by inquiry, study, or investigation; acquiring understanding of, or skill, as in learning the way; learning to dance; learning the truth about something" (Learnativity, 2002)

In the Instructional Transaction Theory, Merrill proposes that *knowledge* is a constructivist experience, where learning is a personal interpretation of the world, and an active process, in which meaning is mainly developed on experience (Merrill, 1991, 1996). The conceptual growth is conceived by negotiating meaning, and sharing perspectives, as well as changing internal representations through, for example collaborative

learning. Merrill further emphasizes that learning should occur in a realistic situation and setting, where testing is an integrated activity with the tasks at hand. This view is generally hold in the current didactical oriented E-learning scene, e.g. as advocated strongly by Jonassen (1992, 1999, 2003).

Returning back to the E-learning and Knowledge Management domain, where Rosenberg discusses training, the author mentions 4 elements of training which are essential. These elements are: intent, design, means and media, and assessment (Rosenberg, 2001).

The intent to enhance performance is derived by the need to reflect the LO learning goals and instructional objectives in the assessment (i.e. knowledge tests). The design reflects the instructional strategy that is appropriate for the learner's attributes and learning requirements, as thse together with the measurement strategy measure the effectiveness of the training. The means and media through which the instruction is presented could consist of a classroom, various technologies, independent study or a combination of approaches. Finally the assessments, provides a means of certifying capabilities and performance.

Through these differing approaches we would like to conclude the fact that the didactical aspects are highly dependent of the context, as well as the theoretical praxis based on a certain educational philosophy. The educational philosophies manifest their purpose by designing learning and teaching theories, which follow a certain task and achieve a goal, through specifically carried out instructions or actions. Therefore it becomes critical in the matter of *learning objects* that an application designed and implemented through the technical specifications shows a correspondence to the needs and requirements put forward in the didactical field through teachers and students.

2 Conceptualising Learning Objects

In the E-learning field strategies for designing didactical and reusable LOs are rarely defined, nor are the relationship between "information, instruction and knowledge" discussed for the purposes of teaching and learning. Therefore, we discuss the concept of information, instruction and knowledge. Previously we have described *knowledge* from the didactical aspects. In our research we have encountered definitions that refer and associate information with knowledge. As mentioned by Rosenberg (2001), we clearly see a

need for differentiation between learning and teaching through the concept of *instruction*. In order to define LO's in a usable way for didactical purposes, we argue that the factors responsible for the creation of an optimal learning/teaching environment or situation should first be studied and considered.

We believe that *learning* is to acquire, understand, comprehend, process and handle information units. Thus the role of LOs in the domain of E-learning is to support similar processes, which consist of: mediating information, transferring information, presenting and re-presenting information. The learner/student has to go through various steps of the learning process, for example; handle information, comprehend it and learn how to use it. Knowing how to use information units and being able to exemplify and explain a piece of information, is a part of the process of a learning experience. Whether this learning experience is individually acquired or collectively is a matter of preference, or mode of teaching and learning.

We do not equalize knowledge with information, although even dictionary definitions cross-reference information to knowledge. But as we will show and point to, in the domain of E-learning, the terminology has often been confused and utilized without any further thought or discussion.

2.1 Information, Instruction and Knowledge

We propose a practical definition of knowledge for the E-learning context: *We know when we can demonstrate and apply our knowledge.* This means that in order to complete a learning process, we first have to internalize the available information and then apply it. The learning process in an E-learning context can support this when it offers means to interact with the LOs (to internalize the content) and practice the individually acquired models on suitable tasks.

In the context of E-learning the following questions are relevant: What is Information? What can we do with it? How do we handle it and describe information to others?

In different resources information and knowledge is regarded as the same thing: "Knowledge derived from study, experience, or instruction" or "The act of informing or the conditions of being informed; communication of Knowledge" (Dictionary, 2003). A third definition of information also refers to "knowledge", thus telling us that "The act of informing, or

communicating knowledge and intelligence" (Merriam-Webster dictionary, 2003).

In this context it is important to make a distinction between the person who shall acquire knowledge and the source (eventually the teacher and his/her means of mediation) of the information. A teacher presenting his/her knowledge will regard the presented information as knowledge (i.e. re-presentation of knowledge), this does not mean, however that this knowledge automatically can be transferred as knowledge for the students. For the students, the re-presentation of knowledge is information.

Information in the technical term is defined as: "Information is stimuli that has meaning in some context for its receiver. Some (if not all) kinds of information can be converted into data and passed on to another receiver. In the computer world, we can say that: Information is made into data, put into the computer where it is stored and processed as data, and then put out as data in some form that can be perceived as information." (SearchDatabase, 2003).

To conclude, we suggest the following term as a highly relevant answer to our questions: "an information object" is defined as "The smallest useful piece of information that can be used and re-used, such as an illustration, a question, a definition, a procedure, or a sound." (Learnativity, 2003).

Sources from E-learning and Knowledge management try to differentiate the term "information" from "instruction", which previously has caused confusion and trouble for those applying it in the domain. Rosenberg present these definitions on information and instruction (Rosenberg, 2001):

Information
- Focused on a specific organisation of content.
- Purpose defines primarily by users.
- Based on the characteristics of the particular knowledge discipline and targeted users.
- Sequenced for optimum reference.
- Primarily centred on effective presentation.

Instruction
- Focused on a specific learning outcome.
- Purpose defined by instructional designers, instructors, etc.
- Based on a strong diagnosis of user characteristics and needs, and targeted to meet those specific needs.
- Sequenced for optimum memory retention.
- Contains primarily presentation, practice, feedback, and assessment components.

Rosenberg further holds that "The real challenge for learning, especially e-learning, is the ability to distinguish the need for information (knowledge management) vs. the need for instruction (online training), and to understand how they work in tandem." (Rosenberg 2001).

The struggle of defining information and knowledge independently has been illustrated in the passage above.

In fact, we expect a gap between the perception of practicing teachers regarding what learning is, and technical instructional designers. For teachers the learning process goes from deriving and collecting information, through instruction/mediation & teaching towards evolving knowledge. Instructional designers on, the other hand, seem to forget the learning process and make a short cut between the presentation and knowledge.

Next, we take a look towards the technical sphere of meta-data and reusability to see how these issues are dealt with.

2.2   The concept of Meta-data

In our research we have concluded that the existence of loose "learning object" definitions are commonly matched with existing standard in the field of the technical domain. SCORM provides directives and guidelines for meta-data and "learning content objects", but it does not define a LO nor discusses any didactical aspects of LOs, even though the document mentions and proposes how learning technologies should be designed for instructional outcomes in instructional settings. Examples of instructional settings in SCORM are "Tailor pace, content, sequence, and style of instruction to the needs of individual learners [….], develop new instructional techniques, such as intelligent tutoring, tutorial simulations, and networked simulations, that take full advantage of the capabilities technology brings to instruction" (from SCORM, ADL, 2001). SCORM promises a future of "learning content object" that are identified as "sharable content object" which have the following properties (quoted from SCORM) (ADL, 2001):

- Durable – do not require modification as versions of systems change;
- Interoperable – operate across a wide variety of hardware, operating systems and Web browsers;
- Accessible – can be indexed and found as needed; and
- Reusable – can be modified and used my many different tools.

The "basic meta-data structure" which is the highly referred LOM document from IEEE is the best practice document, which portrays, describes and groups learning objects into nine categories. These categories are: General, Lifecycle, Meta-Meta-data, Technical, Educational, Rights, Relation, Annotation, and Classification category groups. To answer the question we have posed, we looked closer into the category of "Educational". The elements in the Educational and pedagogical category in LOM are (IEEE, 2002):

- interactivity type (modes of learning: active, expositive, mixed),
- learning resource type (specific kind of LO; most dominant first),
- interactivity level (to which degree the learner can influence various aspects of a LO),
- semantic density (degree of conciseness: size, span, duration),
- intended end user role (principal users of LO, which users was it designed for; most dominant first),
- context (principal environment within which learning and use of LO takes place),
- typical age range (age of typical intended user),
- difficulty (how hard it is to work with/through a LO for the intended user),
- typical learning type (approximate time it takes to work through a LO for the intended user),
- description (comments on how a LO is to be used),
- language (human language used by the intended user of a LO)

The Educational Category (from LOM), with the elements mentioned above and the SCORM do not suffice on a didactical level, because they do not describe how didactical LOs can be designed, or even only be described, nor how Los can be didactically applied. We further oppose the idea of atomizing didactical elements in LOs, which could be handled in a similar manner as meta-data. We believe that the didactical context is vital and essential for all learning aspects, and therefore urge for a clarification in the case of utilizing standards such as LOM and models such as SCORM for creating and implementing Learning Objects.

2.3   The Components of Reusability

Hand in hand with the definition of a LO, is the magical aspect of it's reusability. Reusability implies that a piece of information, presented in any form

suitable for digital presentation, tagged with meta-data (tagging and handling properties for this information), results in an information object, which can be re-applied in many different contexts, transformed through the existing media-channels as well as have abilities to adapt to its users. We find the concept of reusability to be the bottleneck for the design of LOs. It is like waiting for *Godot* (referring to the book "Waiting for Godot" by Samuel Beckett), reusability seems to be something we are expecting to become true. In fact, in the technical domain, the concept of reusability of LOs is one of the most important motivation for the development of LCMS. Until now, however, functional reusable learning objects and systems that can handle these are very rare.

One may then ask, what about the potential of reusability? SCORM mentions "tailor instruction to the needs of the individual […] enable the pace, sequence, content and method of instruction to better fit each student's learning style, objectives and goals". This does not imply that the didactical elements are easy to manipulate in such a sense as suggested above, but perhaps it just needs to be re-defined and re-questioned as a concept (ADL, 2001).

In a major critic presented by Lambe, the author points out many misconceptions and black holes mainly from a technical perspective which encircle around the discussions of the future of LO's (Lambe, 2002). It is stated that those in the technical domain, who believe in the reusability of LOs and support "programmable knowledge" [learning], have ignored the basic cognitive aspects of humans, such as knowing, meaning, communicating, miscommunication, forgetting, remembering, formulating, recognizing, adapting, recognizing, noticing, choosing, liking, disliking and so forth. Instructional designers in the technical domain have treated LOs as knowledge that is a content, an object or a manipulative artifact. Through the treatment of knowledge as a physical artifact or an object, the understanding of LOs has been handicapped. Reusability and context independency or neutrality are pointed to as themes which makes the issue of LO more difficult. Therefore communication between "human experts" and "technology experts" is necessary.

Lamb proposes that it is important not only to work on how to conserve Los, but also to allow them to be disposed. "Learning-needs change faster than learning designs" (Lamb 2001).

We agree with Lambes' propositions regarding the misconceptions and his notion of creating

"disposable LOs" instead of reusable LOs only. We would like to hence clarify and present our definitions of LO's.

3   The process of defining a Learning Object

We have analyzed the domain of LO's and thus we would like to conclude on some assumptions and misinterpretation that exist in the subject matter. We would like to point out what learning objects are *not*, and thus say that a LO is:

- not a knowledge object (by definition)
- does not contain any knowledge but construction parts that could create an individual perception of knowledge
- does not transmit knowledge but information
- cannot be understood independently from it's context
- reusable to a certain extent but not in any subject, for any users, in any format
- not free from their content, but not bound to their content neither
- not an answer to solving the problems concerning the economy of reusability (effort, time, means) for teaching and learning.

Thus we would like to conclude what we believe that a learning object could be and what traits it should possess. A Learning object can be:

- an Information Representation, which carries information about a specific topic
- an assembly of information units, that make a coherent structure about a matter (subject)
- provide information that can be structured and presented in various formats, media and representation but various formats do not automatically transfer the same information
- transformed into differing representations within a space of a single purpose

We would like to clarify that the act of transforming and exchanging format, such as presentation and re-representation in various media-channels, does not automatically imply that a certain LO transfers the same qualities and properties regardless of its format/medium. We believe that a certain change of information content occurs when a LO is transformed into different representation over differing media-channels. These variations could strengthen or weaken the understanding of a LO with a given single objective, when it is presented and re-presented through differing media-channels.

In the propositions mentioned above, we work with and focus on *information* not knowledge as mentioned by Merrill (referred by Lambe, 2002). We have a strong need to separate the presentation of information from knowledge, since an common misinterpretation relies on the fact that when we are referring to LOs, we are transferring knowledge, which is not the case.

In our understanding, knowledge is created in the mind of an individual, and can thus differ from the originator/creator of a LO. A LO communicates information and the process of communicating the content of a LO, is certainly not a transition of knowledge nor is it an acquisition of a direct knowledge source. This is coherent with the basic constructivist "rules" for learning.

3.1 Conclusions

In this paper, we try to differentiate the domain of technical and didactical aspects concerning the question of being or not being of a LO. We would like to conclude that the existing technical definitions do not support nor suffice the need of a didactical understanding and handling of a LO. Optimal learning emerges from the three factors: LOs (in our meaning of the term), mediation (information + instruction + *teachers* knowledge) and students abilities.

In our paper, we have aimed at pointing out aspects of a definition that could help to define and discuss the difficult aspects of a LO. We urge and propose a precise definition for a didactical LO. Hence, a didactical LO is: *a representation of information reflecting the learner situation, teaching methods and the knowledge mediated-processes involved in the experience of learning*. We urge for a better definition of LOs suitable as specifications for meta-data, as well as in models such as SCORM and standards such as LOM, where the technical domain need to be aware of the existing differences that disintegrates the technical perspective from that of the didactics. We aim for further research efforts and practical work regarding the investigation of utilizing LOs in the context of teaching/learning in real-life situations, as well as E-learning.

References

ADL (2001), Advanced Distributed Learning (ADL), Shareable Content Object Reference Model (SCORM), Version 1.2. The SCORM Content Aggregation Model, October 1, 2001.

CISCO (1999), RIO Strategy v3.0 June 25, 1999, Cisco Systems, Inc. Retrieved January 14, 2003, from the World Wide Web: http://www.cisco.com/warp/public/779/ibs/solutions/learning/whitepapers/el_cisco_rio.pdf

Dictionary (2003), Definitions of Information, Knowledge. In dictionary.com: Online Version. Retrieved January 14, 2003, from the World Wide Web: http://www.dictionary.com

Duffy, T. & Jonassen, D.H. (Eds.) (1992). Constructivism and the technology of instruction: A conversation. Hillsdale, NJ: Lawrence Erlbaum Associates.

E-learningsite (2003), Definition of E-learning. In e-learning-site.com: Online Version. Retrieved January 21, 2003, from the World Wide Web: http://www.e-learningsite.com/elearning/basics/basics.htm

Gibbons, A. S., Nelson, J. & Richards, R. (2000), The nature and origin of instructional objects. In D. A. Wiley (Ed.), The Instructional Use of Learning Objects: Online Version. January 14, 2003, from the World Wide Web: http://reusability.org/read/chapters/gibbons.doc

IEEE (2002), Standard for Learning Object Metadata, IEEE 1484.12.1-2002.

IMS (2001), IMS Digital Repositories White Paper Version 1.6 / August 2001 (p 13)

Jacobsen, P. (2001), Reusable Learning Objects: What does the future hold? In e-learning Magazine: Online Version. Retrieved January 21, 2003, from the World Wide Web: http://www.elearningmag.com/elearning/article/articleDetail.jsp?id=5043

Jonassen, D.H., Peck, K., & Wilson, B.G. (1999). Learning With Technology: A Constructivist Perspective. Columbus, OH: Merrill/Prentice-Hall.

Jonassen, D.H., Howland, J., Moore, J., & Marra, R.M. (2003) Learning to solve problems with technology: A constructivist perspective, 2nd. Ed. Columbus, OH: Merrill/Prentice-Hall.

Lambe, P. (2002), "The Autism of Knowledge Management". Retrieved January 14, 2003, from the World Wide Web: http://greenchameleon.com/monaco/Autism.pdf

Learningcirtuit (2003), Definition of Learning Object. In learningcircuit.com: Online version. Retrieved January 21, 2003, from the World Wide Web: http://www.learningcircuits.org/glossary.html

Learnativity (2003), Definitions of Learning Object, E-learning, In learnativity.com: Online Version. Retrieved January 14, 2003, from the World Wide Web: http://www.learnativity.com/

Merriam Webster (2003), Definitions of Information, Knowledge. In Merriam-Webster Dictionary: Online Version. Retrieved January 14, 2003, from the World Wide Web: http://www.m-w.com/home.htm

Merrill, M. D. (1983). Component Display Theory. In Instructional-Design Theories and Models: An overview of their Current Status. Hillsdale, Lawrence Erlbaum associates, Publishers, p 279-333.

Merrill, M. D. (1991). Constructivism and instructional design. *Educational Technology,* May, 45-53.

Merrill, M. D. (1996). Instructional Transaction Theory: An Instructional Design Model based on Knowledge Objects". Educational Technology 1996, 36(3), 30-37.

Merrill, M. D. (2000), Knowledge objects and mental models. In D. A. Wiley (Ed.), *The Instructional Use of Learning Objects: Online Version*. Retrieved January 14, 2003, from the World Wide Web: http://reusability.org/read/chapters/merrill.doc

Rosenberg, M. J. (2001), "E-learning. Strategies for delivering knowledge in the digital age". McGraw-Hill. The McGraw-Hill Companies, USA.

SearchDatabase (2003), Definitions of Information, Knowledge. *In searchDatabase.com: Online Version.* Retrieved January 14, 2003, from the World Wide Web: http://searchdatabase.techtarget.com/

Wiley, D. A. (2000), Connecting learning objects to instructional design theory: A definition, a metaphor, and a taxonomy. In D. A. Wiley (Ed.), *The Instructional Use of Learning Objects: Online Version*. Retrieved January 14, 2003, from the World Wide Web: http://reusability.org/read/chapters/wiley.doc