Learning Objects

By Ken Allan, The Correspondence School, Wellington, NZ

> *"Tell me and I'll forget; show me and I may remember; involve me and I'll understand." Chinese proverb*

Introduction

Have you ever learned how to activate a setting on a mobile phone by studying one of its animated tutorials? Did you at one time make use of online instruction to learn to touch-type or increase your typing speed? Perhaps you were once privileged to operate the controls of a flight simulator as part of the training to become an aircraft pilot. If your answer to any of those is yes then you have benefited from using a learning object.

The learning objects referred to here, and others like them, owe much of their success to one common aspect of their design: feedback that is relevant to the immediate circumstance of the learner - the hallmark of a good learning object. This discussion paper is about the learning object, its design, development and appropriate use as one of the many components in the portfolio of applied e-learning tools and strategies available to the 21st century teacher[1].

Early last century simple mechanical devices were invented to help with learning. The 1960s saw computers assist with traditional learning methods such as face-to-face language instruction. A sophisticated blend of technology and pedagogy was developed for this - computer assisted language learning or CALL[2] - that is still in use today. In the late 1970s it was recognised that digital learning devices could be precision designed to afford specific and objective learning in many areas within a huge range of educational topics. Provided the fabric of their construction was carefully designed, such devices could be accessed almost anywhere at any time and on a variety of electronic media.

A device fitting some or all of these descriptors is broadly termed a digital learning object. It came into its own with the advent of the internet in 1992. Use of the fundamental principles behind learning objects has been raised to a level of maturity through the work of organisations such as MERLOT (Multimedia Educational Resource for Learning and Online Teaching)[3], a free and open resource involving a large online community in the development of learning objects for higher education hosted by the California State University System.

Classification of learning objects and instructional design theory

The question of what a learning object should consist of has been a matter of considerable discussion over the years and there are various prescriptions for this[4]. A learning object can be described simply as any digital resource that can be used to support learning. It includes anything from a digital photograph to an elaborate combination of components that instructs and provides practice examples. David Wiley put forward a taxonomy for classifying learning objects and proposed an instructional design theory for their construction and application[5]. The individual components of learning that together lead to the desired learning outcome have characteristics that can be used to choose a possible learning pathway. Instructional design theory deals with the essential links between what is

to be learned and how to select the most appropriate pathway for the learning. Wiley proposed three constituents of effective learning object implementation:

- an instructional design theory
- a learning object taxonomy
- prescriptive linking material.

The latter defines the relationship between the instructional design theory and the taxonomy and by this means permits the selection of suitable learning objects. His pithy summary for this is, "for this type of learning goal, use this type of learning object". Wiley details these strategies in his dissertation on learning object design and sequencing theory (LODAS)[5].

Learning objects can be transportable and reusable

The perception that a learning object could be designed to be used in a number of contexts initiated the idea that it should also be made so that it is transportable. A device so built is termed a reusable learning object or RLO. Warren Longmire summarises the content of a reusable learning object[6]:

In an environment in which context is scalable and adaptive, the ideal RLO content is:

- modular, free standing and transportable among applications and environments
- nonsequential
- able to satisfy a single learning objective
- accessible to broad audiences
- coherent and unitary within a predetermined schema so that it is easy to catalogue the main idea or essence of the content
- not embedded within formatting so that it can be repurposed within a different visual schema without losing the essential value or meaning of its content.

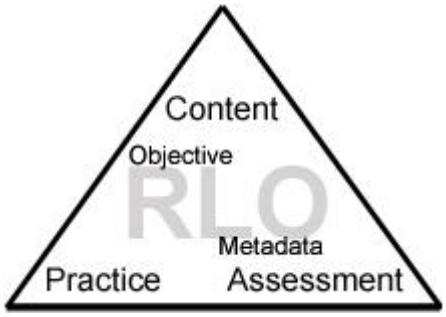
He describes the RLO as having two necessary factors, content and its metadata tag, the latter being a collection of information important to the cataloguing of the RLO for subsequent storage in a way that permits its ready identification and retrieval from a repository. Longmire also suggests the need to contextualise learning objects, for without context they can become "confusing, misleading, or utterly meaningless", and he proposes a series of strategies for doing this[6].

What is contained in the RLO?

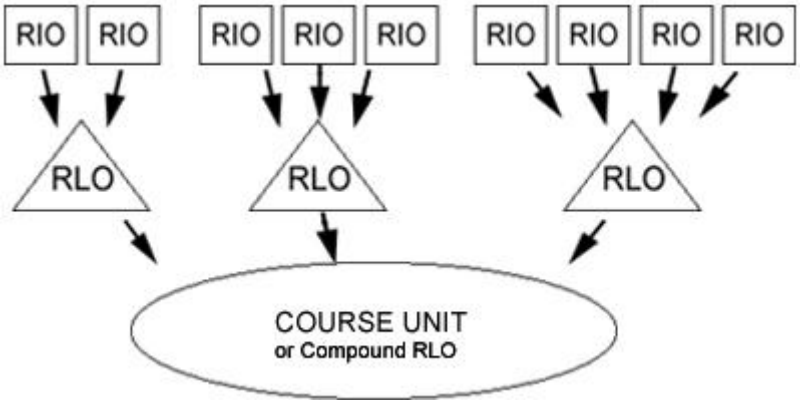
A good learning object is like a well-made brick. It has components, each providing a quality to the overall function, prepared according to defined standards so that their combination can fit an objective purpose within a defined context. If designed correctly it can be used in a related context without the need for alteration, hence the term reusable. While this ideal is important to the life and application of the RLO, the fashionable preference is that it can be repurposed or contextualised when used within diverse contexts.

Cisco Systems used a schematic approach to describe the structure of the RLO, defining the reusable information object (RIO) as a component that has similar properties to the RLO[7]. The RIO consists of static, animated and interactive content including text, diagrams, pictures and videos as well as practice examples and assessment items. Each RIO is built so

that it supports the objective of the RLO. Cisco's RLO has a structure that fits Longmire's summary.



Cisco also developed a strategy for building and implementing the RLO - the primary learning approach is identified to determine what the RLO should contain and this prescription then serves as a plan for its design and construction. Suggested optimum componentry includes an overview, summary and assessment - between five and nine RIOs, though this range may vary widely in practice. A series of RLOs can be constructed according to a pedagogical strategy to form part of a course, or to build a compound RLO.



Granularity

The smallness of each component part, and the number of these incorporated into the whole, relates to what is called the granularity. Though the term is widely used in the context of RLO design and development, there appears to be no clear-cut definition for it. Collis and Strijker describe granularity as "just one of many issues related to learning objects that have different meanings and implications in different organisational contexts"[8].

Granularity has administrative implications when considering matters related to the cost of production and also the data retrieval of each part. In relation to the size of the RLO, granularity has also pedagogical implications especially if it has insufficient componentry to be considered a suitable unit of learning. The RLO should be neither too large in comparison to the size of its components nor too small to perform the pedagogical function in meeting its learning objective. Simplicity of design applies as much to the construction of a good learning object as it does to folding a well-made paper dart; size and functionality need to be optimally balanced for the learning object to be on target.

Metadata, storage and retrieval

For a learning object to be stored and later retrieved easily, it must be catalogued or labelled using metadata, essentially data about information. Criteria for defining metadata and the number of related attributes within it vary according to the specification used. The label or tag, known as the metadata tag, contains digital information that identifies all the important properties of the learning object. When a learning object is selected from a repository its many parts are brought together according to the attributes chosen from its metadata tag. In this way the appearance of the object when displayed may be tailored within the limits of the metadata criteria and according to selected preferences on retrieval. Learning objects that form part of a programme of learning are stored in a repository or repositories accessible by a learning content management system (LCMS)[9] suitable for processing the learning object metadata (LOM)[10].

For LOM to be useful it must adhere to an unambiguous specification of which there are many, including those defined or used by Dublin Core[11], SCORM (Shareable Content Object Reference Model)[12], The Le@rning Federation[13], MERLOT[3], CLOE (Co-operative Learning Object Exchange)[14] and IEEE (Institute of Electrical and Electronic Engineers)[15]. The IEEE Learning Technology Standards Committee has established a set of internationally accepted open standards for learning object metadata adopted by other organisations.

Learning objects should be practical

The learning objective must be suitable for the application of a learning object, and for some purposes there are limitations no matter how well the learning objects are designed. The pursuit of such tools to meet associated learning objectives in these cases will very likely prove fruitless. For instance, it is clear that a learning object cannot be a substitute for a chat-room discussion. Nor would it be fitting to offer one as a replacement activity where the learner is required to collect data from a series of location cams, especially if the gathering process is important to the learning.

The learning object employs a wide range of audio, video, animation and interactive technologies and is perfectly suited to e-learning. It is especially useful for introducing the learner to concepts difficult to present in text, static diagrams or pictures, or where it is difficult or dangerous for the learner to view a particular event such as the separation of chromosomes in the dividing nucleus of a living cell[16] or the Strombolian eruption of a volcano[17]. When the learner is finished interacting with a learning object what is important is not the impact of a clever animation or an impressively dynamic video, but the learning that's imparted and the relevance of that to the circumstance of the learner. It must furnish the learning objective that was on its designer's notebook and it should be memorable for that alone.

Immediacy, interactivity, learning and engagement

Wiley recognised that interactivity is a vital attribute of an effective learning object as "engaging learners, making them active participants in the learning experience, is key to having them meet the learning objective". Interactivity brings immediacy to the learning through instant feedback and lights the spark[18], but its importance is frequently overlooked during the design phase of a learning object. Though it is rarely the province of a learning object to process learner activity or to perform summative assessment, the

information that may result from these is what most teachers look for to establish if learning has taken place. Yet in potential learning situations the learner is often out on a limb wondering what, if anything, has been learned. Authors of early textbooks realised the worth of passive feedback in questions that had answers at the back of the book, alerting the learner to the need for further study when required. Recently, metacognition – thinking about thinking – in relation to the learner thinking about learning has become a fashionable teacher consideration[19]. With respect to these matters the importance of immediate feedback to the learner on what has been learned and what needs to be learned cannot be underrated. And while it is true that opportunities for learner feedback and formative assessment do not ensure that learning happens, their presence allows the learner to evaluate learning progress and they can also stimulate engagement[20]; herein must reside one of the requisites of a well-designed learning object.

Design, development and quality maintenance

Learning object development is no longer constrained by the dictates of those with expert technical knowledge and specialist ability. The steady arrival on the market of new authoring tools permits teachers with little technical know-how to design and create learning objects for themselves. But a most important role of the experienced teacher is in the selection and application of effective learning objects. It appears that these tasks, as well as those to do with building the resources, have fewer problems if careful thought is given at the design stages well before construction begins. Margaret Haughey and Bill Muirhead[21] found that "incorporating all accessibility features into all learning objects made the learning objects more complex to develop, more costly to create and in limited cases adversely affected the overall design of the learning object. An alternative was to develop separate purpose-built learning objects for learners with specific special needs." They put forward a case for developers addressing additional accessibility criteria on an object-by-object basis. Haughey and Muirhead also contend that the trend towards learner-oriented inquiry puts less emphasis on teacher pedagogical orientation and that this shift may favour a more learner-centred approach in the future use of learning objects.

Leppisaari and Vainio[22] posited that "collegialism" among those engaged in learning object development is also valuable for maintaining the pedagogical quality of object content. This opinion is also held by MERLOT[3] where resources are peer-reviewed to ensure quality standards, and by CLOE where recognition is given to the special value of peer reviews in learning object development. CLOE suggests guidelines as well as a model for the peer review process[23].

Rachel Smith offers a cornucopia of invaluable ideas, tips and advice in her comprehensive paper, 'Guidelines for Authors of Learning Objects'[24]. She upholds the principle of learner choice, maintaining that "an object that presents content in an appealing setting, inviting learners to explore at will, is more interesting than a single-path, linear, 'click here to proceed' format. If the only choice is when to click the 'next' arrow, it is difficult for learners to feel ownership of the learning process." She gives sound planning suggestions for building cohesive, well-integrated learning objects:

- Offer multiple paths or branches for learners to explore.
- Allow learners to choose which path(s) to follow rather than forcing them down a particular path.
- Draw a conceptual map of the learning object showing relationships between ideas, content, or sections. As you create the object, make sure those connections are available as path choices.

Smith suggests various avenues for presenting learning objects including "a single learning object to reinforce or provide practice for a topic; sometimes several conceptually related learning objects are provided to explore a topic from different angles or in greater depth. A common way to 'combine' learning objects is to provide an assignment that includes a list of links to the different objects and guidance as to the order in which they should be accessed. Learning objects may also be integrated into a course using a learning management system (LMS) to create and manage the links between objects."

Checking out the future

While the popularity of computer gaming continues to grow and interest deepens in the use of computer games as legitimate means for learning[25], new avenues open for the RLO to continue its development as an e-learning tool. There is no reason, for instance, why games can't be designed to meet all the desired attributes of RLOs. There is also scope for e-books to provide platforms where RLOs can exist as aptly as coloured pictures do in printed books, perhaps fulfilling some of Pithamber Polsani's hope for the development of the e-book to move "beyond the text-centric approach and concentrate on designing participatory environments"[26]. Here the potential is rich for the RLO to establish its niche, illustrating pages of learning in interactive and engaging ways never to be found in traditional textbooks. Who knows? Games designed as learning objects may soon find their way onto portable play-stations, MP4 players and even mobile phones.

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Ken Allan is a distance educator in Science at The Correspondence School, Wellington, New Zealand.