

Learning objects and repositories

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Background and definitions

Learning Objects (LO) are, essentially, digital learning resources. Essential features of Learning Objects are that they should be reusable, accessible, interoperable, and durable (Rehak & Mason, 2003). Therefore, it is crucial that LOs are stored in a way that makes them easy to share, source, and adapt for a variety of purposes. These learning objects can be integrated within a learning design. The term Learning Design is frequently used in two ways.

Firstly, Learning Design is an advanced capabilities or set of specifications to describe teaching practice. When used in this context, the term is often capitalised. Secondly learning design (usually in lower case) is the design and orchestration of a number of different learning activities and resources (LOs) that learners engage in and use to learn a concept (Littlejohn and Pegler, 2007). Research in learning objects and learning design has been driven by three major challenges within practice in further and higher education. Firstly, the call for personalised learning against the backdrop of the increasing size and diversity of the student body. Secondly, the tension between improving education quality and reducing costs. Thirdly, differences in traditional ideas of the purposes of education and what constitutes knowledge (DfES, 2001; Council for Industry and Higher Education, 2002). Solutions to these challenges have sought in the development of use of sustainable and scaleable approaches to course design based around the sharing and reuse of teaching ideas, activities and resources (Falconer and Littlejohn, 2007). Governments around the world are encouraging the development of nationally coordinated open learning resource banks (for example DIUS, 2008). Researchers has been tackling these issues by investigating the ways in which digital learning resources might be developed, shared and reused by teachers and learners around the world so as to benefit from economies of scale. A central idea is that reusable resources (or 'Learning Objects' - LO) produced by publishers, teachers, support staff and students themselves, would be stored in Learning Object Repositories (LORs), where they could be easily accessed, recombined and reused within online courses. Ideally these resources would be designed so that they could be adapted to fit different educational models, subject disciplines and levels of study.

Findings from research

Learning Objects

Six issues associated with the reuse and sharing of resources have slowed the transformation of this vision into reality (Littlejohn, 2003):

Uses of Learning Objects to support learning

Learning Objects are sometimes conceptualized as blocks of content that could be interlinked so as to produce a course. Analogous with Lego, these blocks can be recombined with other blocks and reused in a different course. This simplistic view of learning resources bases teaching approaches around the transmission of blocks of content to students (Wiley, 2000). Contemporary approaches to learning are based on learners constructing knowledge through

interactions with tutors, other students and with learning materials (Palinscar, 1998). Therefore a key area of research is the way in which Learning Objects can be used to support the different kinds of online activities and interaction patterns that teachers use in their teaching. Much of this research has investigated how learning activities and learning designs can be used and reused as resources templates (for example a framework for discussion or a learning task) that teachers could draw upon (Falconer & Littlejohn, 2007; Boyle, 2003).

The application of Learning Objects across different approaches to education

Effective course design is based upon different approaches and educational models. The learning design acts as a framework that integrates course content and learning activities and such frameworks can take multiple forms. Recent strands of research has developed modeling languages and authoring tools to enable teachers to design in an online environment and instantiate such designs in order that activities and resources are presented to students 'on the fly' (Koper, 2003).

The ability to source and share Learning Objects

Without an agreed classification system and terminology it will be difficult to source resources within a LOR. The sourcing, sharing and reuse of resources across many requires standardization. A number of organizations have developed international standards for metadata (IEEE, 2002) to support the sourcing and sharing of resources. This metadata is used in combination with classification or taxonomies systems. However, in areas where terminology is changing rapidly, emerging classification systems, in the form of 'folksonomies' have been developed by communities of users to guide sourcing and sharing.

The optimum size and form of Learning Objects

The smaller or more granular a resource, the greater the possibility of it being reused in another educational context: for example, an individual image is likely to be more reusable than an entire course (Downes, 2000). In contrast it may be less time-consuming for a teacher to reuse a larger resource, such as a learning activity, rather than to construct a course from many small, basic components. Another area of research is around the design of Los of a size and form that maximizes their reusability.

Another approach, developed by the Centre for Excellence in Teaching and Learning (CETL) in Reusable Learning Objects (RLO-CETL for short, <http://www.rlo-cetl.ac.uk/>), is to view learning objects based on Boyle's (Boyle, 2003; Boyle and Cook, J, 2001) notion of decoupling and cohesion; which is in itself taken from software engineering. Each learning object developed is characterised by being a cohesive learning resource focused on one clear learning goal. Each learning object is also decoupled in that there are no 'link outs' to external resources; this is crucial for reuse. Scaffolding is the third core principle informing this approach, developed approach RLO design. Scaffolding was introduced by Wood and Bruner (1976) as a term to describe the 'recognition-production' gap between what learners want to achieve and what they are able to effect themselves without assistance. For an RLO to scaffold learning involves the use of rich-media visualisations and timely prompts in order to help learners recognise and bridge knowledge gaps.

A definition from the Wisconsin Online Resource Center, Beck (2008) suggests that learning objects have the following key characteristics:

- 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;
- are self-contained each learning object can be taken independently;
- are reusable a single learning object may be used in multiple contexts for multiple purposes;
- can be aggregated learning objects can be grouped into larger collections of content, including traditional course structures;
- and are tagged with metadata every learning object has descriptive information allowing it to be easily found by a search.

The above usefully extends the RLO-CETL definition along the lines of aggregation and tagging but omits the pedagogical dimension.

Sharing Learning Objects within communities

Reuse of LOs requires significant changes in teaching practice. Teachers spend less time creating learning resources, but more time developing activities for students, re-contextualizing resources and describing new resources with metadata (LTS, 2002). The need to find, create and share resources will require changes in the roles of other staff in the educational institution, not just teachers. This necessitates greater collaboration through communities that exist within, across and between educational institutions. The UK-based Reusable Learning Object, Centre for Excellence in Learning and Teaching (RLO-CETL), based at the London Metropolitan University, University of Cambridge and University of Nottingham has trialled examples of how to re-use learning resources in a variety of learning contexts. In one stand of work (Holley, Bradley, Greaves and Cook, 2009) learning objects developed to support students within a blended learning context have increased student personalised learning: learning that can be any time, any place, any where. A suite of learning objects for improving students' study skills have been developed by the RLO-CETL (see screen shots). Two case studies of use within and across communities (Holley, et al., in press) have evaluated RLO use with students at two UK HE institutions. The study has tentatively demonstrated any time, any place learning: the first at London Met where they were developed, and the second at Thames Valley University (TVU), where they have been reused in a different context. Student evaluation data highlight that the design and the learning objects have encouraged personalised learning. For example at TVU, data from a student questionnaire, individual RLO feedback forms and a student focus group provides evidence of why and how students welcome this additional support to aid their learning, and how it is making them become more independent as learners. Statistics drawn from the Virtual Learning Environment (VLE) provide an insight into when students are choosing to do their learning, which is not confined to university hours, and indicates an extremely flexible approach to when they study. The study also made a comparison of the student cohort from the previous year, which shows that the intervention of the RLOs and Blackboard VLE had an impact in improving students' learning. This work has been extended more informally to facilitate learning 'any where', through the incorporation of learning objects that can be used on mobile phones (see Bradley et al., 2007; Smith et al, 2007). Screens from the Referencing Books and Reflective Writing RLOs

Systems and processes for sharing Learning Objects

The reuse of LOs across learning communities requires distributed, digital repositories serving communities of users across multiple institutions, educational sectors and nations. Some researchers have focused on the organizational and cultural issues (rather than technological and pedagogical barriers) inhibiting the reuse of resources. This research has taken place in parallel with the emergence of real and virtual communities. Despite these changes there have been few changes in a fundamental way at the level of teacher practice (Collis & van der Wende, 2002). Such change requires reuse to extend beyond reuse of LOs to encompass the sharing and reuse of teaching ideas and activities.

Learning Design

At the simplest level, learning design to support teaching practice can be viewed as the orchestration of a number of different learning activities and resources (LOs) (Littlejohn and Pegler, 2007). The orchestration of these activities and resources will depend on three interrelated factors (MacDonald, 2006). Firstly, the purpose of the learning, which depends on the learning objectives or outcomes. Secondly, the context of learning, focusing on specific characteristics of the learners (e.g. their prior knowledge and experiences or where students are learning). Thirdly, tutors' and students' preferred approaches to teaching and learning. Effective learning and teaching requires the design of approaches to teaching that support independent thinking, team working and enterprise (Garrick, 1998). In these approaches learning activities are often scaffolded in advance so that students can be adequately briefed about the activity. Increasingly these sorts of learning activities require the use of technology tools to support online collaboration and access to digital resources (Contreras-Castillo et al., 2004). Effective use of learning technologies and reuse of digital resources in practice requires teachers to have guidance on how to use these tools to best effect.

Documenting Learning Design

Research has focused on documenting the design of learning activities to share and reuse approaches to practice, providing advice and guidance and increasing the efficiency of planning. Researchers have been investigating if and how documented learning designs might provide guidance for teachers to help them model good pedagogic practice that can be shared and reused, promoting efficiency and quality assurance. These sorts of learning designs are sometimes called 'lesson plans' (Falconer & Littlejohn, 2006). These are of any size and complexity, from a semester long course down to an individual learning activity. Two representation systems that have been developed through extensive consultation with teachers are the Australian Universities Teaching Committee (AUTC) temporal sequence system (www.learningdesigns.uow.edu.au/) and the LDLite lesson plan (Littlejohn & Pegler, 2007). Researchers believe that sharing and reuse of these sorts of learning designs will lead to more efficient and sustainable approaches to e-learning (Beetham, 2004; Falconer & Littlejohn, 2007).

As outlined above, a primary motivation for developing learning objects is reusability. The RLO-CETL has developed a complimentary approach to the 'lesson plans' described above. Generative Learning Objects (GLOs) represent the pedagogical pattern at the heart of a learning object that provides the basis for reuse. Many specific learning objects can be generated from this core pedagogical pattern. The focus in this approach is on reusable pedagogical designs rather than content. This concentrates attention in the right place: the quality of the design for learning. This approach is much more powerful than the traditional approach of producing concrete learning objects. The practical benefits include: 1) The

strategy of using and reusing LOs is more productive – many specific learning objects can be developed based on the same pedagogical pattern 2) The learning objects produced are highly adaptable. Tutors and learners can not only reuse these learning objects: they can repurpose them to meet their own needs and preferences. To download the GLO authoring tool and user guide go to the GLO Maker website: <http://www.glomaker.org>

Educational Modelling Language

A machine-readable language for describing learning designs can be used to describe teaching and learning at a generic level, enabling learning technology tools and resources to be setup and orchestrated automatically (Masterman, 2006). Two of the most widely used of these languages is SCORM (Shareable Courseware Object Reference Model) and Educational Modelling Language, which has been incorporated into the IMS Learning Design specification, to code, transfer and play learning designs (Koper et al., 2003). A learning design system ‘inspired by’ IMS and EML is the Learning Activity Management System (LAMS www.lamsinternational.com/), which enables teachers to plan activities using drag and drop icons, and then to run them in an online Learning Environment. Despite these advances in recent years, researchers have yet to find descriptions that teachers can understand and apply easily (Burgos & Griffiths, 2005).

A number of organisational and representational issues remain unresolved. Firstly, representations need to be meaningful and useful to a different staff in education, for example teachers, educational developers and technical developers. Secondly, learning designs must be represented in different ways and at different levels suited to differing processes during planning or adaptation of a design (similar to an orchestral suite being represented as a programme overview, an individual piece or a full orchestral score). Thirdly, representations are usually difficult to construct, therefore researchers are investigating ways of representing designs as dynamic processes, rather than static products. Research into these issues are likely to result in the emergence of user-friendly learning design and design running tools.

Issues with Learning Design

There are problems in trying to create meaningful learning designs by combining and sequencing reusable Learning Objects (Friesen, 2004; Parrish, 2004; Wiley, 2003; Beetham, 2004). Such learning designs often do not capture the essence of a good piece of teaching. Learning Objects cannot provide insight into the tactics teachers adopt during real-time teaching, such as the ways teachers interact with students to provide feedback (Littlejohn, Falconer, & McGill, 2006). This tacit information is usually communicated through dialogue. Therefore teachers’ communities of practice that support teachers talking around their use of Learning Objects is an important aspect of extending and improving teaching practice (Falconer, Beetham, Oliver, Lockyer, Littlejohn, 2007). The way repositories are used to source, share and manage LOs depends both on aspects of the repositories themselves and on key characteristics of the communities that use them.

Learning Object Repositories

The increased use of LOs has led to an escalation in the number of Learning Object Repository (LOR) systems that support the sharing and reuse of Los. Essentially a LOR is digital store box that provides services to designated communities by hosting collections of digital resources for learning and teaching (Heery and Anderson, 2005). Research studies have shown that the way repositories are used to source, share and manage LOs depends both

on aspects of the repositories themselves and on key characteristics of the communities that use them (Margaryan & Littlejohn, 2007).

A factor affecting the adoption and reuse of RLOs is the ease with which they can be sourced and shared. One way of sharing RLOS is through community based LO repository systems. These LO repositories are online, digital stores that host collections of digital resources in a learning object format. A range of national and international LO repositories have been established. Some may support sharing across a single organisation, while others are federated around discipline based communities, or communities adopting particular approaches to teaching.

LO repositories are increasingly being used by a range of culturally-diverse communities, including work-oriented communities (communities of practice); research-oriented communities in academic and business; educational communities (classroom or virtual university communities); and hobby-oriented communities (fantasy or gaming) (Seufert, Moisseeva, & Steinbeck, 2001).

Dimensions of LORs

A number of important aspects (dimensions) of repository systems were determined through focus group activities with users and curators of a range of repository systems (Margaryan, A., Currier, S., Littlejohn, A., & Nicol, D., 2006). These six dimensions draw out important aspects of the context within which the LORs operate within and across communities, including: (1) The purpose of the repository; (2) The subject discipline the LORs has been created to support. Although some LORs are mono-disciplinary, many are multidisciplinary; (3) The scope, for example some LORs support single departments or institutions, while others operate at a regional, national, or international level; (4) The sector, LORs are used in schools, higher and further education institutions as well as hobby-based or work-based communities; (5) The contributors who may include teachers, students, publishers, institutions, employees or hobby enthusiasts, depending on the scope and sector; (6) The business model that governs the trading, and management framework underpinning the repository.

Implementation of repository systems must also take into consideration dimensions of communities that may impact on requirements for LORs.

Communities

Sharing RLOs through repositories has had limited success. The issues that inhibit sharing and reuse of learning resources will differ across communities, although some will also be common across learning communities. The Community Dimensions of Learning Object Repositories (CDLOR) study, funded by the UK Joint Information Systems Committee (JISC) recently investigated enablers and barriers to successful use of LO repositories (Margaryan & Littlejohn, 2007). <http://www.academy.gcal.ac.uk/cd-lor/>

The way repositories are used depends on the needs of individual communities. For example, members of geographically dispersed communities are likely to communicate and interact in different ways as compared with locally based, tightly knit communities (Littlejohn and Margaryan, 2006). Dimensions affecting communities are outlined in the next section.

Dimensions of communities

Research indicates that issues that inhibit sharing and reuse of learning resources will differ across communities. Consequently some key factors that influence LO repository implementation will differ across communities, while others are common across the wider repository problem-space. Community dimensions include:

1. Purpose, the shared goal/interest of the community; the reason why the community was formed in the first place;
2. Dialogue, modes of participation and communication (online, face-to-face, or mixed) adopted by the community;
3. Roles and responsibilities;
4. Coherence, whether the community is close-knit or loosely confederated/transient;
5. Context, the broader ecology within which the community exists (for example, institutions, organizations, professional bodies, governments, etc.);
6. Rules, implicit and explicit rules that govern the functioning of community (for example, ground rules of conduct, rewards and incentives mechanisms, control of access and use of resources, etc.); and
7. Pedagogy, predominant teaching and learning approaches used in the community (for example, problem-based learning, collaborative learning).

Framework to guide repository implementation

These dimensions were integrated into a practical framework that is being used by repository curators to guide implementation of repositories (Margaryan, Milligan, and Douglas, 2007). This framework has been devised to support repository curators, managers, and anyone involved in repository implementation to identify potential issues that could impact the uptake of repositories. The framework consists of ten questions, which guide curators through the process of defining the scope of repository and collecting information from community or communities that repository aims to serve.

Q1. Why are you setting up a learning object repository?

[relates to repository dimension of "Purpose"]

Q2. How many communities is this repository likely to serve?

[community dimension of "Composition"]

Q2.1. Do these communities already exist?

Q2.2. What sector do these communities operate within?

[repository dimension "Sector"]

Q2.3. What is the subject discipline of the community?

[repository dimension of "Discipline"]

Q2.4. What is the scope of the community?

[repository dimension of "Scope"]

Q3. What is the purpose of the community that the repository will serve?

[community dimension of "Purpose"]

Q4. Who are the key actors in the community and who, of these, will contribute to the repository?

[relates to community dimension of "Roles" and repository dimension of "Contributors"]

Q5. What is the pedagogic approach of the community?

[relates to community dimension of "Pedagogy"]

Q6. How coherent is the community?

[relates to community dimension of "Coherence"]

- Q7. What are the modes of participation and communication within the community?
[relates to community dimension of “Dialogue”]
- Q8. What is the ecology of the community?
[relates to community dimension of “Context”]
- Q9. What is the business model of the repository?
[relates to repository dimension of “Business model”]
- Q10. How do you envision the evolution of the LOR?

Uses of the framework to implement LORs

Ideally the framework would be used by implementation teams comprising learning designers, teachers or subject-matter experts, information specialists, and learning technologists. This framework has been validated by the Australian, government-funded Carrick Exchange to determine its usefulness in guiding repository development, increasing the sharing of RLOs within and across communities. The framework is available from www.academy.gcal.ac.uk/cd-lor/documents/CD-LOR_Structured_Guidelines_v1p0_001.pdf

Open Educational Resources

Background

Throughout the Higher Education sector in the UK there is debate on use and reuse of open educational resources to ensure strategic approaches to blended learning implementation are sustainable long term. In 2009, the UK Funding Councils identified open content release as having high importance.

Aiming to be at the forefront of development of expertise in this area, the UK Joint Information Systems Committees (JISC) launched a programme on Open Educational Resources, including Learning Objects (OER www.jisc.ac.uk/oer). The programme comprises a wide range of institutional and discipline based projects working towards open content (release and reuse). Central to the programme is institutional/ national policy and culture change, moving away from conventional focus on content production. Learning resources created by a range of individuals, institutions and subject centres will be released into Jorum Open (JISC supported national repository), using the creative commons licence. A successful programme outcome will comprise projects that will be sustainable beyond their funded life. In 2009-10 the programme is releasing significant amounts of high quality resources

Barriers and enablers to effective release and reuse of OERs

A key aim of the programme is to identify barriers and enablers to effective release and reuse of Open Educational Resources. This programme is building on other significant, international initiatives including MIT Open Content (USA), Open University Open Learn (UK Open University), Carrick Institute Open Source Initiative (Australia), United Nation Open Coms and the Open Courseware Initiative (global, primarily, the USA, UK, Spain, Japan and other affiliates) . The JISC OER programme intends to move beyond these initiatives by examining the creation, use and reuse of resources authored by individuals or groups towards multiple forms of reuse of resources, including the adoption of materials in ‘mashups’.

OERs and collective knowledge

A trend in blended learning, identified through key reports, such as the 2009 Horizon Report, is the increasing engagement with collective knowledge: the knowledge residing in people, practices, and machines, including social agents, social and learning objects, tools, artefacts, information and practices. Increasingly learners must have the capacity to use this collective knowledge and create the new knowledge. These ideas draw upon a metaphor of the 'wisdom of the crowds' (Surowiecki, 2004) the idea that groups of connected people are better able to solve problems than individuals. Within this metaphor the consumption and creation of collective knowledge is the responsibility of each individual. Although this metaphor has been contested (Keen, 2007), it offers potential for learning to be supported by a wider and more diverse range of knowledge resources. From this perspective learners are recognised as a contributors to collective knowledge – not just in terms of the resources they create but also through reflection, gaining experience, developing reputation, forming trust based relationships, and benefitting from emergent patterns from others, to provide additional cues as to quality and utility of resources. Over time, the knowledge held by the collective is enriched by the contributions of the collective, and individual learners learn from each other's actions and benefit from seeing how other's solved problems, the resources they used and the routes they took to learn (Littlejohn, Margaryan and Milligan, 2009).

Collective learning

Siemens (2006) highlights the centrality of networked access to knowledge resources in learning. He describes learning as 'the process of creating networks' that connect people, organisations, libraries, books, databases, websites and other information sources. Three ways of interacting with collective knowledge have been emphasised in contemporary approaches to learning (Dron, 2007; Siemens, 2004; Collis and Moonen, 2001). In consuming collective knowledge, learners need to be able to identify and source knowledge residing within the collective. To enable them to find relevant knowledge, the knowledge base must be transparent and accessible. Learners continually refine their view of the collective knowledge by connecting resources people, discussions and reflective notes. They contribute to the collective knowledge, through creating, sharing and feeding knowledge back into the collective. These three components represent a set of intertwined activities rather than discrete linear steps and represent the primary mechanisms by which an individual interacts with the collective to attain their goals (Margaryan, Milligan and Littlejohn, 2009). The relevance to Learning Objects and Learning Object Repositories is that resources are likely to become more widely used, varied and openly available.

The future of Learning Objects seems exciting if yet unknown. What is clear is that these resources, along with new tools and processes could be important in enhancing learning in ways that enable contemporary, networked learners to leverage collective knowledge in order to enhance learning.

Conclusions: future trends in the use of LORs

1. The concept of LOs and LORs provide a useful basis for sustainable forms of e-learning and blended learning. There is a growing trend towards the development and release of Open Educational Resources (OER). Much of this work has been led by the Open University in the UK and Massachusetts Institute of Technology in the US. In 2009, a major UK initiative focused on the largest open release of LORs in the world to date was launched by the UK Joint Information Committees (the JISC OER Programme);

2. The development of international standards around Learning Object Metadata (LOM), Educational Modelling Language (EML) and Shareable Courseware Object Reference Model (SCORM) are easing the development of learning design tools;
3. Despite this, social and cultural barriers are providing more challenging than technical issues. It is difficult to change current ways of working towards more sustainable practices (for example teachers tend to reuse resources within small, localised, tightly bound groups rather than sharing resources with a wider collective);
4. Most initiatives around the use and reuse of LOs are designed such that teachers will select and reuse resources. However, LOs can also be reused by learners;
5. The sourcing and reuse of LOs by students, rather than teachers, is common in non-formal learning, but is relatively untested in formal contexts.

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