
UNIT 6 DEVELOPMENT OF REUSABLE LEARNING OBJECTS

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6.1 INTRODUCTION

For teaching your learners would you like to use the resources that are available or re-create those that exist? Would you share the resources you develop? The 21st century is the knowledge age, which is characterized by the use of technology for accessing, creating, and sharing knowledge based resources. These resources support 'learning', and are hence, 'learning objects' (LOs). The LOs that are developed for sharing, being reusable, are known as reusable learning objects (RLOs). In this unit we have discussed the concept of RLOs. We have also shown how some of the steps of the ADDIE model of ID (see unit 1) have been taken for designing and developing RLO with multimedia content. Thus, while the earlier three units enable you to develop courseware for delivery through single medium this unit will help you to develop multimedia content, which you may develop as RLOs. This unit is thus about RLOs but it also focuses on the development of multimedia content that can be offered as an online courseware.

6.2 OBJECTIVES

After studying this unit you will be able to:

- Explain the concept of RLOs;
- List the benefits of using RLOs;
- Describe authoring tools; and
- Develop reusable multimedia content using authoring tools;

6.3 WHAT ARE REUSABLE LEARNING OBJECTS?

For understanding the concept of RLOs you need to understand the idea of LOs. An LO is a collection of content items, practice items, and assessment items that are combined on the basis of a single learning objective (Beck, 2010). As per this definition, content explaining the concept of learning, along with activities that allow learners to practice what they have learnt, and items for assessing learning comprise an LO. Further, as per this definition an LO has one instructional objective. How many objectives does the unit you are now reading have? Check 6.2 to find out.

Authors like Wiley (2000); Wiley & Edwards (2002) are of the view that an LO is any *digital* resource that can be reused to support learning. However, according to Learning Technology Standards Committee, IEEE (2002, reaffirmed in 2009) LOs are any entity, *digital or non digital*, which can be used, reused, or referenced during technology-supported learning. This definition unlike the earlier one, views LOs as digital as well as non digital content. South & Monson (2000) also say that LOs range from maps and charts to video demonstrations and interactive simulations. These definitions are thus broader than that of Wiley's definition. However, as per L'Allier, (1997) LO is the *smallest independent structural experience* that contains an *objective*, a *learning activity* and an *assessment*. As per this definition a map, a chart, and so on do not qualify as an LO. Why? This is because an LO is developed with an instructional objective and includes suitable learning experience, and items for assessment of learning. Hence, photographs, audio, and video files in themselves are *assets* that support the formulation of content for explaining concepts, facts and procedures (Wagner, 2002, as cited in Koh, 2017) but are not necessarily LOs. Further, LO is a small but an independent unit. This implies that the content of an LO is adequate for learning, and learners do not have to use other resources for understanding the concept. For example an image of digestive system is only an asset that supports learning. Since it lacks explanations of the structure and function of digestive system and includes just an image, it is not stand alone, i.e. an independent unit of learning. A stand alone content, requires instructional objectives, corresponding explanatory content, and assessment mechanisms. Cisco Systems, Inc. (2001) says that LO has a *single learning or performance objective*, that is built from a collection of *assets* that provide *static or interactive content* and activities for practice. As per this definition too, an LO has only one objective(s). However, it describes content as *static and interactive* types. Unlike static content, which you are reading now, interactive content responds to user's inputs and can even give feedback. For example you may have attempted online quizzes that offer feedback &/display scores as per the inputs you key in. You may have come across images (used for selling products) that we can enlarge, examine parts like the sole, heel, front part of a shoe, and read the descriptions popping up. Barritt & Alderman (2004) say that LOs have granularity, like a grain of sand/wheat/rice, and an LO is although small, nevertheless it is a complete unit. Definitions of L'Allier and Cisco underline this. Beck (2010) also

says that LOs are much smaller units of learning than courses, while Barritt & Alderman (2004) say that LOs are authored in small pieces, assembled into a database, and then delivered through a variety of delivery media.

Laverde, Cifuentes, & Rodríguez (2007) define LO as a digital *self-contained* and *reusable* entity, with a clear educational purpose, with at least three internal and editable components: content (comprising definitions, explanations, reading documents, links to other resources, videos, and the like), learning activities and elements of context (allows reuse in other scenarios). This definition like some of those you have read considers LO as *digital content*. Further like the definitions of L'Allier and Cisco it considers LO to have an educational purpose, i.e. *instructional objective*. Furthermore, L'Allier's definition includes the word 'independent' and in this definition we find the word '*self contained*' but both have the same meaning.

The definitions of LO that you have read give you an idea of the characteristics of LO. We also find that LOs have been interpreted in different ways (Barritt & Alderman, 2004). Churchill (2007) therefore says that LO remains an ill-defined concept. However, the idea of granularity and the aspects of L'Allier's definition provide a comprehensive view of LOs.

Activity

You have read the definitions of LO. Does the unit you are reading now qualify as an LO? Justify your response.

You may have noticed that some of the definitions of LO include the word 'reuse'. A learning object which is developed for repeated use is a reusable object and a reusable object developed for learning is a reusable learning object (RLO). Mere access to resources however does not make them reusable. The resource besides being accessible should be suitable for repurposing to match the learning needs of those reusing it. For instance on purchasing a dress we get access to it but it is of little use if we cannot alter it as per our size. However, an RLO on 'development of SLM for print medium' developed with the purpose of training distance education teachers can be reused and repurposed for training employees engaged in developing user manuals for industrial products. Further LOs are stand alone components but these can be assembled and packaged into larger units like modules and courses. LOs can therefore be aggregated (Beck, 2010; Downes, 2004, as cited in Kinshuk & Jesse, 2013). The aggregation of LOs into larger units is however possible if the property of granularity is maintained (Koper, 2003). For example grains from different packets can be repackaged only if they do not stick to each other, i.e. are independent granular units.

Box1

Wayne Hodgins introduced the term RLO. He was inspired by his children playing with Lego building blocks (colourful plastic blocks with holes into which children fix other blocks and construct structures like furniture, houses, automobiles and the like). He says that his journey into the world of learning objects started while watching his children play with LEGO™ blocks (Hodgins, 2000).

Hodgins says that learning objects are fundamental elements of a new conceptual model for creating and distributing content, which is much richer and complex than its simpler building blocks. For instance, objects in text, audio, video can be combined to form complex content. Hodgins explains this with an example from the construction industry. He says

that construction of buildings provides a robust analogy for this as on average, 85 to 95% of the materials used nowadays in buildings be it commercial or residential, are pre-built components. Doors, windows, cupboards, sinks, tiles, light fixtures are all manufactured to meet specific standard dimensions and attributes, and these pre-manufactured objects are available, before the building is conceptualized, designed, or built. Hodgins says that RLOs are similarly built using multiple LOs.

6.3.1 Characteristics of RLOs

You have read what RLOs are. What are the characteristics of RLOs?

RLOs are meant for reuse and repurposing: Copyrights restrict free use, and adaptation of copy righted products requires the author’s permission. Open licenses however permit users to adapt, i.e. repurpose the product but citing the original author is necessary. For content in public domain the author gives up ownership over it and the content is free for use even without citing the author. Without open license LOs cannot be ‘reused’ (see the unit on OER, MES-033).

RLOs are meant for imparting instructions: The very definition of LOs make it clear that these are developed for facilitating learning.

RLOs have granularity: Reuse and repurposing require an RLO to be small in size. However, size and scope of RLOs may vary, and an RLO may comprise simple learning experience or may be short course providing complex learning experiences.

RLOs should have simplicity: You have read that LOs are small. Hence their objectives should be few and they should not be loaded with content. As per software engineering principles, LOs should be as simple as possible, as simplicity greatly aids recombination and reuse, even though involvement of multiple perspectives supports learning (Boyle, 2003). For instance a text based LO describing the problem of receding ground water level has simplicity and is easy to share and repurpose but multiple perspectives are introduced by adding a video that shows its impact on farming and this strengthens learning and enhances the pedagogical value (capacity for teaching) of the RLO. Yet objects are most useful for instructional ‘reuse’ when they center on a single, core concept (South & Monson, 2000). Each RLO should therefore have a single learning objective (Boyle, 2003; Grunwald, Sabine & Reddy, 2007). However you can assemble several RLOs as per instructional needs.

RLOs are self contained, independent entities with stand alone content that is included specifically for attaining the instructional objective (Barritt& Alderman, 2004; Beck, 2010). Boyle (2003) also says that RLOs should be as far as possible free standing, and should not refer to content covered in another object. RLO should therefore be self contained. These are supposed to be independent as learners do not have to depend on other sources of information while learning.

Activity

Do you think the section ‘Introduction/objectives/summary/ a figure of this unit’ could be an LO? Why? Which section(s) of this unit can be turned into LO?

RLOs are stored and managed in repositories. RLOs are mostly in digital format and this makes it easy to access, combine these into a course, update, store in repositories and curate (repurpose, for instance by adapting the content for meeting the needs of the course/learners for which the RLO is used). Some of the repositories

that provide access to e-learning materials are MERLOT (Multimedia Educational Resource for Learning and Online Teaching; <http://www.merlot.org>), DLESE (Digital Library for Earth System Education; <http://www.dlese.org>), SLOOP (Sharing Learning Objects in an Open Perspective), Orange Grove (<http://www.fldlc.org/harvestroad.htm>), Health Education Digital Assets (HEAL), Wisconsin Online Resource Center (<http://www.wisc-online.com/>). RLOs are managed by deleting outdated objects, updating objects, storing these systematically (Grunwald, Sabine & Reddy, Konda (2007).

RLOs have metadata tags comprising information that describes the content. This makes RLOs searchable and hence accessible. Meta means beyond. Meta data therefore means data describing the content of the RLO. For example a packet of chips bears information about the company manufacturing it, the ingredients, date of packaging, price, and other aspects. This information helps to locate the packet and guides our decision to buy it. RLO metadata can be as basic as the author's name, the RLO's title, subject, and instructional objective, audience profile or include details like course completion criteria, access rights, instructional strategy and the like (Barritt & Alderman, 2004). Barritt & Alderman cite the example of a book, which has metadata like the book title, author, ISBN, table of contents, publisher, and so on. IGNOU's courses and blocks also have metadata like titles and codes that help in locating these in e-gyankosh (IGNOU's repository of digitised content) or at a book fair. Keywords comprising words/phrases that describe the content could also be the metadata. For example, for the unit on instructional design (ID) the key words could be instructions, ID, and ID models. When key words are included in the search box, Search engines like Google, Yahoo search the web for the content.

RLOs should be free of fixed format and cultural context: An LO may be used in multiple contexts for multiple purposes (Beck, 2010). Hence it must be easy to adapt, update, and customize. Hence avoiding a fixed format while developing these makes their reuse and repurposing easy. For example while repurposing, if you want wider margins, captions in bold/italics, the format of the unit (RLO) must allow it. Further, RLO can be used by a wider audience if it is free of cultural context. For example food, dress, traditions, idioms, and many other things are related to culture and hence, understood only by those familiar with it. While developing LO the content has to be such that it is widely understood.

RLOs need to have interoperability: To understand this let us study these examples.

1. Rita speaks only Tamil and, cannot communicate with those not knowing Tamil;
2. Nita finds that her device (computer) cannot communicate with a particular file and generate meaningful outputs. The data in the file however becomes meaningful when she downloads Hindi font.
3. Sima finds a suitable RLO for teaching instructional designing. However she can use it in her course only if the LMS (a tool for offering online courses) she uses and the devices like phone, laptop, tablet, and so on that her learners use for accessing the courseware, can read and communicate with the data (content) in the RLO. She knows that her learners use different systems and devices and even mobile phones do not have the same operating system.

RLOs therefore need to be interoperable so that these operate across different platforms and communicate with other tools (Grunwald, Sabine & Reddy, 2007). Interoperability requires meaningful exchange of data across devices, systems,

applications and products, without the user having to take special initiatives. Developing RLOs that are ‘interoperable’ across different systems is therefore a major goal and a challenge, and to enhance interoperability RLOs are ‘packaged’ in a standard container format (Boyle, 2003). Pappas (2017) says that using HTML5 based eLearning authoring tool instead of Flash for creating RLOs is helpful as many learners use mobile devices that cannot play content created with Flash. You will read more about it later in this unit.

Box 2

Read and reflect on this:

OERs (Open educational resources) (See unit 4 MES-033) and RLOs have several similarities. Both are developed for instructional purpose, meant for sharing, reusing and redistributing. Further both have metadata tags and are stored in repositories created for storing and managing these. Literature that clearly differentiates these two is however scarce. Authors like Kawachi (2014) are of the view that the RLO movement led to the concept of OERs that are open for use unlike the more restrictive RLOs. Kawachi (2014, p.9) says that “The early history of OER lies in the development of learning objects and in particular reusable learning objects...” He further says that RLO movement seemed to slow down largely because RLOs were not suitable for different e-learning needs, RLOs do not cater to users’ (teachers’ and learners’) individual needs, and also because it was difficult to adapt RLOs because of copyright concerns. Kawachi (p9) also says that “The key difference between those RLO and the current OER is the legal copyright labels attached to OER to permit others to reuse and adapt them without needing to get any further copyright permissions”. However many RLO like those developed by the School of Health Sciences, University of Nottingham (<https://www.nottingham.ac.uk/nmp/sonet/rlos/>) are licensed under a Creative Commons (an open license that allows reuse, see unit on OER, course3). This is in keeping with ‘reuse’ principle of RLO. Moreover ‘reuse’ and ‘copyright restrictions’ are contradictory. Hence, how can we impose restrictions on the use of resources developed for *reuse*? Is it possible that a new term (OER) was coined even though RLOs and OERs have similar functions?

Box 3

The **National Repository of Open Educational Resources** is an initiative of the Department of School Education and Literacy, Ministry of Human Resource Development, Government of India. The Central Institute of Educational Technology, National Council of Educational Research and Training developed it and manage it. NROER has a rich repository with OERs (text, audio and video) organized in a theme-wise manner.

6.4 WHAT ARE THE BENEFITS OF RLOS?

The earlier sections give you an idea of the importance of RLOs. Let us explore it further. Knowledge society is a networked society that requires collaborative knowledge creation and knowledge sharing (Tan, Hung & Scardamalia, 2006) and technology helps these processes. The concept of RLO is in line with such views as it upholds knowledge sharing instead of repeated investment of time and other resources for creating resources that already exist.

Boyle (2003) says that good eLearning resources are expensive to produce. RLOs save time and money required for creating new ones. Therefore RLOs are being used in education, military, corporate sector and other areas for training programmes (Grunwald, Sabine & Reddy, 2007). In education face to face teaching can use RLOs for enriching/supplementing the content taught, resulting in blended learning. Distance education offered through online courses can hugely benefit from RLOs. We can upload RLO to the LMS used for offering the course and plug-in the new eLearning content (Pappas, 2017). RLOs can not only be used in a course but several RLOs also can be repurposed, formatted in a similar way, and combined to develop a course (Pappas, 2017).

Apart from saving resources, RLOs introduce more perspectives to the content taught. For example a teacher presents the problems commonly faced by adolescents of her country but adding RLOs bring in the perspectives of other societies too. Discussions and deliberations are enriched when multiple perspectives are involved.

We have discussed the rationale for using RLOs. Should we also allow others to use and repurpose the content we generate? Today collaboration is more important than competition and instead of closely guarding knowledge we need to share it. Further repurposing knowledge can enrich it. Learners also benefit as they do not have to enroll in a long duration course for learning one topic. For example a learner may be interested only in understanding the digestive system. Using an RLO on this topic would be more economic than enrolling in a physiology course. Moreover learners not having access to good libraries, online platforms with journals and books, and good teachers benefit when RLOs are used. Therefore, as per Wiley (2002) just as greater technological bandwidth enhances access to resources, RLOs increase teacher bandwidth and benefits more students by making good teachers available to more. Creating RLOs also benefit teachers, especially when developing it collaboratively using technology that supports distributed authoring (authors at different places create and edit content). New teachers can learn from experienced ones and everyone gets to learn from others in the team. However, there could be institutional and logistical barriers to reuse of RLOs (Berkins, 2016). Some of these barriers (listed on the ADL RUSSEL site at <http://adlnet.gov/russel/>, cited in Berking, 2016) are - the content generated is not stored in approved, accessible content repositories; creating, uploading, and maintaining metadata and or SCORM content packages (see 6.7.4) is a time-consuming process; creating and registering content in approved content repositories is time-consuming; and so on.

Box 4

You may be aware of IGNOU's e-GyanKosh. It is a National Digital Repository to store, index, preserve, distribute and share digital learning resources. These resources are guarded with copy right but apart from IGNOU's learners, teachers and learners of conventional universities; those preparing for competitive examinations; professionals and many others use these. Access to these resources is allowing many people to learn. Are these resources RLOs? Why? Resources in IGNOU's e-gyankosh have copy right. Moreover these resources include objectives, content, and assessment mechanisms but these are not granular and have not been developed with the intent of reuse and re-purposing.

6.5 SELECTING RLOS

You may come across many RLOs but the decision to use these has to be taken carefully. Which aspects of the RLOs should we examine? A teacher being a

subject matter expert should check the authenticity of the content. Second, Koh (2017) says that absence of clear pedagogical purpose can lessen the effectiveness of RLOs. This makes it clear that RLOs should be imported into a course only if the RLO help to attain the course objectives. Third, RLOs that engage learners only in reading text or watching video, have a behaviouristic orientation (see unit 2) and are teacher centric as learners only receive information. Bannan-Ritland, Dabbagh & Murphy (2000) however say that not just the course with which RLOs are used, but RLOs too should support meaningful learning. RLOs that include activities to engage learners in thinking and doing make learning an active and meaningful process, and adopt learner centric pedagogies. For instance, RLOs that offer simulations and educational games require decision making by learners; RLOs requiring exploration of real problems like declining ground water level, pollution and so on, engages learners in problem solving.

Fourth multimedia provides a rich learning environment as it involves more than one sense (seeing, hearing) for learning. Hence RLOs with multimedia are more suitable. Fifth navigation within the RLO content should be smooth. Sixth RLOs need interoperability so that learners can access these on various types of devices.

Check your progress 1

Mark the correct response:

1. All RLOs include LOs- true/false
2. LOs and RLOs both must be reusable- true/false
3. Metadata is not essential for RLOs-true/false
4. RLOs are accessible because of their interoperability-true/false
5. RLOs should have a fixed format-true/false
6. Use of RLOs saves resources-true/false

6.6 HOW TO DESIGN RLOS WITH MULTIMEDIA CONTENT?

You have read what an RLO is, its importance, and how you should select RLOs for your course. You have also read that RLOs are usually digital and can be integrated into an online course you are teaching. Therefore, a stand alone digital courseware that includes content in one or more media, has very few instructional objectives, and can be reused and repurposed is an RLO. Hence, in this section and the subsequent ones we shall focus on design and development of digital courseware. Before we discuss these let us study the concept of multimedia as RLOs may offer multimedia content.

What is multimedia? IGNOU uses *multiple media* for delivering instructions. This means that various media deliver content independently like a radio programme uses audio medium, print medium delivers SLM, video medium is used for a television programme. *Multimedia* integrates content developed for delivery through various media. The content is delivered using CD/DVD or it is delivered online. For example films and television programmes usually have multimedia content, which may include content in the form of text, audio, still and animated images.

You have read the strengths and weaknesses of different media in Unit 2. In educational multimedia different media complement each other. For example video has the potential for demonstrating processes and situations; text describes a

movement but an animated image shows it. Therefore the content in various media complement and supplement each other so that learners ‘see’, ‘hear’ and read. However, we should make sure that they do not see, read and hear the same thing. Hence an assembly of text, videos and audios that repeat the content hardly comprises multimedia. Therefore, a video that show a person delivering a lecture, the content of which has been explained through print duplicates the content. Instead it should show what the print cannot.

6.6.1 Instructional designing

You know that a courseware is designed before it is developed and you also know how it is designed (Units 1,2). An RLO imparts instructions. Hence development of an RLO should begin with an instructional design. Let us study this example:

Sima uses the ADDIE model for developing RLOs. In keeping with this model she has to- analysis, design, develop, implement, and evaluate the content developed. Let us see how she takes these steps.

Analysis of target audience needs

Sima’s develops the demographic profile of her learners and assesses their learning needs. She finds that they lack the understanding of learning. She also finds that most of her learners -are graduates; prefer English as the medium of study; and use their mobile phone, laptop, tablets and sometimes desktops for working online.

Designing content

Sima knows that the RLOs need only a few objectives, and should avoid content overload, but at the same time these should include stand alone content. Therefore she sets only one instructional objective - ‘learners will be able to describe the process of learning’. She analyses learning along its approaches (see unit 1). For each approach she organizes the content and selected the media for delivering it. She decided to use text based resources to define and explain the approaches, images including a flow chart for describing information processing, an audio recording that explains the flowchart; and short videos that demonstrate learning in various situations.

Developing content

Sima developed metadata tag for the RLO and mentioned the title of the course, her contact details and that of her institution, the instructional objectives of the RLO and the type of audience that would benefit from it. Sima developed some of the resources (see 6.7) and procured some that had open license. After that she developed exercises for assessment. Sima carried out formative evaluation of the content (text, audio and video) vis a vis the instructional objective, with the help of her colleagues.

Implementation and Evaluation

Sima assembled the resources in various media (see section 6.7) and implemented the course by delivering the content and assessing learning. She used the data pertaining to learners’ achievement, and their feedback for summative evaluation.

6.7 HOW TO DEVELOP RLOS WITH MULTIMEDIA CONTENT?

After designing the phase of development begins. You need to follow the processes described in the earlier units for developing courseware for print, audio and video media and if you need multimedia content you can develop content for each medium.

However, how will you assemble these? Even if you procure open source content, which may be LOs or may be just resources for learning like documents explaining a concept, diagrams, and so on, or if you already have these, ready in your repository, you will have to assemble these for a multimedia product. How will you assemble these? Assembling content in various media requires special tools (authoring tools) and skills. We would like to remind you that multimedia content is not just a collection of isolated elements in different media but each one of these helps to facilitate the attainment of the overall instructional objective of the multimedia content. Hence each element you include must strengthen the others. For example visuals projecting drought support text describing water scarcity.

6.7.1 Authoring Tools

What are authoring tools? Multimedia authoring tool is also known as an authorware, as these are softwares that help us to author content. Authoring tools are software applications, used for developing eLearning products, and these are useful (for teachers) as programming skills are not required for creating content with these tools (Berking, 2016). Hence teachers can use these tools. Authorware allows simple learning experiences like reading text, watching video to complex ones like participation in simulations, gaming, virtual worlds (an environment in which the computer/phone user can participate. For example users can be the citizens of a virtual society and interact with other users [virtual citizens], drive a car, carry out an experiment and so on). However, a common feature of these tools is that these offer templates on which multimedia elements like text, graphics, video, etc. can be organised and edited. A template is a pre-formatted fixed space like that you get on opening a file for making slides for presentation. The space serves as a screen for placing content (Fig.3).

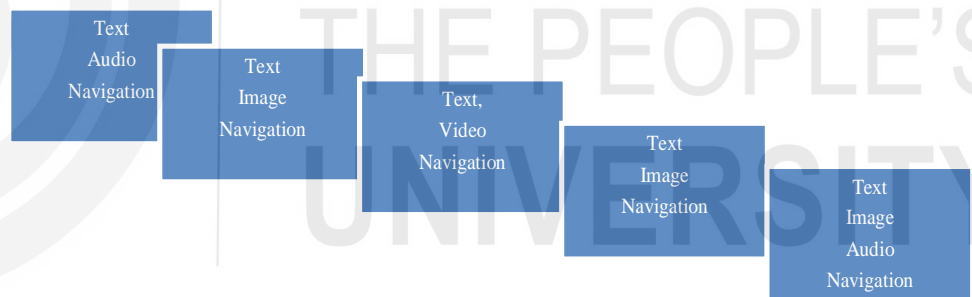


Figure 3: Templates with screens for placing content (text/audio/visuals)

Barritt & Alderman (2004) say that new authoring tools allow the repurpose and reuse of LOs, and some of these can also support the creation of simulations, media elements, mechanisms for interactions, and so on (see box 5). They also say that either these tools can be used or else other tools that help to develop these elements can be used, and the elements developed thus can be assembled using an authoring tool. For example you can use tool for word processing and editing for creating text, tools for creating and editing graphics, tools like spreadsheets for analysing data, tools for recording and editing audio and video and use an authoring tool to assemble the elements you have developed. Barritt & Alderman therefore say that the use of traditional media tools for creating sound, graphics, simulations, or video are still necessary. Authoring tools can be used to assemble these and to build interactivity into the content.

Box 5

What type of learning experience can authoring tools help us to provide?

Authoring tools can perform a variety of functions. Let us explore some of those described by Berking (2016). Specialized simulation development tools can be used for developing simulations. A simulation helps to provide learning experiences like flying aeroplane, carrying out hazardous experiment, and the like and is used extensively in games, military training, automobile manufacturing and many other sectors; Some tools help to generate content for collaborative learning; Even though most authoring tools can now deliver content to mobile devices, there are tools for generating content for mobile learning (m-Learning); There are also tools for developing pedagogic elements like graphics, audio, video, and animation files, educational games, virtual role plays (that learners watch and critique), intelligent tutoring systems, and the like. Thus authoring tools can help to create various types of content for providing different types of learning experiences. Authoring tools also help in creating mechanisms for assessment like quizzes, and help in tracking learning outcomes, passing scores, learners completing activities of the course, and so on.

Quality of the multimedia content depends on the content included and on technical expertise in assembling, repurposing, presenting and packaging these. Teachers have the understanding of content but may not have the technical expertise. Therefore, Watson (2010, as cited in Cinici & Altun, 2018) says that they should be provided with technical support. However some tools are easy to use and teachers do not have to depend on technical experts for developing content. Nevertheless, using some tools may involve a longer learning curve (graphical representation of learning attainment vis a vis the time taken. Easy things have a shorter learning curve as learning takes less time) as learning to use these requires a lot of practice and hence time. To know more you may visit <https://slejournal.springeropen.com/articles/10.1186/s40561-018-0060-3>

Which authoring tool will you select?

Now that you have an understanding of authoring tools, you may be wondering about the best authoring tool. This depends on various factors like whether it would be an open source/freeware/proprietary tool (see box 6); capacity to use the tool given that some require a steep learning curve; type of learning experiences to be provided, i.e. simple ones like watching a video and reading text or complex ones like simulations; capacity of the tool to generate SCORM/other standard compliant content (discussed later in this unit), the scale at which the content will be published, and other such aspects.

Box 6

Free, open and proprietary tools

Free tools- users can run, adapt, and redistribute without legal restrictions like skype, Adobe Reader;

Open source tools- Mozilla's Firefox web browser; Python programming language; Apache HTTP web server are some examples of open source tools. These tools have a source code that is publicly available but under a license that gives users the right to use, adapt, and distribute the software;

Free and open source software: is free as well as open source like Google chrome, Audacity for editing audios, and the like.

Proprietary: owned by an individual/company with restrictions on use; and the right to use can be purchased.

Berking (2016) says that for selecting an authoring tool it is necessary to consider the technical characteristics of output (content generated). Some of these mentioned by Berking are - the authoring tool should generate content that supports many media file formats see box 7); enable automatic scrolling of content on mobile devices; produce output supported by a wide variety of platforms (like Mac, PC), browsers (like Internet Explorer, Chrome, Mozilla, Firefox) and their older versions, and screen sizes (like that of smart phone, tablet, desktop); support responsive design so that the content dynamically adapts itself to tablets, mobile phones, and desktop computers, and different version of the content is not required for each device; requires a minimum of players and plug-ins, especially proprietary ones; support creation of a desktop executable file that can run on CDs or DVDs or run on the desktop after being downloaded from the intranet.

Box 7

What is file format? File format is the structure of a file that tells a program how the data within the file is organised so that the program can retrieve, recognize and display it. Examples of file formats-.doc, .pdf, for word documents; .htm, .html for Web files; .MP3, .WAV,.WMA for audio; MPEG-4, Quicktime, AVI, H.264, for video; JPEG, GIF, PNG for graphics; SWF, GIF for animations)

You may also visit <https://etd.vt.edu/howto/accept.html>

6.7.2 Developing Storyboard

Assembling content in various media needs a plan, which is developed in the light of the instructional objectives. You have read in unit 5 that a story board is a full graphic expression of ‘what’ the screens will look like, what pictures (still and moving) will be seen, and what audio and text will accompany the images (Khan,2008). What is a screen? You may have used an ATM machine and found that a screen shows options for language - English/Hindi. By selecting an option we navigate to the next screen, which may display options like services, mini statement, balance information and so on. By clicking on one of these options we navigate to another screen with some more content. Therefore multimedia content needs to be visualized and organized as screens, and each screen can be planned using a story board. The story board should indicate all the elements as well as the links for navigation. Khan therefore says that a well prepared storyboard indicates everything that can be seen or heard or experienced by the user. Examine the components of the story board in Figure 1.



Figure 1: Story Board for a screen (source: MES 034, Designing Courseware, IGNOU, 2008)

Let us now examine Figure 2.

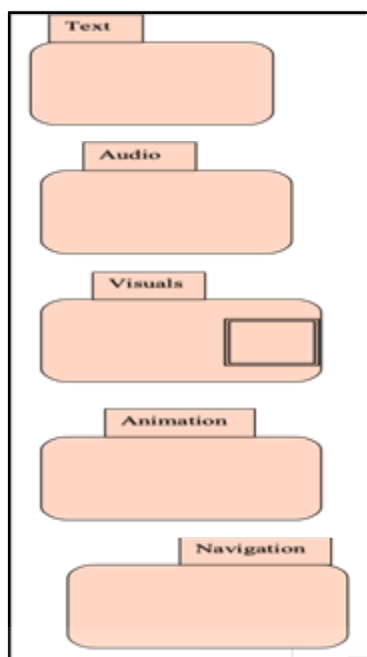


Figure 2: Components of a screen (source: MES 034, PGDET, IGNOU, 2008)

Figure 2 shows the five components used in the screen of Figure 1. The components also known as elements are text, audio, visuals, animation and navigation buttons (Khan, 2008). Each component needs to be indicated on separate cards/boxes. If the text is short, like a caption, it can be included in the box/card meant for text. Similarly for the audio the card/box should mention the audio file to be used. The card/box for visual describes the visual as static/animated image/ video clip/video and the corresponding file. Cards/boxes for video and audio also mention their duration. Except navigation, it is not necessary that all the components are present in every shot/screen. Depicting navigation is however important for visualising how learners can move across the screens. According to Khan some key navigation buttons are start, end, next, previous /back, home, etc., and we need to mention on the card/box, the type of navigation button and what its action would lead to.

Khan (2008) says that a clear and detailed storyboard helps to visualize the content, its layout and other important aspects. She cautions that it has to be developed with care as making corrections after the content has been developed could be difficult. Aesthetics of the content is also important. Images should be used only if these explain the content better. The font, style, animation, special effects, and the like should be chosen with care so that there is no jarring effect. Animating text can be avoided if it has no pedagogic purpose. Animations should therefore be used for meaningful communication, not merely for adding effects. Colour combinations should also be soothing and contrasts created with light background and darker text colour enhances readability. We need to remember that rich colours and stylish designs may decorate the content but not necessarily make it readable. Similarly loud background music of an audio may make the narration inaudible. Too many objects and too much text on a screen should also be avoided.

6.7.3 Using Authoring Tools for assembling Resources

You have read that authorwares can be used to create content, and also used for assembling resources that have been developed/procured and stored. The latter option is easier and authoring tools provide a template into which the resources are imported. Even those who have not used such authoring tools for creating multimedia

content are likely to have authored multimedia content. When? Many of us before delivering speech/lectures make slides for presentations. Power point is one such commonly used tool but there are many others including those which are not proprietary. Therefore, it is very likely that you have some experience of authoring content. However presentation programmes like power point allow the inclusion of elements in various media, addition of animations and pop ups (for including references, glossary, etc.) but it is not suitable for offering large amount of content, and there could also be loss of interactivity, and reduced interoperability (Kilimenko, 2013). Therefore for developing e-content including multimedia RLOs, authorwares are better options than softwares for making presentation. A courseware, which may be an RLO also needs to be delivered after it has been developed (Box 9).

Box 9

How do we develop and deliver online courses? Tools for developing and delivering online courseware are usually different and while authorwares are used for developing content, a Learning Management system (LMS), a software helps to host and offer online courses. An LMS helps in administration, documentation, tracking and reporting learners' participation and performance, besides providing scope for interaction through discussion forum, threaded discussions and so on. Usually it is not used for content creation but some recent ones are allowing content creation as well and hence function as authorwares. Learning Content Management Systems (LCMS) applications are however basically platforms for administrative activities, content management, storage, delivery and assessment but these tools also integrate authoring functions that help to create content (Berking, 2016). Similarly Authoring tools are not strictly used for authoring content but also for hosting and delivering content and managing learning by tracking results, providing feedback and so on.

Some authorwares are rapid authoring tools. These softwares are useful for online content development and are useful for quickly developing web-based content including courses with interactive and multimedia content. These tools are simpler to use (Berking, 2016) and can help to create, use and repurpose and publish content (making content accessible from any computer with an Internet connection). These tools can be in the form of plug - ins. While using presentation programmes (like power point) as an authoring tool, plug-ins can be added for making it a rapid authoring tool for creating interactive multimedia content and publishing it. There are many such free add-ins that you can use. Unlike plug-ins some authoring tools are standalone products that need to be installed in the computer thus dispensing the need for installing a software to operate it. There are also cloud-based authoring tools. These tools do not have to be downloaded and installed in the computer but are entirely online. These tools are installed on a cloud server and use the web browser as the application interface. You can create content individually or collaboratively along with your co-authors using these tools. This is called distributed authoring. Users can access these tools anytime, anywhere provided they can access the internet. From content creation to publishing, all activities are online with these tools. Content is also saved to the cloud and is stored there.

A Case

Let us read a teacher's narrative of her experience of using an authorware for developing and delivering a multimedia courseware. The author of this

courseware had no previous experience of using an authorware. As she requested anonymity, we address her as N.

N wanted to design, develop and deliver a short course as an RLO with multimedia content for teaching photosynthesis. She explored several authorwares and selected the free trial version of a web based authorware that could help her to design develop, publish, host and deliver her course. It also allowed her to track her learners' progress and achievement. She created an account and logged in and explored the features of the authorware. She found that the tool would provide her with templates for building every component of the course right from its metadata to introduction, objectives, content, and assessment and so on, and the tool was also quite user friendly. It also had word processing and editing tools for creating text based content.

N selected the colour and lay out of her courseware, font for the title, and included 'The process of photosynthesis' as the course title, and her institution's logo. She used the template offered by the tool for describing her 'audience profile'. After that she used the template for writing the introduction to the course and highlighted what the course would offer to learners.

Next she developed the instructional objectives. She found that she could write these in her own way or use the template that guided the development of instructional objectives. Using the template meant describing 'what' and 'how', learners would learn and the 'learning outcomes'.

After that she developed the frames (content for various sections). The authorware provided her with the option of adding subsections and sections and thus structuring the content she generated and she could edit the content she had created earlier. She could therefore edit the text, remove or add elements in various media like documents, graphics, videos, and audio.

While creating a section of her course content she found that the template was like a page. The space at the left of the space for content creation listed options like text, images, interactivity, quiz and she could 'drag and drop' any of these into the space for content creation (Figure 4) and either create or import LO from her store of objects in her computer or even from online sources like Youtube. For example after dragging in the option for text creation she could develop text/import a document with text



Figure 4 Template for creating a section by assembling objects. The dotted arrows represent drag and drop options into the space meant for content creation/import.

For detailed text she imported documents stored in her computer but for brief texts like headings and captions she carried out word processing using the authorware. The tool for creating and editing text was the same as that she used on her computer. She found that the objectives she had imported for

creating content into the template were stored in ‘my library’ within the tool. Importing these elements (documents, video, pictures) was also simple and the process was the same as that adopted for attaching files to e-mails. Further videos on you tube could also be used. She added captions for the elements she imported and made the content interactive by adding buttons for navigation.

For creating assessment tools she found that there were many options like fill in the blanks, matching text, multiple choice and open ended questions. She could drag in and drop any or even all of these and using the template for generating quiz and giving feedback for wrong responses, she could generate quizzes. The tool also had mechanisms to calculate scores, provisions for carrying out learner satisfaction survey, and allowing learners to download certificates after passing the course. N previewed the content and found that it was ready to be published. The tool was cloud based and it allowed her to publish the course using a private link, within a website, on its cloud, intranet, and the LMS she used.

Activity

We have narrated N’s experience. After reading her experience you should use an authorware for creating e-content. There are many free authoring tools. Some proprietary tools also allow free trials and cloud based ones do not even have to be installed in your computer. Use any one of these and explore its features. Develop/procure the content you would like to use and use the too for developing multimedia content for a topic you would like to teach online.

6.7.4 Standards for development of e-content

A digital courseware can be used as an RLO if users can use it in the LMS they use for delivering courseware. Suppose you plan to purchase a charger for your phone you need to specify the phone you use but while buying a DVD for watching a movie do you worry whether your DVD player will be able to play it? The DVD can be played on a DVD player manufactured by any company. To ensure this, DVD movies are developed as per certain standards (SCORM Explained 101: An introduction to SCORM, n.d.). Online courseware is usually offered using an LMS. Just like DVDs and DVD players, the courseware and LMSs need to be compatible. RLOs and the system like LMS through which it is offered therefore need to be compliant to some set standards. The Advanced Distributed Learning (ADL) project of the U.S. Department of Defense, has set Shareable Content Object Reference Model (SCORM) specification (Barritt & Alderman, 2004). However, SCORM standards being technical in nature, we shall not discuss these specifications. Apart from SCORM, there are however other standards but in this unit we shall discuss only SCORM.

Why follow SCORM standards? Just like the DVD standards that make sure that all DVD players can play a DVD, SCORM conformant LMS/other systems can play any content that is SCORM conformant, and any SCORM conformant content can play in any SCORM conformant LMS (SCORM Explained 101: An introduction to SCORM, n.d.). SCORM thus standardizes the means of communication from the RLO to the LMS and make these compatible across systems (LMSs) that host and deliver these (Berking, 2016). Therefore, while selecting LMS for delivering courseware we need to opt for those that confirm to these standards, and while selecting authoring tools for developing e-content we need to select those that generate content which is compliant with these standards. Berking therefore suggests that

while selecting the authoring tool we need to ask questions like-does the tool include compliance checkers? Does the tool warn if you try to do something that will make the course non-compliant? A number of tools that help to develop SCORM compliant e-learning courses are available but Berkins says that an authoring tool can support SCORM requirements to widely varying degrees, and the user has to evaluate how fully the tools support each of these, and in what way.

Since RLOs are used for training and education, many companies, and organizations require SCORM compliance. While selecting authoring tool for developing RLOs and systems for delivering these we need to be careful about these standards. However, SCORM, like any specification, are not fixed but grows and changes over time (Barritt& Alderman, 2004) and there are also different editions of SCORM.

According to Berking (2016) ADL has identified certain attributes for all distributed learning environments, i.e. when teachers and learners are at different places and teaching and learning are at different times [asynchronous] using resources that may be web-based. These attributes are:

- **Interoperability:** allows use of instructional content across systems;
- **Accessibility:** the ability to locate and access instructional components from multiple locations and deliver them to other locations.
- **Reusability:** the ability to use instructional components in multiple applications, courses and contexts.
- **Durability:** the ability to withstand technology changes over time without costly redesign, reconfiguration, or recoding.

According to Berking ADL promotes the use of the SCORM, in order to achieve these attributes in distributed learning environments. Further SCORM compliance makes the content more adaptable as it can be repurposed and updated using a wide range of authorware.

6.7.5 Organising instructions using four quadrant approach

Resources for online courses offered through the SWAYAM (see course1) platform of India are organized as per the four quadrant approach. You will find this approach in MOOCs offered by many institutions. This approach organizes the content along four distinct dimensions. RLOs are not necessarily courses but these can be developed as short courses for teaching a concept, and the content can be developed along these dimensions. The first quadrant of SWAYAM includes videos for e-tutorials; the second includes e-Content with about 3500 words (PDF, Text, e-Books, open content Illustrations, links to content and so on. The third quadrant involves Assessment (Problem/ Solutions, multiple choice questions, Short answers type, Quizzes, Assignments etc.). The fourth quadrant involves a discussion forum that allows learners to interact with instructors and with peers(Source: <https://swayam.gov.in/>)

6.8 EVALUATION

You have read in the earlier units that courseware developed has to be evaluated. You have also read about the types of evaluation in Unit 2. Therefore you know that formative evaluation is a step towards quality assurance. Assessment of RLOs before publishing help to ascertain whether the content developed meets the instructional objectives. Formative evaluation of e -content requires thorough testing

procedures that include checking the e-content's functionality. Khan (2008) suggests that there is a need to make sure that all the links operate as designed and navigation is smooth, and it passes the performance testing using different hardware and operating system configurations. Khan also says that trialing, i.e. field testing helps in formative evaluation. Testing, trying out and revision being cyclical in nature, the revised prototype is tested and tried out again. After the course/training programme has been implemented user's views on the content generates data for summative assessment. Authorwares include provisions for collecting such feedback. Further for RLOs their interoperability also needs to be checked.

CHECK YOUR PROGRESS 2

Mark the correct response:

1. Instructional design is essential for RLOs - true/false
2. In multimedia content a video is ideal for detailed explanations - true/false
3. The four quadrant approach using a discussion forum makes learning a social process - true/false
4. A story board captures and visually projects the plan for multimedia content - true/false
5. All Authoring tools have a steep learning curve - true/false
6. Authoring tools can create objects but are mostly useful for assembling objects- true/false
7. Content authored and systems delivering these need to confirm to standards ensuring interoperability- true/false

6.9 SUMMARY

LO is granular and includes the smallest independent structural experience that includes an objective, a learning activity and activities for assessment. A learning object which is developed for reuse and repurposing is an RLO. Since RLOs are meant for reuse and repurposing, hence these need to be short and simple with preferably few instructional objectives. These should also have metadata for easy access. Further RLOs usually are with a digital format because of which these are easy to access, reuse, repurpose and update.

RLOs benefit learners and instructors and are means for sharing knowledge. RLOs also save time and money as content already available can be reused or repurposed without recreating these. However before using RLOS, it is necessary to check their suitability for instructional purpose. Suitability of an RLO is determined by the content RLOs offer and their pedagogic soundness. Their capacity to fulfill instructional objectives is however the main criterion for deciding to reuse &/repurpose RLOs. Interoperability of RLOs is also important so that these can be used across systems and devices.

RLOs are often developed as multimedia, and to develop it a story board is helpful. An authoring tool is used for creating the content and/ for assembling LOs that have been developed/procured. The content generated is then evaluated. It is also essential to use authoring tools that develop content which is compatible with various systems and devices and SCORM is one such specification of standards.

6.10 UNIT END ACTIVITIES

1. Develop an instructional design for developing an RLO for a topic you would like to teach.
2. Develop/procure the resources required for the RLO.
3. Explore authoring tools, especially those that are not proprietary and compare their features.
4. Select an authoring tool and develop an RLO.

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online learning.

6.12 ANSWERS TO CHECK YOUR PROGRESS

CHECK YOUR PROGRESS 1

1-true 2-false 3-false 4-true 5-false 6-true

CHECK YOUR PROGRESS 2

1-true

2- false

3-true

4-true

5-false

6-true

7-true

