# CHAPTER 2

# REVIEW ON LEARNING OBJECTS

## 2.0 Introduction

Before the implementation of the system, some literature review had been done on previous study of Learning Objects. The information was gathered from resources like journals, articles, books and Internet. The finding of the literature review has been analyzed and grouped based on their criteria in this chapter. The first criterion is Learning Objects. This criterion discussed about the definitions, functional requirements and related information about Learning Objects. The second criterion discussed about the analysis of the availability of current Learning Objects found in the market.

### 2.1.0 Learning Objects

Learning Objects, first popularized by Wayne Hodgins in 1994, had become a popular topic in recent years in the computer-mediated learning field (Polsani, 2003). This new developing of reusable learning content approach had been increasingly gaining attention among educational technology and computer science researchers (Daniel, 2004). Learning Objects is designed specially for flexibility and re-use, which can be stored in database and tagged for easy searches. Learning Objects is also the fundamental elements of a new conceptual model for content creation and course composition in Web-based education (Frosch, 2004).

### 2.1.1 Definitions Of Learning Objects

There are several definitions about Learning Objects. National Learning Infrastructure Initiative USA, described Learning Objects as modular digital resources, uniquely identified and meta-tagged, that could be used to support learning (Robert, 2002).

David A. Wiley described Learning Objects as any digital resource that could be reused to support learning. The main idea of Learning Objects was to break educational content down into small chunks that could be reused in various learning environments, in the spirit of object-oriented programming (Wiley, 2002).

Learning Objects Metadata Working Group of the IEEE Learning Technology Standards Committee (LTSC) described Learning Objects as any entity, digital or non-digital, which could be used, re-used or referenced during technology supported learning (IEEE, 2003).

Another author named Pithamber R. Polsani, in his study "Use and Abuse of Reusable Learning Objects", also described Learning Objects as an independent and self-standing unit of learning content that was predisposed to be reused in multiple instructional contexts (Polsani, 2003).

Based on these definitions, Learning Objects could be concluded as any independent and intelligent digital resources that are reusable, interoperable, durable and accessible to support learning process or system.

### 2.1.2 Types Of Learning Objects

Any learning material can be Learning Objects. Learning Objects can vary in size, scope, and level of granularity ranging from a small chunk of instruction to a series of resources combined to provide a more complex learning experience. Learning Objects can have multimedia content, instructional content, instructional software and software tools,

and persons, organizations, or events as a reference during technology supported learning (IEEE, 2003). Besides, the content of Learning Objects may be any interactive or passive types and it can be in any format or media type, such as HTML, JavaScript, PDF, audio, video, PowerPoint presentations, online textbook and others (Daniel, 2004).

However, Learning Objects can be grouped into three categories as practice, informational and integrated. Practice Learning Objects is a type of resources that provides learner learning or studying by repetition, rehearsal or carrying out of exercises. This type of Learning Objects is suitable for tactile or kinesthetic learning style learners.

Informational Learning Objects is a type of resources that provides learner learning or study from a collection of fact, data and knowledge derived from study, experience and instruction. This type of Learning Objects is suitable for visual and auditory learning style learners.

Table 2.1 Types Of Learning Object (Clive, 2000)

| **Types Of Learning Object** | | |
|---|---|---|
| **Integrated** | **Informational** | **Practice** |
| Mini-tutorials<br><br>Mini case studies, simulations, etc. with supportive information | Overviews / summaries<br><br>Descriptions / definitions<br><br>Demonstrations / models<br><br>Worked examples<br><br>Cases / stories<br><br>Papers / articles<br><br>Decision aids | Problems / case studies<br><br>Games / simulations<br><br>Drill-and-practice exercises<br><br>Review exercises<br><br>Tests / assessments |

Integrated Learning Objects is much more effective for learners. This type of Learning Objects combines both practice and informational Learning Object into one that can provide learners study not only by exercises, but also the knowledge. It is suitable for

all types of learning style learners including visual, auditory and tactile/ kinesthetic. Table 2.1 list out the different types of Learning Objects.

### 2.1.3 Features Of Learning Objects

Based on British Columbia Ed Tech User's Group discussion on Learning Objects January 2003, Learning Objects is an indexed, digital format and can standalone or is independent of a specific context and content. This ensures Learning Objects can act like a block of independent contents that are reusable, interoperable, durable and accessible (Norman, 2003).

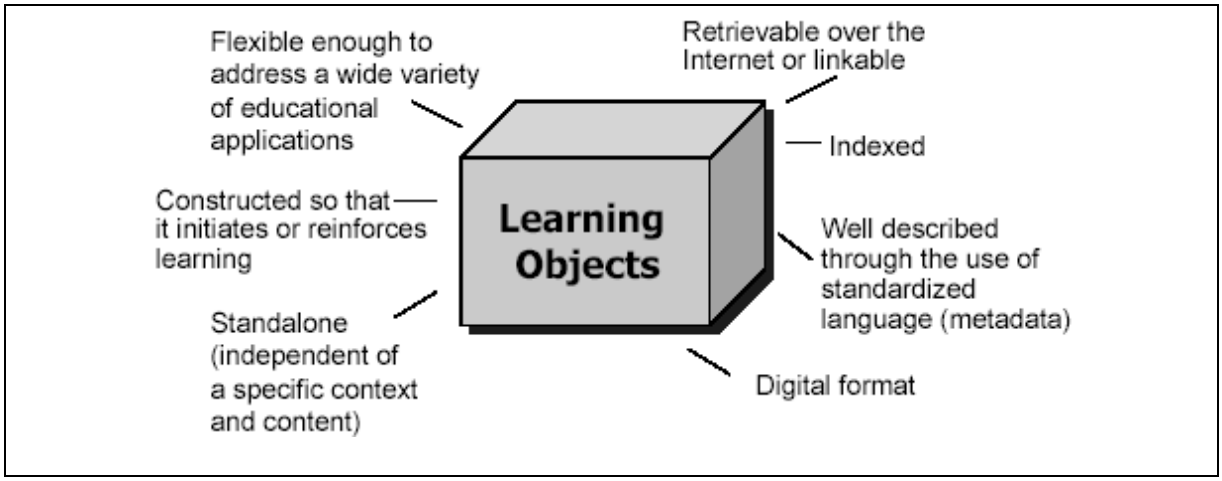


Figure 2.1 Characteristics Of Learning Object (Norman, 2003)

Reusability is defined as the ability to use software over again instead of being forced to rewrite it. It enables the small units of Learning Objects to be used on more than one instructional contents. Besides, reusability also enables the contents of Learning Objects on the same Learning Objects changeable or updated in case of contents of Learning Objects may vary from time to time.

Interoperability is defined as the ability of independent, distributed software components to operate together as part of a larger system. It enables Learning Objects not only to work with data processing, but also to represent the instructional contents for

learners. Besides, it also enables exchanged and used information to include database sharing between the delivery media and knowledge management systems.

Durability is defined as the probability that an item continues to function at its useful life without requiring overhaul or rebuilding due to technology. It enables the Learning Objects to develop with existing technology that can be used for a long time as technology always improved from time to time.

Accessibility is defined as the ability to communicate or to deal with a computer system to store data or retrieved data. It enables the contents of Learning Objects to be easily searched and viewed. It also enables Learning Objects to be accessed from anywhere with available of network. Table 2.2 list out the functional requirements of Learning Objects.

Table 2.2 Functional Requirements Of Learning Objects (Tim, 2003; Polsani, 2003)

| Term | Description |
|---|---|
| Reusability | Learning content modularized into small units of instruction suitable for assembly and reassembly into a variety of instructional context. The same Learning Objects could used in multiple contexts for multiple purposes. |
| Interoperability | Learning Objects shall be independent of both the delivery media and knowledge management systems and its instructional units could interoperate with each other. |
| Durability | Units of instruction that can withstand ever evolving delivery and presentation technologies without becoming unusable. |
| Accessibility | Learning content shall be tagged with metadata so that it can be stored and referenced in a database and can be available anywhere, any time that can be discovered and reused across networks. |

Besides, Lim Kin Chew from National Institute of Education, Singapore described that Learning Objects had the characteristics such as small units of learning, self-contained,

reusable, can be integrated and tagged with metadata. These characteristics are used to gauge its quality and utility. The descriptions of each characteristic are as follow:

1. Small units of learning

   Learning Objects usually comprise a smaller unit of learning than a course, typically ranging from two to 15 minutes.

2. Self contained

   Each Learning Objects is self-contained and can be used independently with other Learning Objects.

3. Reusable

   Learning Objects is reusable. The same Learning Objects can be used in multiple contexts for multiple purposes.

4. Could aggregated

   Learning Objects can be grouped into larger collections of content to create more substantial units of learning.

5. Tagged with metadata

   All Learning Objects are tagged with metadata that can describe the Learning Objects and are allowed to be easily retrieve in a search.

### 2.1.4 Why Do We Need Learning Objects

Similar with other instructional resources, Learning Objects had its own advantages that can encourage an increased of creation and usage of Learning Objects. Learning Objects developed and stored in many different places on the Web had a tremendous potential to benefit e-learning in particular and education in general (Mohan, 2003). The advantages can be view as five categories. The five categories are production cost,

flexibility, pedagogy, end user cost and industry support. The advantages of each categories are as follow (Robby, 2001):

1. Production cost

   Learning Objects with different contents can be maintained and updated separately. The cost can be saved when there is an existing Learning Objects without needing to create a new one.

2. Flexibility

   The choice of Learning Objects becomes more flexible for developers with the availability of difference standard for Learning Objects.

3. Pedagogy

   Instructional templates can be created for specific types of Learning Objects that may encourage developers to operate in more disciplined ways with a positive effect.

4. End user cost

   Learning Objects approaches prevent it's users from using the specific systems. The market for content took on more of the properties of a typical consumer market with lower costs and increased choice in selecting Learning Objects.

5. Industry support

   All leading system vendors and content producers are supporting some Learning Objects standards like Sharable Content Object Reference Model (SCORM) that are based on or that complemented a Learning Objects approach.

### 2.1.5 Drawbacks In Learning Objects

Besides the advantages described on section 2.1.4, drawbacks in Learning Objects can also be viewed on the same five criteria. The five criteria are production cost,

flexibility, pedagogy, end user cost and industry support. The descriptions of Learning Objects rollbacks are as follow (Robby, 2001):

1. Production cost

   Retooling and retraining costs are required for a Learning Objects system when the system is changing from a self-contained system.

2. Flexibility

   Total interoperability is maintained when using standard-based Learning Objects as it restricts the scope of learner information that is accessible by content.

3. Pedagogy

   Restrictions on learner information available can restrict pedagogical approaches that used lengthy discursive material. This may not benefit from the use of Learning Objects.

4. End user cost

   The converting existing content to a Learning Objects approach cost may be significant depends on the subjects.

5. Industry support

   It takes more time for a vendor community to adopt an approach and the available time for the products to implement the approach.

### 2.1.6 Learning Objects Metadata

A metadata is data that provides information about or documentation of other data managed within an application or environment. Metadata is also a machine understandable information for the web. Metadata is defined as data that provides an effective mechanism for describing and locating data that is relevant to a particular user (Burnett, 1999).

In relation to Learning Objects, Learning Objects Metadata is defined as the attributes required to fully or adequately described a Learning Objects (IEEE, 2003). In order to reuse content from one system to another, IEEE had released the standardization of Learning Objects Metadata, IEEE 1484.12.1-2002 in year 2002. IEEE Learning Object Metadata (IEEE LOM) was the first accredited standard for learning technology (Mohan, 2003). The standardization of the IEEE's Learning Object Metadata represented a major step forward in terms of resource description, discovery and reusability (Van, 2003). IEEE LOM contained nine categories of XML data elements to describe Learning Objects, General, LifeCycle, Meta-Metadata, Technical, Educational, Rights, Relation, Annotation, and Classification. This nine categories are intended to simplify the discovery, management, and exchange of Learning Objects (Mohan, 2003). However, there was a problem for this standard. The problem for this standard was that not all of the 65 simple data elements are comprised in the standard used in new Learning Objects Metadata implementation (Van, 2003).

### 2.1.7 Learning Objects Repositories

Learning Objects repository is a search database that grouped digital resources and/or metadata that can be reused to mediate learning (NLII, 2003). It is a strategic technology that underpins a mixed learning environment and improves the management of all learning assets.

Repositories was set up by education authorities or by professional organizations; others by commercial organizations to share resources and development costs. It had even been suggested that the creation and distribution of Learning Objects represented "a new economy of education" at the university level (Downes, 2002).

The majority of Learning Objects repositories today contained resources for tertiary education or for continuing professional education and training (Laurel, 2004). There were two types of Learning Objects repositories, such as those containing metadata only and those containing Learning Objects with its metadata. Besides, there are two basic organizational distinctions in repository set up, such as repositories integrated with Learning Contents Management System product and repositories that are set as standalone portals offering Web-based search and retrieval. Thus, the repositories set up follow two models, a centralized - metadata on a single server or Website and a distributed - metadata located at several connected servers or Websites (Downes, 2002).

### 2.1.8 Learning Objects Technology Standards

Recently, many learning technology standards had been established, such as SCORM, IMS, AICC, CETIS (Centre For Educational Interoperability Standards) and IEEE LTSC (IEEE Learning Technology Standards Committee). Within these standards, the three standards that dominate e-learning are SCORM standard from ADL initiative, AICC standard from AICC organization and IMS standard. At this section, there will be a description of the three popular standards used in Learning Objects approach.

#### 2.1.8.1 SCORM

Sharable Content Object Reference Model (SCORM) is a standard initiated by the Advanced Distributed Learning initiative (ADL) in year 2000. SCORM purposes to establish a standard protocol for the courseware to communicate to underlying Learning Management System (LMS) (Shih, 2005). Besides, SCORM is also purposed to provide reusability and interoperability of learning resources by leveraging the advances in all fields related to e-learning through proper integration and extension of various existing models

(Arapi, 2003). Besides, SCORM is created for easy portability of learning content from one LMS to another and implemented Learning Objects that are reusable, accessible, interoperable and durable (Bohl, 2002; Sheng, 2005).

The current SCORM standard is designed specifically for browser-based delivery of learning content that comprised of two parts. The first part is the definition for communication between learning units and tracking server using tightly controlled Application Program Interface (API). The second part is the definition for computer readable packaging of a learning unit, or Sharable Content Object (SCO) (Courses, 2005). SCO is a standardize form of reusable Learning Objects. Firstly, Learning Objects developers create several individual SCO. After the SCO had been created, the SCOs are assembled into a package with delivery instructions. The package is sent to LMS for package management. After the package reached LMS, LMS loads the SCOs from the package and delivers it to the learner's computer according to the delivery instructions. The computer is communicating with the LMS when a SCO has arrived and informs LMS to deliver the next SCO when the delivery process of previous SCO is finished.

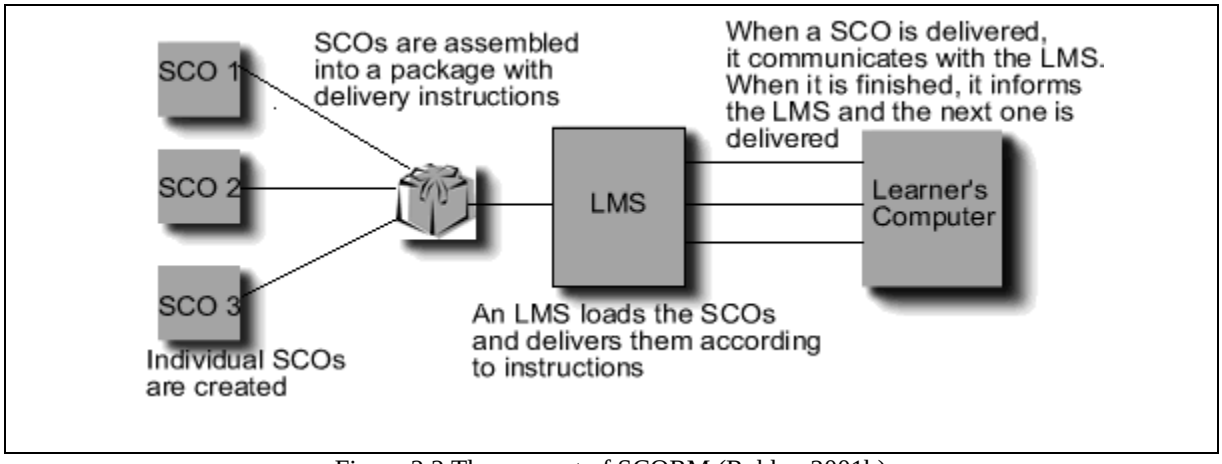


Figure 2.2 The concept of SCORM (Robby, 2001b)

#### 2.1.8.2 IMS

IMS Global Learning (IMS) is an international consortium of members from academic and commercial sectors. Besides, IMS is also the acronym for instructional management system (Harvi, 2002). IMS defines a range of XML specifications to enable the interoperability among distribution application and services in education. Besides, IMS Content Packaging Specification also provides the functionality to describe and package the educational content in a single compressed file in order to import and export the learning resources across content management system.

There are two elements in IMS, the manifest file that described the content of package and the learning resources such as web page, multimedia files and text files. The manifest file is a file that describes the metadata, organizations, resources and sub-manifest. The IMS metadata is design based on the IEEE Learnng Object Metadata and purposes to provide value-added descriptions that enables various functions to be fulfilled, which includes the location and storage of learning resources (Boon, 2002).

#### 2.1.8.2 AICC

Aviation Industry CBT (Computer-Based Training) Committee (AICC) is an international association of technology-based training professionals. In the past 15 years, this committee had developed guidelines for aviation industry in the development, delivery, and evaluation of CBT and related training technologies. AICC standard is a standard or guideline for LMS interoperability that enables shared data within CBT courseware from different LMS developers (AICC, 2005). Besides, AICC is a standard to standardize instructional material for aircraft manufacturers and buyers. AICC also standardize the ways Learning Objects communicate with learning content management and LMS. In order

to standardize, AICC guidelines and recommendations covers nine major areas that includes LMS, Learning Objects and learning tracks or program (Harvi, 2002).

### 2.1.9 Technology Used In Learning Objects

There are several technologies used in developing Learning Objects. The most popular technologies used are developing Learning Objects with XML and developing Learning Objects with database.

XML stand for eXtensible Markup Language. XML is a subset of Standard Generalized Markup Language and a text-based data format for structured documents that are designed and developed by World Wide Web Consortium. XML is a tag language that looks similar to Hypertext Markup Language (HTML) with more user-defined tag support. XML is also a meta-language for defining other markup languages to the needs of industry or discipline as well as the metadata for Learning Objects. The primary goal of XML was to provide a marking text components and use the marking data for exchange among the information sources (Cheng, 2000; Pokorny, 2000). The attributes of Learning Objects include the path of Learning Objects saved that are recorded in XML pages for easy search. The Learning Objects are only retrieved when it is called. The details of Learning Objects Metadata are described in section 2.1.6.

A database is a carefully organized set of data stored on a computer and managed by a special application called database management system (DBMS) (Burrows, 2000). A database provides a framework that supported real-time, dynamic environment without data redundancy (Gary, 2001). The main purposed of a database system is to provide users an abstract view of data with certain hidden details of how the data were stored and maintained (Abraham, 2002). To develop Learning Objects with database technology, the Learning Objects created is saved together with the metadata in the database or just saved the

metadata in the database. This technology created Learning Objects Repository that can save all the Learning Objects in a database. The details of this technology are described in section 2.1.7, Learning Objects Repositories.

### 2.1.10 Basic Functions In Learning Objects Systems

EduTools has made an analysis on the functions of six described systems in year 2004. 44 functions in 10 categories were analyzed (Scott, 2004). In this section, only eight of the functions analysis results are listed out. These eight functions are mostly related to the system. The first function is searching. Searching is the ability to find Learning Objects based on keywords or other metadata fields. The second function is browsing. Browsing allows users to locate content by drilling down defined categories or subject classifications. The third function is to have personal collections. This function describes that users can bookmark the objects found across user session. The collection can be in order or be organized and it can also be shared.

The fourth function is the context usage illustrators. Context usage illustrators describe the mechanisms for communicating different learning contexts to which Learning Objects had been re-used. The fifth function is accessibility. This function allows people to access the Learning Objects information through online. The sixth function is customized look and feel. Customized look and feel is the ability to change the graphics and how a repository looks. The seventh function is multiple collections. This function describes the ability to service multiple transaction with a single installation. The last function is media transformation and display. This function involves conversion of data or file or information from one format to another.

### 2.1.11 Learning Objects Projects Around The World

There are numerous Learning Objects projects around the world, such as CAREO, SPLASH, MERLOT and SOCCI.

#### 2.1.11.1 Canada

##### 2.1.11.1.1 CAREO

URL: http://careo.netera.ca/

Campus Alberta Repository of Educational Objects (CAREO) is a project supported by Alberta Learning that will create a searchable, web-based collection of multidisciplinary teaching materials for educators across the province.

##### 2.1.11.1.2 SPLASH

URL: http://www.eduspplash.net/

SPLASH is a peer-to-peer software that allowed user to create own mini-repository that is funded by Portal for Online Objects in Learning (POOL) Project, a consortium of several educational, private and public sector organizations to develop an infrastructure for Learning Objects repositories. These mini-repositories are linked together so users can search all the POOL sites from their own SPLASH applications.

#### 2.1.11.2 Australia

##### 2.1.11.2.1 SOCCI

URL: http://socci.edna.edu.au/content/

Learning Federation's School Online Curriculum Content Initiative (SOCCI) is a national digital repository project for schools in Australia. SOCCI is funded by The Learning Federation to generate online curriculum content for Australian schools.

#### 2.1.11.2.2 LRC

URL: http://www.edlrc.unsw.edu.au/

Learning Resource Catalogue is an EDTeC initiative that had been endorsed by the U21 Consortium. LRC provided the mechanism for academics at UNSW and other U21 Collegial institutions to manage and share their teaching resources online. Besides, the LRC represented a means of collegial interaction for the purpose of providing learning resources such as Learning Objects for students at all levels.

### 2.1.11.3 United State Of America

#### 2.1.11.3.1 MERLOT

URL: http://www.merlot.org

Multimedia Educational Resource for Learning and Online Teaching (MERLOT) was created in 1997 by the California State University Center for Distributed Learning as a free and open resource designed primarily for faculty and students of higher education. Information hosted in MERLOT can be used free for educational, non-commercial perposes. Besides, materials that are linked to MERLOT had a range of license agreements from public domain to commercial.

#### 2.1.11.3.2 SMETE

URL: http://www.smete.org

Science, Mathematics, Engineering and Technology Education (SMETE) is funded by National Science Foundation, USA. SMETE is a dynamic online library and portal of services by the SMETE Open Federation for teachers and students.

#### 2.1.11.4 United Kingdom

##### 2.1.11.4.1 NLN

URL: http://www.nln.ac.uk/

National Learning Network (NLN) is a joint initiative of a number of British organizations and their mandate is to provide the use of technology in higher and further education and long-term funding provided by the British National Government. NLN provides information on various Instructional Learning Technology (ILT) solutions to United Kingdom colleges seeking to take advantage of learning technologies.

##### 2.1.11.4.2 SoURCE

URL: http://www.source.ac.uk/

SoURCE aimed to explore customizationas a technique for increasing the extent to which educational software is used and re-used appropriately in higher education. This project focus on dissemination by investigating the feasibility of setting up a "Natioanl Library of Reusable Educational Software" (RESL) that overlook the metadata and interoperability issues.

### 2.1.12 Current Available System

There are a number of available Learning Object system or repository that had been developed. In this section, a review of six Learning Object system or repository is made. The six systems include HarvestRoad Hive, Intrallect Intralibrary, NorthPlains Telescope Enterprise, Ex Libris Digitool, Concord Masterfile and Dspace.

#### 2.1.12.1 HarvestRoad Hive®

URL: http://www.harvestroad.com/

HarvestRoad Hive® is an independent, federated digital repository system that manages sharing and reusing of any form of content in any online learning environment across any number of locations or countries and integrated with any Learning Management or ERP System. It is designed to solve the information management problems that surfaced when organizations implement e-learning. The analyses of functions for this system are as follow:

1. Searching

   This system supports simple searching across all metadata fields, full text index, word stemming, Boolean search and an advanced search of specific fields. Users can save complex search criteria for later reuse. The system supports searching across the entire collection or bounded by individual collections.

2. Browsing

   Users may browse content by pre-set category. Categories are not driven by metadata-based taxonomies but are instead entered directly into the system. Resources can be placed in multiple categories that allows them to be found at different points in the overall taxonomy. Multiple nodes of the taxonomy can be browsed simultaneously, showing an aggregation of the browse results list.

3. Personal collections

   Not Supported

4. Context Usage Illustrators

   Not Supported

5. Accessibility

The system provides <*alt*> tags on all system images and interface elements and appropriately titled frame sets that described the functionality of the frame layout.

6. Customized Look and Feel

Many aspects of the look and feel of the software are configurable through style sheets. Multiple organizations or faculties can have their own bureaus on the same server. New pages can be created from the repository with data incorporated by using a proprietary scripting language.

7. Multiple Collections

The system support sub-licensing to enable a single installation to be partitioned into multiple independent "bureaus," which facilitates multiple repositories for faculties, projects or separate organizations. Content can be shared across these bureaus.

8. Media Transformation and Display

The software can be auto-generated HTML and XML from a wide variety of 'Office' products using Verity's HTML Export Engine. The Hive Plug-in for Reload Editor can dynamically render previews of content packages in HTML.

#### 2.1.12.2 Intrallect Intralibrary

URL: http://www.intrallect.com/products/

IntraLibrary is a solution for building a Learning Object Repository that enable educators to share and re-used Learning Object on the web. It is an enterprise software with an intuitive web-interface and enable the simple creation of a Learning Object Repository or digital repository for any institution, project or subject group, in compulsory education, post-compulsory education and professional training.

The feature of Intralibrary includes storage and retrieval of Learning Objects, searching and structured browsing of the repository Inline tools for cataloging Learning Objects, personal collections of Learning Object, supported for any digital format and import and export of content packages conformant to IMS and SCORM specifications. The analyses of functions for this system are as follow:

1. Searching

   Supported simple searching of administrator configurable text fields, word stemming, Boolean and wildcard search and an advanced search with multiple constraints on specific fields.

2. Browsing

   Users may browse all items in repository by subject classification. The system supports a multiple-taxonomy view. Resources can be placed in multiple categories in multiple classifications systems which allows them to be found at different points in the overall taxonomy. Taxonomy trees can edit online that includes adding or cutting or pasting or deleting functions on leaf nodes and sub-trees.

3. Personal collections

   Users can store personal pointers to objects within the system.

4. Context Usage Illustrators

   URLs can add to comments to refer to uses of objects.

5. Accessibility

   The Royal College had reviewed the product for accessibility for the Blind (UK).

6. Customized Look and Feel

   Vendor branding can be removed from system.

7. Multiple Collections

   Not supported.

8. Media Transformation and Display

   The system can dynamically render previews of content packages in both HTML and structured views.

#### 2.1.12.3 NorthPlains Telescope Enterprise

URL: http://www.northplains.com/products/t_ent.asp

TeleScope Enterprise is North Plains' flagship product for digital asset management with over 10 years of continuous innovation. It had been designed to serve as the primary software platform for media production tools integrated such as Adobe Creative Suite, Digimarc, Telestream FlipFactory, QuarkXPress and Virage VideoLogger. Besides, it is the initiation and staging platform for providing essential digital asset management services such as data modeling, metadata management, workflow and automation, version control, user and workgroup management, asset security and privileges as well as device and storage management. The analyses of functions for this system are as follow:

1. Searching

   Supports simple searching across all metadata fields and full text index, word stemming, Boolean search and an advanced search of specific fields. Besides, users can search for objects of similar visual appearance or text lookups of key frame captions in rich time-based media.

2. Browsing

   Users may browse all items in repository by textual or pictorial views according to file system directory structure, production grouping, access control definitions or other arbitrary groupings.

3. Personal collections

   Users can create an unlimited number of catalogues that can serve as personal pointers to objects within the system.

4. Context Usage Illustrators

   The system automatically lists out all objects that contained the specified asset.

5. Accessibility

   Not Supported.

6. Customized Look and Feel

   A Software Developer's Kit is available for altering the look and feel of the thick client front end. The web-based front end is alterable through editing WebObjects and JSP files.

7. Multiple Collections

   The system supports multiple collections, each with their own front end.

8. Media Transformation and Display

   The system supports the creation of thumbnails and previews of media objects and complex multi-page items. The system can auto-generate alternate media representations of existing media assets in a large number of formats. In addition, the system provides a media conversion framework and SDK that allows developers to build third party conversion tools for any media format.

#### 2.1.12.4 Ex Libris Digitool

URL: http://www.exlibrisgroup.com/digitool.htm

DigiTool from Ex Libris is a client-server application that enables organizations of any size to manage, control and share existing digital content or to embark on the digitization of a collection. It is designed for digital collection administrators, an enable

efficient upload of digital content, individually or in batches as well as management of user records and profiles. The analyses of functions for this system are as follow:

1. Searching

   Supports simple searching across all metadata fields, full text index, Boolean and wild card searched and an advanced search of specific fields. Search terms are highlighted in returned results.

2. Browsing

   Users may browse all items in repository by textual or pictorial views according to title, author, subject or issue date. Resources placed in multiple categories are allowed them to be found at different points in the overall taxonomy.

3. Personal collections

   Users are given a personalized space through which they could track the status of their submissions to the repository.

4. Context Usage Illustrators

   Not supported.

5. Accessibility

   The product provider self-reports that the software complied with Section 508 of the US Rehabilitation Act.

6. Customized Look and Feel

   The system may get customized when installed to represent institutional look and feel, branding.

7. Multiple Collections

   The system supports multiple collections, each with their own front end.

8. Media Transformation and Display

   The system supports the creation of thumbnails and previews of media objects. The system supports display of images using JPEG 2000 standard for enhanced image presentation, manipulation and security.

#### 2.1.12.5 Concord Masterfile

URL: http://www.concord-usa.com/MfOverview.htm

Concord's Masterfile Digital Content Server is a scalable platform for the storage and management of all types of electronic files. When coupled with one or more applications, it delivered a comprehensive solution to the daunting task of managing large amounts of information while making it easily accessible to authorized users. Masterfile consists a dynamic HTML conversion facility that allows users to view items through their browser, even if they did not have the ordinal application on their desktop. Besides, the flexible metadata and search capabilities provides the ability to find items based on a large number of criteria, which configured to suit the user's business environment. The analysis of functions for this system are as follow:

1. Searching

   Supported simple searching across all metadata fields and full text index, an advanced search of specific fields.

2. Browsing

   Users may browse all items in repository by pre-set category, title, author or issue date. Categories are not driven by metadata-based taxonomies but were instead entered directly into the system.

3. Personal collections

   No information.

4. Context Usage Illustrators

   The system automatically listed out all objects that contain the specified asset.

5. Accessibility

   Screen-readers read short and long alt-tags.

6. Customized Look and Feel

   The system supports customization to represent institutional look.

7. Multiple Collections

   No information

8. Media Transformation and Display

   The system converted common file formats (nearly 400) to HTML on demand and on the fly. The system supports the creation of thumbnails for JPEG images.

#### 2.1.12.6 DSpace

URL: http://dspace.org/introduction/index.html

DSpace is a groundbreaking digital institutional repository that captures**,** stores**,** index**,** preserves and redistributes the intellectual output of a university's research faculty in digital formats that is developed jointly by MIT Libraries and Hewlett-Packard. It is available to research institutions worldwide as an open source system that is customized and extended. It is designed for ease-of-use with a web-based user interface that is customized for institutions and individual departments.

Besides, DSpace is an open source software system that enables institutions to capture and described digital works using a custom workflow process, distributes an institution's digital works over the web, so users can search and retrieves items in the collection and preserved digital works over the long term. The analyses of functions for this system are as follow:

1. Searching

   Supports simple searching of author, title, word stemming and truncation of search terms and keywords fields. In addition, it also supports searching across the entire collection or bounded by individual collections or communities.

2. Browsing

   Users may browse all items in repository or an individual collection by title, author or issue date.

3. Personal collections

   Users are given a personalized space through which they tracked the status of their submissions to the repository.

4. Context Usage Illustrators

   Not Supported

5. Accessibility

   No indication of supporting accessibility initiatives or devices.

6. Customized Look and Feel

   The entire look and feel of the software is configurable through stylesheets. The web interface is implemented using Java Server Pages.

7. Multiple Collections

   The system supports multiple collections, each with their own front end.

8. Media Transformation and Display

   Not Supported

### 2.1.13 Analysis Of Current Available System And LOOOP

Analyses of the eight functions on the six current available systems are described on previous sections with LOOOP. Based on the analysis that showed at table 2.3, all of the

systems have the functions that allows users searching and browsing. Thus, the systems Harvest Road Hive and Concord Masterfile are not provided users have their own personal collections in the systems. Furthermore, there are only four systems that provides the mechanisms for communicating different learning contexts to which Learning Objects has been reused. The four systems are Intrallect Intralibrary, NorthPlains Telescope Enterprise, Concord Masterfile as well as LOOOP.

Thus, both of the NorthPlains Telescope Enterprise system and Dspace system are not provided the function accessibility and the ability to change the graphics and how a repository look. Intrallect Intralibrary and Concord Masterfile are the two systems within seven systems that did not provide multiple collections saved in the systems. For the function of media transformation and display, only Dspace was not provided with this function.

Table 2.3 Analysis of current available system with LOOOP

| Systems / Functions | Harvest Road Hive® | Intrallect Intralibrary | NorthPlains Telescope Enterprise | Ex Libris Digitool | Concord Masterfile | DSpace | LOOOP |
|---|---|---|---|---|---|---|---|
| Searching | √ | √ | √ | √ | √ | √ | √ |
| Browsing | √ | √ | √ | √ | √ | √ | √ |
| Personal Collections | X | √ | √ | √ | - | √ | √ |
| Context Usage Illustrators | X | √ | √ | X | √ | X | √ |
| Accessibility | √ | √ | X | √ | √ | X | √ |
| Customized Look and Feel | √ | √ | X | √ | √ | X | √ |
| Multiple Collections | √ | X | √ | √ | - | √ | √ |
| Media Transformation and Display | √ | √ | √ | √ | √ | X | √ |

## 2.2 Summary

Review of Learning Objects is a study for previous work that is related to the project. The literature reviews done on this project are Learning Objects approach and its related topics, such as definitions, features, types and others. The reviews enable readers to know more about the background of the related topics of the project. Thus, reviews of previous study can also give a more understanding to the study of this project.