

# Digital Content Framework

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## **Abstract**

*eLearning is now an integral part of education delivery in learning institutions worldwide. Among educators, the development of reusable, interoperable and standards-conforming learning objects made accessible via the Internet is important to teaching and learning. This is because of the increasing economic costs involved in the design, development, deployment and evaluation of learning content.*

*This paper outlines a framework for teachers and educators in Singapore for the design, development, evaluation and sharing of digital learning content that can be deployed in various pedagogical frameworks whether they are content-driven or process-driven learning.*

*Firstly, this paper will explain what constitutes "digital content". Various types of "digital content" ranging from asset to learning object to reusable information object and to unit of study will be explained. Characteristics like granularity, interoperability and sharability will be*

*discussed together with their implications. The difficulties associated with each type of "digital content" classification will also be addressed in this paper.*

*Secondly, this paper will explain how the different types of "digital content" can be designed and developed, bearing in mind criteria like reusability, interoperability, standards conformance and sharability. In particular, the paper highlights Dr. Ruth Clark's five types of content that apply to eLearning. These are concept, fact, principle, procedure and process. The next stage is to create the storyboards to transform the content to a digital format. The CISCO's RIO/RLO model is recommended as a practical way to develop the storyboards.*

*Thirdly, the paper touches on the conversion of existing eLearning content to the new "digital content" format. Three approaches to designing reusable objects will be reviewed. These are the CISCO's RLO/RIO, the Adobe's (Macromedia's) Flash and the NETg's Model. These models will be used to explain how to convert*

existing content to the new object-oriented design approaches.

*Lastly, this paper will explain how “digital content” can be evaluated properly. Different types of evaluations will be discussed together with the advantages of using evaluations to improve quality, design and development of eLearning.*

## **1 Digital Content Framework**

### **1.1 Necessity for a Framework**

A framework is like a supporting structure around which something can be built. A framework can also be a system of rules, ideas or beliefs that is used to plan or decide something, e.g. a legal framework for resolving disputes [1].

In the same way, eLearning needs a framework which will address the design, development, evaluation and sharing of the digital content.

In Singapore, we are developing a Digital Content Framework for all teachers, educators and trainers who use eLearning.

### **1.2 Rationale for the Framework**

The following are some of the rationale for developing such a Digital Content Framework:

- a) Teachers, educators and trainers need some kind of structure and “language” for them to share, exchange and collaborate best practices in teaching and learning using eLearning.
- b) There is a need to separate the content from the system(s) that help to deliver the content to the end-users. Teachers who conceptualize and develop the content for delivery to the students need to be

recognized for their efforts. Their intellectual property needs to be protected from piracy and unauthorized usage.

- c) Rich and interactive digital content can help to facilitate the integration of ICT across the school curriculum. The availability and suitability of appropriate digital content are critical success factors in increasing the usage of ICT in the schools.
- d) With our schools and universities developing many digital content repositories, we need a framework so that our teachers and educators can learn to share and evaluate digital content using an accepted metadata system like the Content Exchange Metadata System (CEMS) developed for Singapore schools.

## **2. Classification Model for Digital Content**

### **2.1 Explanation of the term “Digital Content”**

By “digital content”, we mean the following:

- a) The content is in a discrete, granular format, commonly referred to as a “learning object”;
- b) Learning objects are digital;
- c) By “digital”, we mean that the learning objects can be distributed using the Internet.

The following list is given by Rory McGreal in the book, “Online Education Using Learning Objects” [2]:

- Asset;
- Component;
- Content Object;
- Educational Object;
- Information Object;

- Knowledge Object;
- Learning Object / Learning Resource;
- Media Object;
- Raw Media Element;
- Reusable Information Object;
- Reusable Learning Object;
- Unit of Learning;
- Unit of Study.

### 3. Different Types of Digital Content

The diagram below gives a general classification of the different types of digital content within the context of teaching and learning. This classification provides some measure of significance each component has for the practitioners/users.

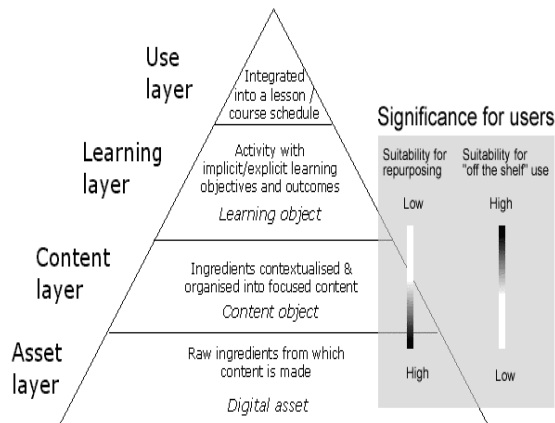


Figure 1 – Digital Content Classification Model [3]

The general understanding is that there is no simple definition for “digital content”. However, for the purpose of developing a framework, a classification of characteristics of the “digital content” will suffice.

#### 3.1 Classification Table

Based on Figure 1 above, we can identify the characteristics of the various classification of the “digital content”:

	Context	Learning Objective	Activity /task	Guidance (sequencing, Feedback)	Related to quality aim
1					
2	√				
3	√	√	√		
4	√	√	√	√	√

Table 1. Characteristics Classification Table (Legend: 1 – Asset Level; 2 – Content Level; 3 – Learning Level; 4 – Use Level)

With such a classification table, we can have the following correlation based on the CISCO’s RLO/RIO strategy. (RLO – Reusable Learning Object; RIO – Reusable Information Object):

Layer name	Purpose	Correlation to CISCO’s RLO/RIO
Asset Layer	<u>Digital Asset</u> – raw ingredients from which content is made	Asset
Content Layer	<u>Content Object</u> Ingredients contextualized & organized into focused content	Reusable Information Object (RIO)
Learning Layer	<u>Learning Object</u> Activity with implicit/explicit learning objectives & outcomes	Reusable Learning Object (RLO)
Use Layer	Integrated into a lesson / course schedule	Lesson

Table 2 – Correlation with the CISCO’s RLO/RIO Strategy

Within the **Asset layer** the object is free of context and has infinite uses. This means that it can be used within many learning

activities in order to achieve many learning outcomes.

However, an object within the **Learning layer** has fixed learning objectives and has a unique purpose. The area allocated for each layer is an approximate representation of the metadata (known also as labels) required to identify it.

### 3.2 Content Ecosystem

The content ecosystem maps out the range of the different digital content starting from the small content assets to learning objects and finally to the learning environment. As shown in Figure 2 below, two important factors that determine the granularity of digital learning objects are the context and the reusability. Whilst the small content assets can be shared widely, however, the context of its usage is limited. On the other hand, a learning environment will be ranked very high in terms of the context but its reusability will be very low. The optimal point is somewhere in between. This is where the learning object, with a learning objective for the content, some practice and a final assessment will be a suitable type of granular learning object that teachers should aim to design and develop.

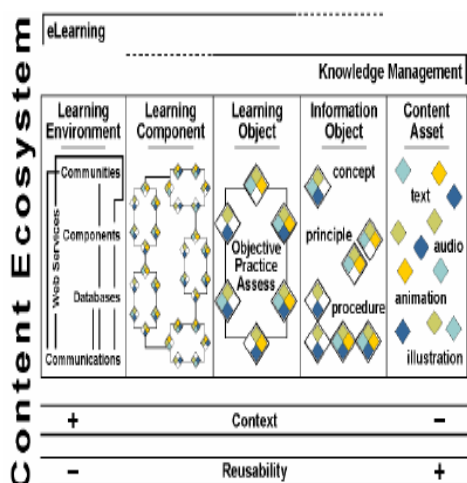


Figure 2 – Content Ecosystem

The content model compares very well with the CISCO’s RLO/RIO Strategy:

S/No.	Reusablelearning.org’s Content Model	CISCO’s RLO/RIO Strategy
1	Learning Environment	Course
2	Learning Component	Module
3	Learning Object	Lesson (RLO)
4	Information Object	Topic (RIO)
5	Content Asset	Screen/ Page Asset/ Element

Table 3 – Comparison of content models from Reusablelearning.org and CISCO’s RLO/RIO Strategy

### 3.3 Defining the “content” in “digital content”

Dr. Ruth Clark (1999) has categorized the content of an e-lesson into concepts, facts, processes, procedures and principles.

Content Type	Definition	Example
Concept	A category that includes multiple examples	Democracy
Fact	Specific & unique data or instance	William Shakespeare wrote Hamlet
Process	A flow of events or activities	Photosynthesis
Procedure	Task performed with step-by-step actions	Chemical titration
Principle	Task performed by adapting guidelines	Principle of Archimedes

Table 4 – Clark’s five types of content

### 3.4 4 Architectures of Online Learning

Dr. Clark has also introduced the 4 architectures of online learning. These are the receptive, the directed, the guided

discovery and the exploratory ways of online learning.

Receptive:

- Fixed-paced linear disclosure of the learning experience with limited learner control;
- Examples: listening to a lecture; watching a video; multimedia-based product course that describes the benefits and features of the Iridium satellite-delivered telephone system built by Motorola;
- Absorbs knowledge of skills without questioning;
- Lack of externally prompted interaction.

Directed:

- Characterized by short lessons that includes rules or definitions, examples, and practice exercises;
- Lessons are generally sequenced starting with easier or prerequisite skills, and build gradually to more complex skills;
- Frequent questions with feedback are provided to build patterns of correct associations;
- Used in early computer-based training (CBT);
- Example: Online learning on a telephone system: Learners are guided step by step to take the correct actions to answer, transfer, and end telephone calls. If they make a mistake, corrective feedback is given—followed by an opportunity to try again.

Guided Discovery:

- Example: A multimedia course designed to teach a company’s purchasing agents various cost-accounting techniques;

- Learners are provided the case study on their computer and they have numerous sources of help—including web sites, reference books, and video conferences with suppliers and experts;
- Learners are situated at their work sites with access to typical work tools such as sources for case information and for assistance.

Exploratory:

- Little or no control over learners because they are free to find information and training resources within the learning environment to meet their specific needs;
- The advent of the World Wide Web (WWW) has given impetus to architectures that are highly learner controlled. The learner is free to access diverse repositories of information that can include demonstrations, examples, and practice exercises. The role of instruction is to provide a rich layered or networked resource of information and effective navigational and orientation interfaces so learners can acquire the knowledge they need.

**3.5 Interactivity & Engagement in Digital Content**

In discussing the design and development of digital content, many people have come across terms like the interactivity of the digital content. However, many courseware designers and developers may interpret the term “interactive” in various ways as applied to educational courseware. In this Framework, we propose using a simple scale known as the Guerra Scale. The Guerra Scale is a scale developed by Tim Guerra and Dan Heffernan. The scale outlines the range of online content from one

to ten. The number “one” involves the common experience of simply reading text on a screen and “ten” represents a virtual reality scenario.

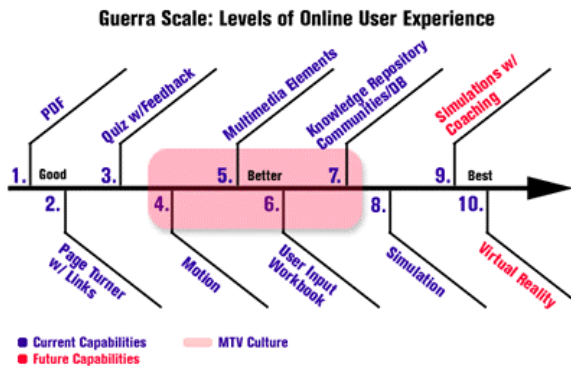


Figure 3 – The Guerra Scale on Interactivity

The table below gives examples on the use of this Guerra Scale:

Guerra Scale	Example
1	PDF document
2	Page turner
3	Dynamic feedback to tests, quizzes
4	Movement on text and graphics
5	Multimedia elements – audio & static or moving graphics
6	User Input Workbook
7	Knowledge Repository Communities
8	Simulation
9	Real life coaching
10	Virtual Reality

Table 5 – Examples of the Guerra Scale

#### 4. Model for Aggregation of Digital Learning Objects

##### 4.1 Hierarchy for Content Aggregation

The diagram below represents the proposed model for content aggregation:

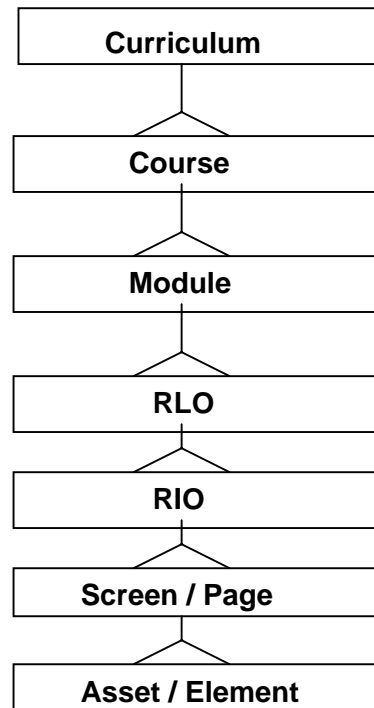


Figure 4 – Content Aggregation

##### Examples:

- Curriculum – The curriculum for Secondary 3 (Normal Stream);
- Course – The Mathematics course for the Secondary 3 (Normal Stream) Curriculum;
- Module – The Module on Algebra in the Mathematics Course for Secondary 3 (Normal Stream) Curriculum;
- Lesson – The Lesson on Polynomial Equations in the Algebra Module of the Mathematics Course for Secondary 3 (Normal Stream) Curriculum;
- Topic – The Topic on Solving Quadratic Equations in the Polynomial Equations Lesson of the Algebra Module of the Mathematics course of the Secondary 3 (Normal Stream) Curriculum;
- Granular object – This can be a

screen showing the MathML (Mathematical Markup Language) representation of a quadratic equation.

#### 4.2 Representative Learning Object Templates

- a. CISCO's RLO/RIO Strategy
- b. Adobe's Learning Object Approach
- c. NETg's Learning Object

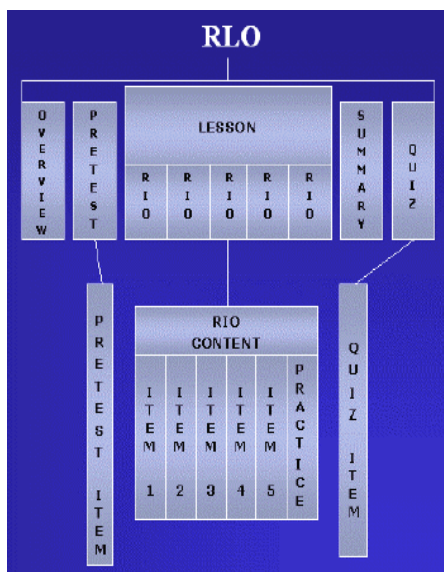


Figure 5 – CISCO's RLO/RIO Structure

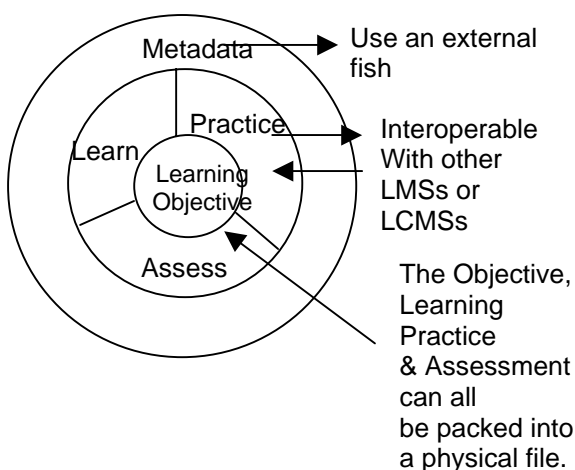


Figure 6. Adobe's (Macromedia's) Learning Object Model

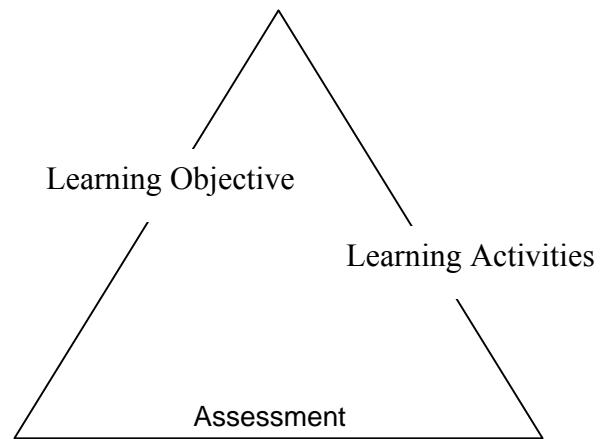


Figure 7 – NETg's Learning Object Model

#### 5. Evaluation of Digital Content

Digital content are evaluated in two distinct ways:

- a. Learning objects are evaluated as individual tools to determine if the learning object is a quality learning tool.
- b. The instruction in which the learning object has been embedded is evaluated to determine the effectiveness of the learning outcomes using the learning object.

There are many different models which can be used to evaluate digital content, e.g. the evaluation systems used in **MERLOT** (Multimedia Educational Resource for Learning and Online Teaching, <http://www.merlot.org>), **CLOE** (Cooperative Learning Object Exchange, <http://cloe.on.ca>) and the rating system used in **WISC-ONLINE** (<http://www.wisc-online.com>).

A simple yet comprehensive evaluation is proposed in our Digital Content Framework:

S/No.	Review Item	Yes	No
1	Is the learning object appealing overall?		
2	Is the experience of using the learning object a pleasant one?		
3	Are the technical requirements easily understood and easily met?		
4	Is it easy to find your way around the learning object		
5	Is the content complete and correct?		
6	Are the activities appropriate to the content?		
7	Is the scope of the learning object suitable: neither too limited nor too general for your purposes?		
8	Does it mean the educational goal you decided upon?		

Table 6 – Simplified Evaluation Checklist

## 6. Summary

This Digital Content Framework deals with four major aspects: the meaning of “digital content”, design models of the “digital content”, development models for “digital content” and the evaluation of “digital content”. With this Framework in place, we believe we can elevate eLearning to a higher level and not deal with the design, development and evaluation of “digital content” in an ad hoc manner.

## References

- [1] <http://dictionary.cambridge.org>
- [2] McGreal, Rory, et al. (2004) *Online Education Using Learning Objects*. RoutledgeFalmer, ISBN 0-415-33512-4
- [3] Technology for eLearning, <http://ferl.qia.org.uk/display.cfm?page=307>