Flexible E-Content

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Abstract:

E-Content and learning objects promise reuse, accessibility, interoperability, scalability, and affordability. Issues such as intellectual property, decontextualization, technological barriers, standards and specifications not supporting reuse, and quality have prevented the realization of these principles. This paper argues that Flexible EContent whereby intellectual property rights is articulated, and technical barriers removed through the use of tools, standards and specifications that support repurposing, can lead to reuse. Analyzing the results of several case studies the technical and intellectual property conditions for reuse are articulated and examples from industry are provided.
Background
Technical, structural, cultural and linguistic challenges, as well as issues of accessibility, pedagogy and quality, frequently constrain the flexibility of design and development of e-content. The need for modular e-content that can be shared among and between different end-users is being driven by the ubiquity of digital content, as well as efforts to continue development of e-resources while reducing costs. The promise in which reuse may reduce duplication of effort, increase accessibility, reusability, interoperability, flexibility, durability, and scalability and provide cost savings is still largely unrealized by content object approaches (Wiley, 2004). Wiley, Recker, and Gibbons (2000) argue that removing the context from learning resources to create learning objects, decontextualizing the media, produces objects that are actually more costly and difficult to reuse. The standards and specifications developed and implemented to date can actually limit the potential for object reuse (Wiley, 2002).

Wayne Hodgin’s Content Object Model (Figure 1) argues that increasing context reduces reusability. Flexible E-Content should make it possible to keep the reusability potential high while increasing context (Wiley, 2004).

![Figure 1 - Wayne Hodgin's Content Object Model](image)

Defining the different elements of reuse will help to clarify the development strategies required to provide cost savings, sustainability and the extension of the application of content objects.

Three Types of Reuse

Sharing
Sharing assumes e-content requires no changes to technology, content, or appearance. The sharing of e-content, for example, has been defined by the Advanced Distributed Learning (ADL) initiative in the Sharable Content Object Reference Model (SCORM) specification (www.adlnet.org). Learning object compliance with the SCORM standard ensures that learning objects can easily be shared between systems.
The challenge of sharing digital content without adaptation or customization is that few learning programs share the same audience characteristics, learning objective, or delivery systems, and fewer still operate under the same technical requirements. The sharing of learning objects in their original format, without any adaptation is primarily limited by technical factors such as:

- Delivery Platform (CD-ROM to Web, Web to Personal Digital Assistant)
- Performance Changes (increase in bandwidth, decrease in bandwidth, increase in processor speed)
- Display Changes (i.e. increase or decrease in screen resolution)
- Operating System Changes
- Browser Changes
- Proprietary Formats

**Multipurposing**

In a 1993 Wired Magazine column, Nicholas Negroponte expressed a need for the automatic transcoding of digital content from one medium to another. Whether automatic or manual, the transcoding of e-content can be referred as multipurposing.

The potential for information objects to be multipurposed is limited by the granularity of the objects, as well as content and curricular factors. The latter may include:

- Cultural differences
- Accessibility
- Regionalization (spelling, product names)
- Language
- Discipline

**Repurposing**

In Negroponte’s 1993 article, he also addresses the need to customize, add, delete, edit, change and enhance content – repurposing (Negroponte, 1993). In the case of web-based learning objects, context is often the most important factor in the design of educational experience. Often it is the learning design, not the content itself, that is critical when working with new educational media. The context, or learning design, may be called the pedagogical wrapper that justifies a digital asset being called educational.

The repurposing of learning objects through adaptation or enhancement is significantly limited by contextual or environmental factors. These include

- Age and other audience characteristics
- Learning Theory
- Venue (i.e. museum, classroom, web)
- Intended educational experience (i.e. structured learning, self-directed, information)
- Jurisdiction
- Expectations of delivery platform.

**Flexible E-Content Model**

The forces driving change in e-content necessitate a more flexible approach to the design and development of e-content. Flexible e-content should be designed to allow responses, including dynamic responses to the change forces acting on content. Flexible EContent (Figure 2) should allow creators to not only reuse the e-content, but to multipurpose its components where possible.

Developing flexible e-content in a way that would not only allow sharing, but promote repurposing, will provide further cost savings and opportunities to enhance, sustain and extend the content and the associated infrastructure (Hartnett, 2002; Doerksen, 2002; Wiley, 2000). The Flexible E-Content Model is a high level blueprint for tool developers and content creators to help realize these potential cost savings.

The Flexible E-Content Model attempts to illustrate that by using a layered, or composite approach to the design and development of flexible e-content, the key components are accessible to promote all types of
reuse; reuse of components and of the aggregation of those components. The result is flexible e-content. The layers include:

**Context**

Context is key in order to enable reuse. A subtle change in context can have a profound impact on the flexibility of e-content. Context may be seen as the sequencing, relationships, user preferences, learning styles, reading level, language, and logic of the content in a program. The context could enable different rules of accessibility to be applied to content.

Context can be seen as the environment or social context for e-content. There are some good examples of existing technologies that support the reuse and transformation of context. These include Cascading Style Sheets (CSS), eXtensible Mark-up Language (XML), XSLT, Resource Description Framework (RDF), IMS Learning Design, and XML User interface Language (XUL).

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**Metadata**

Storing metadata as a layer of flexible e-content will promote the ability to add the e-content to other delivery systems, for example digital libraries, digital archives, learning object repositories, learning management systems and so on. Reuse potential is increased with the inclusion of license information within the metadata.

**Media**

Ensuring that media, including text, graphics, video, audio, animations, simulations, and other media types, is uncoupled from other layers is fundamental. This allows easy updates, changes, and re-optimization for different or emerging delivery platforms. The need for a source file to allow transcoding is key to reuse.
Striving for a media format that can automatically transcode to accommodate different delivery environments will greatly enhance the flexibility of e-content.

User Interface
User Interface (UI) refers to the means by which a user interacts with e-content. The UI may differ depending on the requirements of different delivery systems, e.g. cellular telephones, personal computers, computer kiosks, voice recognition, screen readers, joysticks, cameras, haptic devices, augmented reality, as well as future media. Each interface will have specific input and output methods. The opportunity to access other technology layers (code, context, media, metadata) will allow users and developers greater potential for reuse according to a given user interface.

Code Libraries
Reusable code libraries contain the code and functionality, and may dictate the platform in which the content, media, and GUI are delivered and displayed. This code can present the sequence established by the context, respond to user interaction, manage access, and display the program. Having programmatic code separate from other layers not only allows reuse of code libraries, but supports use of different code libraries to add on other layers. The latter will be significant in overcoming the technical factors driving reuse such as changes in technology and platform differences.

Methodology
The Flexible E-Content Project was a 10-month research and development project focusing on the technical and pedagogical issues surrounding the reuse of digital content. The Project focused on models of reuse for digital content within and across communities of practice with project participants bringing expertise from various disciplines from across Canada. This project encouraged the sharing of e-content, collaboration between groups producing innovative e-content, the development of new technologies and end user applications.

As many as 13 participants from across Canada and one in the United States, started the project with the idea of reusing each other’s content. The participants included universities, a college, school boards, non-government organizations, museums, and private sector companies. Participants presented their organization’s available content in a face-to-face meeting about 1-month into the project. A repository of content links was created from these meetings. A Sharing Matrix was then created by taking those participants interested in reusing another participants content. Each interested participant then filled out an IP Matrix which expressed the content they were interested in and the type of usage (educational/non-educational/commercial) and type of reuse (sharing, multipurposing, repurposing). The participants where then encouraged to create a creative commons licence and formally request permission for reuse. Then the reused content and any new intellectual property was to be developed, properly attributed with a licence, made available to the new audience, and evaluated.

Results
Following the content reuse process, six content reuse projects resulted from an initial fourteen pieces of digital content presented by participants for reuse. The eight available content were not pursued due to various reasons. These included model of exchange, intellectual property, and/or technology. In the majority of cases where content was presented and not reused, the equity of the exchange in real or perceived value between participants was not significant enough to continue to pursue reuse. A related issue of intellectual property constraining reuse, mostly due to lack of clarity, closed the door on possible reuse scenarios for participants.

The six content that were successfully reused also suffered from the lack of value propositions between partners and lack of clarity or intellectual property, but given quality of content or motivation of participant, or both, these issues were ultimately resolved resulting in six case studies in the reuse of digital content. These case studies can be found at www.flexec.ca website. Five of six of the reused content was repurposed and the other was multipurposed from one streaming video format to another.
The technical considerations surrounding the reuse of the content were then captured in the FlexEC Guidelines as recommendations for developing flexible e-content that supports sharing, multipurposing, and repurposing. The full set of guidelines is available on the [www.flexec.ca](http://www.flexec.ca) website, below is a summary of the recommendations and examples provided in the full guidelines.

### Summary and Recommendations

The fundamentals behind the flexible e-content model, as outlined above, can be based on more detailed, specific criteria. It should also be recognized that few or no content development or media development tools known to the authors support the Flexible E-Content Model proposed or all the criteria summarized below. However, as the industry continues to evolve there are many tools and techniques emerging that are leading the way in demonstrating the possibilities of flexible e-content.

The specific criteria and examples summarized below represent eight requirements considerations for flexible e-content and include considerations within scope of the Flexible E-Content Project. The detailed descriptions and review for each of the guidelines is beyond the scope of this paper. For more information on each of the requirements considerations refer to the full set of guidelines (downloadable at www.flexec.ca).

1. Media production techniques support multipurposing and repurposing  
   *Example: Adobe Photoshop*
2. Metadata: Distributed or Embedded or Both  
   *Example: Adobe Photoshop*
3. Inclusion of IP License  
   *Example: Adobe Photoshop, Creative Commons*
4. Externally Controlled Intra-Object Navigation  
   *Example: SMIL*
5. Support for Standards and Specifications such as:  
   *Examples: CSS, IEEE LOM Metadata, IMS Content Package, IMS Learner Information Package Accessibility for LIP (ACCLIP) specification, MPEG-4, MPEG-7, IMS Learning Design*
6. Reusable code libraries  
   *Example: Concurrent Version System (CVS)*  
7. Externally “Articulated” Learning Designs or User/Learner Profiles  
   *Examples: IMS ACCLIP, IMS Learning Design*
8. Externally Controlled User Interface/Presentation  
   *Examples: QuickTime, Windows Media Player, CSS*

There is much further work to be done to improve support for the sustainability, design and development of flexible e-content. Awareness and adoption of standards and specifications by users, tool developers, and others is a first step toward meeting goals for reuse. Given the state of the e-content industry today, what are some key principles that can be taken away from the discussion above? In other words, what can be done to design and develop e-content?

1. Separate context, media, user interfaces, code, and metadata.
2. Develop media with reuse in mind and use sound media production techniques (e.g. save source files).
3. Articulate the Intellectual Property clearly and reasonably.
4. Use and purchase tools that support:  
   - the export of metadata (e.g. XMP support);  
   - well-known metadata standard;  
   - Cascading Style Sheets (CSS);  
   - XUL;  
   - Learning Design;  
   - ACCLIP;  
   - Reusable Code Libraries;
• SMIL;
• MPEG-4 (not just the video codec);
• MPEG-7 (asking for it even when you know it is not available can help drive developers);
• XML, XSL, and XHTML;
• Accessibility; and
• Content Packaging.

In addition to the specific recommendations above, there are also other, more general, things that the community can do to achieve flexible e-content and as a result provide more content overall. These include:
• getting involved in the standards and specifications working groups;
• urging that different jurisdictions and governments work together strategically to solve intellectual property, quality; and technical issues;
• letting tool developers know that purchase decisions will demand support for standards that support flexible e-content;
• working towards sustainable models for content reuse.
References


