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Best practices in digital object development for education: Promoting excellence and innovation in instructional quality and assessment

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Abstract

A program of development of online learning resources should provide content, resources, support and activities to promote excellence and innovation in instructional quality and assessment. This article provides details on five best practices in digital object development for teaching and learning. In addition, an evaluation of the learning object development programs with a view toward the ultimate impact on student perception and success is evaluated. There is evidence provided by digital object researchers that digital object development is effective in the education setting.

Introduction

Digital objects are objects that are edible (continuously modified), interactive (offer alternate pathways for users to activate or explore functions embedded in the object), open and reprogrammable (accessible and modified by another digital object), and distributed (information components delivered via information infrastructures and the Internet) (Hui, 2012). The success of development programs depends upon the design and development of the digital objects. These objects must be developed in a way that will benefit the developer (instructional designer), administrator (teacher, trainer), and user (company, organisation, education) (Beaudrie & Boschmans, 2013). The developer must follow a set of guidelines to build the digital objects. With the development of each new object, the process becomes easier and the development time decreases, thereby allowing the developer to build more digital objects and receive more finances (Carmichael & Burchmore, 2010). A well-developed digital object allows teachers to successfully incorporate it into an instruction set in the proper context, without first determining if the object will enhance the curriculum. Most importantly, the user or student benefits from the well-developed digital object through increased knowledge of a specific instruction set. Therefore, it is essential that digital objects be developed using best practices or principles (Kott, 2012).

The goal of this paper is to identify best practices for the development of digital learning objects for teaching and learning. Next, the role of each best practice will be discussed in addition to how it will benefit the development process.

Best practices for digital object development

Digital object development plays an important role in today's society, with majority of it occurring in education (Hui, 2012). Specifically, American education integrates learning objects into curricula on a daily basis. Along with the development of digital learning objects, social, cultural, and ethical issues must also be considered.

The majority of digital learning objects for education are developed within the United States. For example, because of trade restrictions, digital learning objects developed in certain countries cannot be used in others (Murray-Lasso, 1990). For example, an American software company could not comply with the Mexican government's restrictions. As a result, there is no means of installing US-developed software in Mexico.

Language is an important constraint on educational software. Digital learning objects must be developed in a variety of languages, to address the diverse populations of education. If teachers and students do not understand the learning object, then it is of no value to them. In addition, the instructional designer must consider cultures preferring writing over speaking and vice versa (Dunbar, 1991). There may be students who prefer learning objects with audio and some who do not.

Another aspect of digital object development to consider is curricula. For example, different countries and cultures emphasise different content areas within mathematics. One culture may focus on theory, while another emphasises application (Dunbar, 1991).

Digital objects developers must also consider the pedagogical approach. Learning styles used in online exercises may differ across countries or cultures (Murray-Lasso, 1990). For example, one may teach conceptual and intuitive aspects of mathematics, while another may teach rote-fashion mathematics. Therefore, a combination of learning styles (pedagogical approaches) is recommended when developing the learning object (University of Illinois, 2015).

Social, cultural, and ethical issues are very important aspects to consider in the development of digital objects in American education. While these are specific to any culture, there are general best practices used in the development of all digital objects, regardless of cultural, social, or ethical issues.

Although there are no specific guidelines for instructional designers on planning, designing, and developing digital objects, several authors in the literature have developed some to aid in the development process. These guidelines (best practices) suggest how to provide adequate but general content, determine the level of detail of each digital object and format and store them for future use (Kott, 2012). Several authors agree on five best practices for developing digital objects: granularity, formatting standards, stand-alone capabilities, composition and stylistic approach, and creation of metadata and tags (Kott, 2012).

Granularity of Digital Objects

The details level or granularity of a digital object is a critical factor that determines its reusability. Ideally, a digital learning object should include no more than four related ideas (University of Illinois, 2015). The instructional designer must determine how many topics are stand-alone or reusable in a different context. A digital object consisting of more than one idea should have one main idea. Other ideas should be derived from or dependent upon the main one. If the content depth of the digital object is ascertained by the idea or concept, then it is not subject to the opinions of an individual's choice of instructions or methodologies (Matthews, Hin & Choo, 2014).

Currently there are no standards for verifying the details depth of digital objects. However, Iverson suggests it remain small for potential reuse (2013). Hui (2012) adds the need to foster a competency-based learning approach that is also adaptive in nature. In addition, Graham (2013) suggests that a digital object's content level should be based upon a meaningful separation of learning that can be completed by a student in an ongoing effort; allowing learning to take place in one sitting.

Flexibility is a major issue that depends upon the details of the digital object. If it is small, then it can be used in multiple contexts. For example, one type of learning may require concepts to be presented first, followed by problems. Conversely, another application may present the problems first, then concepts (University of Illinois, 2015).

There are several factors aiding instructional designers in determining the content depth of digital objects, including the instructional formatting used to create the content and delivery system. Specific usability requirements may influence decisions regarding content (Hui, 2012). There are more generic objects developed, where the primary goal is sharing and reusability. This may result in profits being a primary concern. As a result, minimal digital object content variations support maximum reuse 2012).

Formatting standards for Digital Objects

Proper formatting of digital objects ensures quality, uniform, and understandable pedagogical strategy. Good formatting techniques ensures digital objects are frequently used, as instructional designers easily accept these for creation of other objects.

Digital objects should follow a standard format. Several instructional design books explain how to tailor what is being taught to instructional strategies. This format includes a broad, comprehensive view of the task or activity, identifying the steps of the activity, overseeing the users (students) as they show mastery of each step, demonstrating how to integrate all steps of the activity, and providing systematic practice to the application.

The technical specifications address interoperability and the physical structure of the digital object to easily manipulate elements (Kott, 2012). Objects should be developed for all operating systems and delivery media. XML is the ideal language to use (NISO, 2007). It is a metalanguage written in SGML, which allows one to design a markup language for easy document exchange across the Internet. Presentation and content, and structure separation are the foundational logic behind XML, which allow the flexibility required to control and put digital objects into action (Oorschot, 2012).

Issues concerning digital object formatting must be solved before being used in school environments. These environments are quite new to using digital objects in the curriculum. Formatting issues, such as the operating systems or instructional strategies that enhance learning types must be considered and structured correctly, to lessen frustration for teachers and students. Selecting instructional strategies have been shown to enhance different learning styles.

Stand-alone capabilities of Digital Objects

All digital objects should be independent of other objects or activities in order to properly function in a curriculum. Objects must have organised knowledge elements and allow guidance and feedback for students (Wiley, 2001). In order to contain the aforementioned factors, digital objects must be created using generic information. Instructional context comes from assembling objects into an instructional sequence. Longmire (2000) suggested the following guidelines for designing stand-alone objects. First, use correct content and language for all appropriate audiences. More audience-specific information can be added, if desired, once the instructional designer assembles the object into the instructional context (Longmire, 2000). Next, the object content must be similar in nature to the content of a typical lesson. The objective is to create instruction and not merely information (Instructional Designs, 2013). Then, each digital object must not cause confusion between other unrelated topics (Iverson, 2013). Finally, individual objectives must be satisfied by the development of content (Longmire, 2000).

Primary and secondary school students are a prime reason why digital objects are developed to be stand-alone. It is best for students to learn content, one objective at a time, since their minds have not developed enough to retain large chunks of information at one time. Stand-alone digital objects are developed in a generalised manner, so that teachers can reuse the object in different learning contexts. Students or any learner retains information as a result of practice or, for this purpose, reusing digital objects.

Composition and stylistic approach of Digital Objects

Composition and style play a vital role in whether a digital object will hold the interest of the user. Once the composition is discovered, the style of the object can be designed. The composition includes the elements of the object, whereas the style is the appearance.

The composition of a digital object consists of elements such as text, image, multimedia, video, glossary, and assessment. A digital object should consist of a combination of multiple elements, to reinforce the communicated concept. It also provides more than one way to foster understanding of the represented idea(s). This facilitates learning based on learners' characteristics and choices (Giaretta, 2011).

The presentation of digital objects is based upon style and appearance. Specifications are determined by instructional designers/developers image layout, font, colour, and text (Beaudrie & Boschmans, 2013). The combination of these structural elements should be consistent throughout the digital object. XML is known for separating appearance, content, and structure. As a result, subject matter experts (SME) can exclude the stylistic approaches. Since XML is flexible, different content can use the same style sheets without additional development (Wiley, 2001). Each style sheet can be edited without affecting or making changes to the other. An ideal situation would be to develop user-controlled stylistic environments and several interfaces. The most suitable forms of exploring and interacting with the knowledge and interacting is then chosen by the user for maximum effectiveness and benefit.

Style and composition are two factors of digital object development that will grasp the attention of students. The more colourful and exciting the object appears to be, the longer a student will want to work on the activity. Although all internal features and technical aspects of developing a digital object are vital, style and composition become equally important in the development stage, to make it an enjoyable learning experience for students.

Metadata and tags for Digital Objects

A good digital object has and is associated with metadata. All good objects have administrative and descriptive metadata (Kott, 2012). Administrative metadata provides information that manages a resource, such as who can access it or technical information such as file type (Graham, 2013). Descriptive metadata describes a resource for purposes such as identification and discovery. It includes elements such as title, author, and keywords (2013). Metadata must provide descriptive information about the object. It is considered to be structured data describing the content. Metadata file creation is known as tagging. Once created, the metadata file is placed within a repository or specific storage (Longmire, 2000).

Metadata is valuable for the discovery of existing content in a content repository. Instructional designers use metadata to search for existing learning objects. In addition, they write metadata for newly-created objects. Users can understand what a learning object is without seeing it. This is done by completing fields in the metadata file. Eventually, high-quality metadata may be required to assemble objects used by learning management systems to adapt the material to the needs of the learner (Coyle, 2010). Below is a summarised list of guidelines related to the use and development of metadata:

- If an instructional designer creates his/her own metadata scheme for internal use, develop a set of tags that are not very big. Tagging and cataloguing is the greatest expense and delay in developing objects (Coyle, 2010).

- Object hierarchy should be represented using a language such as XML. As a result, a tagging system can be used to structure online course object components. (Iverson, 2013).

- Constantly evolving trainings should not use metadata schemes (also called schema). By the time the metadata schema are built and tagged, they may be obsolete (Schwartz, 2000).

- Create content objects as interactions stored in databases, and representations of instruction (Iverson, 2013).

- Create the metadata to describe the learning object. The metadata should describe the object's teaching objectives, use requirements, and content (2013).

- Best practices in digital object development demonstrate how detailed development process is. Many organizations such as universities use these strategies to create effective learning activities for students.

Conclusion

Digital objects used in settings are appropriately defined as any digital resource that can be reused to provide learning support (Wiley, 2000). Developing these objects require careful consideration of specific instruction as well as curricula. Several best practices for the development of these objects include granularity, formatting standards, stand-alone capabilities, composition and stylistic approach, and metadata creation (Giaretta, 2011; Kott, 2012). Granularity addresses the amount of detail within the object. It should neither be too vague or specific to function as a learning activity. Formatting standards deal with the object's compatibility for all operating systems. Stand-alone capabilities deal with the inclusion of all development features needed for the object to be an independent learning activity. Composition and stylistic approach addresses the learning object's appearance to the student. Metadata creation addresses the description of the digital object content. This information should provide the user an overview of what the digital object is about (Giaretta, 2011; Kott, 2012). These practices combine to form a digital object composed of all necessary components – content, resources, support and activities.

As more educational organisations develop and use digital learning activities, the more common technology integration and online learning will become in education. This technology exposure will increase student knowledge in several different subject areas. As a result of using best practices, digital objects become measurable, notably successful or effective with the intended audience, and, in some cases, replicable. Formatting, composition and stylistic approach, and stand-alone capabilities are clear practices that produce solid goals, and the progress towards them can be measured for creditability and validity (Community Tool Box, 2015). These guidelines have been evaluated and applied to digital object development by many instructional designers. The methods are more successful than other similar practices because they not only yield good results but also make progress towards achieving good digital object development and maintenance processes (Graham, 2012). In addition, these practices have been well documented, to reproduce operative digital objects in other settings.

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