

# Context for Content: Shaping Learning Objects and Modeling a Domain Ontology from the Teacher's Perspective

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## ABSTRACT

This paper describes an ongoing research project that involves the study of teachers' information seeking behaviors, needs and practices in relation to a collection of primary source materials available through the UNC Library's digital library *Documenting the American South* (DocSouth). By gaining an in-depth understanding of the needs and wants of teachers in the context of their work, we hope to build a collection of learning objects and a domain ontology that not only facilitate teachers' access to the cultural heritage materials, but their actual use in the classroom.

## Categories and Subject Descriptors

H.3.7 Digital Libraries – User issues.

## General Terms

Documentation, Design.

## Keywords

Context of use, Digital libraries, Learning Objects, Ontologies.

## 1. INTRODUCTION

"...digital libraries should exist not just as collections of resources, but also as sensemaking tools that help those resources to life." [1].

This paper describes on an ongoing research project that involves the study of teachers' information seeking behaviors, needs and practices when accessing collections of digital learning materials for use in the classroom. Gaining an in-depth understanding of the needs and wants of library users is key to building better digital libraries and library services. This study focuses on a specific segment of digital library users, secondary school teachers. It concentrates on their information seeking goals when searching for digital primary source materials that support their teaching and learning activities. The purpose of gathering data of this kind is to take a more user-centered approach to the design and development of a collection of learning objects and to ground

the construction of an ontology intended to support the indexing and retrieval of the collection into the teachers' semantic context.

## 2. BACKGROUND

Rich collections of cultural heritage materials are being digitized and made available in massive quantities. "What can we do with million books?" Crane recently asked referring to the exponential growth of digital library materials, not to mention projects such as *Google Library* [2]. Beyond the sheer magnitude of digital content openly accessible, it is important to recognize the wide range of uses that digital libraries support, as well as the number of user communities that may benefit from their resources. Cultural institutions have only recently begun to purpose and customize their digital collections for specific uses and user communities, yet it is not clear how much customization is based on speculation or prescription and how much is based on users' expressed needs.

Educators at all levels represent a growing and increasingly essential community of digital library users. Repurposing the digital assets of library collections for educational use is a challenge that builders of digital libraries have only recently begun to address. Borgman points out the contrast between the limited number of tools and services available to support educators in their teaching with the richness of digital primary source materials [3]. To date, relatively little is known about how teachers actually search for materials or how they would like to use the digital objects they find. The need to better understand how educators seek, select, and use digital materials is essential. Beyond information seeking behavior, the more that is known about the teaching and learning needs and practices of this community the better libraries can design and develop appropriate services and tools [4].

Toward this end, a user-centered approach has been adopted by the *Documenting the American South* (DocSouth) digital library (<http://docsouth.unc.edu/>). DocSouth provides access to digitized

primary source materials related to U.S. Southern history, literature, and culture. The DocSouth collections include works of Southern literature, slave narratives, public documents, diaries, photographs, oral history interviews, artifacts, and more. Launched in 1996, DocSouth has grown into a successful and well-established electronic publishing initiative with over 175,000 pages of content. Originally intended to serve researchers of the American South, DocSouth has actually been accessed and used by a broad international audience made up of educators, genealogists, amateur historians, and other lifelong learners [5]. As a public institution of higher education, the educational community represents a particularly important audience for DocSouth and is therefore at the center of a series of qualitative studies intended to gain feedback on the current use of the collections as well as to guide new directions for accessing and using this rich collection of cultural heritage materials.

A series of usability tests and focus groups involving secondary and higher education faculty identified areas where access and use of DocSouth for instruction was problematic (for details see [6]). The data from these qualitative user studies inspired two interrelated tracks of research and development activities: the creation of a collection of re-usable learning objects and the construction of an ontology to support the indexing, retrieval, and use of the collection.

### **3. SHAPING DOCSOUTH LEARNING OBJECTS FROM THE USERS' PERSPECTIVE**

Focus groups consisting primarily of secondary school social studies teachers have been conducted during the past three DocSouth Summer Institutes and have been used to gather feedback on how to customize DocSouth materials for educational purposes. The feedback has informed the design of a prototype collection of learning objects developed by the UNC Library's Instructional Services staff in collaboration with faculty and graduate students from the UNC School of Education.

Learning objects are defined by the IEEE LTSC [7] as "any entity, digital or non-digital, which can be used, re-used or referenced during technology supported learning." Such a broad definition implies that learning objects may come in a wide range of shapes and sizes as well as complexity of structure and density of content. The context of access and use of digital educational materials as described by the sample of teachers participating in the user studies has laid the groundwork for defining what functional requirements the learning objects should satisfy to suit the instructional needs of the teachers.

The intent behind the design of the learning objects was not to prescribe how the materials should be introduced or used in the classroom, but to make them as accessible, reusable, and interoperable as possible to complement and enhance traditional classroom teaching. Further testing of the prototype collection will occur at the 2006 DocSouth Teacher's Institute.

### **3.1 Use in Context**

Analyses of the user data collected to date indicate that contextual opportunities and constraints often determine the use or non-use of digital resources in the classroom. These conditions can be described as individual, institutional, and pedagogical.

A well-documented and compelling constraint teachers experience is the lack of time. Due to their intense workloads, teachers have limited time to prepare for their classes. Spending hours sifting through the mountain of digital materials available on the web is not a viable option. The amount and the size of the material can be overwhelming; especially when they need to factor in the level and time their students may have to work with the material. For digital libraries like DocSouth, initially designed for researchers, where comprehensiveness and detail are the goals, the sheer size and volume of the materials becomes useless to busy secondary teachers. For example, teachers indicated that the manuscripts and other text documents in DocSouth were too large to be used in the classroom. They expressed the need for pre-selected "key" segments or excerpts of the texts (not beyond 2 or 3 pages). Such comments helped to clarify the size and density of content the learning objects should have. This finding also led to the decisions to provide educators with objects of varying granularity. Prototypes range from highly granular (e.g. a single image or excerpt of text) to less granular, but still light-weight, loosely packaged combinations of instructional content.

Curricular standards, considered here to provide institutional context, have also helped shape the development of both the learning objects and the ontology. National and state teaching standards are the foundation upon which lessons and activities are prepared. School-based performance award programs put teachers under increasing pressure to "teach to the test" and to some extent limit their flexibility. Considered by the instructors as a challenge to educational quality, teachers from the focus groups pointed out how final testing has narrowed the curriculum content. With these teachers' concerns in mind, digital content appropriate for the collection of learning objects has been primarily based on the curriculum outlined in the North Carolina Standard Course of Study for 6-12 grades (<http://www.ncpublicschools.org/curriculum/>) and the National History Standards. Likewise, these state and national standards form the base of the domain ontology.

The trade-off between instructional contextualization and reusability is a hotly debated issue within the community of learning objects developers [8]. Learning objects that are highly tied to curriculum standards can serve specific audiences or learning objectives quite well, but their reuse for other audiences or other objectives may be limited. For example, a learning object aimed specifically at teaching 8<sup>th</sup> grade students about the causes of the Civil War may be ideal for an 8<sup>th</sup> grade social studies class but too simplistic or inadequate to be used in a college or university-level class on the Civil War. On the other

hand, if a learning object is not associated to a specific instructional context, it may not serve educators who have limited time to provide the necessary customization.

From a pedagogical perspective, teachers manifested interest in the ability to aggregate digitized historical objects through space and time, as well as from personal or familial perspectives. This would enable them to perform comparisons through spatial and temporal dimensions according to the guidelines derived from the curricular standards (e.g. Era 5, Standard 2B (5-12) of the National Standards for History: “Compare and contrast women’s homefront and battlefield roles in the Union and the Confederacy”).

Developing students’ historical thinking skills has become a major objective in current pedagogy and represents a serious challenge for teachers. The use of digital primary sources in the classroom is considered essential to engage students in learning activities that encourage critical thinking and diversity of points of view in defining the past [9]. Teachers highlighted the role that biographies and personal narratives have in stimulating students’ interest in history by relating content from the past to their lives. They pointed out the importance of visual resources, especially images and photographs, in helping them to make history relevant and engaging to today’s students. The directive to “Never walk into the classroom without a picture” can effectively “move students outside of their own time and place” [10]. Some teachers indicated the desire to incorporate not only more images, but also sound into their teaching. Others, however, noted the technical difficulties in using multimedia. For example, while digital recordings of oral histories are highly desirable, designers must consider the implications of file size and software requirements before assuming oral histories can easily be used in an instructional environment.

Of particular interest to this researcher was the assertion from the teachers that lesson plans broken down by grade level were less important than subject or topic access to a collection. Teachers asserted that they knew what their students were capable of handling, whether it was tenth graders performing at an eighth grade level or eighth graders performing at tenth grade level. No educational materials are used “off the shelf”. Instead, teachers customize whatever they find for the educational needs of their students [6]. This confirms what Artacho has said: “Learning is a process between teachers and students, and teachers tend to have their own view of learning and the way they use learning materials in class” [11].

This finding, and the others have guided initial decisions about how the objects should be structured and made accessible. In general, DocSouth learning objects will not be rigidly structured in packages of content that would limit the possibility of dynamic aggregation of content and will not have ascribed to them specific learning objectives or pedagogical properties and requirements. It is hoped that this will facilitate reusability of the

individual objects and flexibility of use across disciplines and in different instructional contexts.

#### **4. MODELING THE DOCSOUTH ONTOLOGY FROM THE USERS’ PERSPECTIVE**

One way to add context to learning objects without limiting their usability and re-usability is by assigning metadata relevant to specific communities of practices. This is the approach adopted for the DocSouth learning objects collection. Domain-specific metadata will describe the content of the learning objects enabling a more precise description. A step further will be to ground the metadata into a domain ontology as a way to enable more sophisticated search, aggregation, and navigation functionalities that better serve the information seeking needs of the community of educators and learners.

The user studies indicated that instructors often have difficulty locating materials that are appropriate for their courses. Teachers lamented the difficulty in constructing search queries. They shared a general dissatisfaction for keyword searching that, for example, does not allow contextualizing information. One teacher lamented that “if you pop in ‘slavery’ and maybe you want to know about the slavery in Jamestown as opposed to Civil War era slavery” it is too hard to locate relevant materials. Related to the search was the need to be able to quickly assess the content of the site. The teachers noted the importance of knowing what was *not* in the collection, as much as what was.

Teachers identified some of the weaknesses of the metadata and controlled vocabulary associated with the DocSouth collections (specifically, MARC and Library of Congress Subject Headings (LCSH)) in retrieving images and other types of resources from the collections [12]. For example, teachers consistently noted the importance of having geographic access to primary materials; yet the geographic place names used as subject descriptors of DocSouth resources failed to provide the level of detail they wanted. Other relevant knowledge such as biographical information that teachers considered key for active learning, was underrepresented throughout existing metadata.

This type of feedback reflected the need to address not only how the learning objects were constructed, but also how their content would be described, searched for and retrieved. This triggered the idea to investigate the potential that an ontology-driven approach could have in facilitating access to the learning objects.

The importance of ontologies has been recognized in a variety of research fields and application areas including digital libraries and, more recently, e-learning systems [13]. An ontology of the domain of North Carolina history of the 19<sup>th</sup> century designed for and applied to the DocSouth learning object collection may provide helpful functionalities to facilitate teachers’ access to

learning objects. First, the ontology can prove useful to overcome the limitations of subject access. The deployment of ontologies to structuring and defining the meaning of metadata terms and support rich semantic annotations of digital resources has been addressed as a key to advance information services including search and discovery [14, 15]. For example, the ontology enables concept-based searching that can improve precision of results far beyond common keyword matching. Moreover, the ontology could provide a framework to support teachers in contextualizing information. Ontology-based metadata describing domain-specific information about the objects' content may enable content aggregation in ways teachers have suggested as useful (e.g., by geographic locations, historical events, people roles) regardless the media types of the resource. This functionality may produce fluid combinations of text, image, and possibly sound which could trigger new instruction activities and address different learning styles.

If displayed on the search interface, the ontology has the potential to offer navigation support that would facilitate the seeking process of the teachers. "Think about the material as a concept map so that you can navigate the site as related ideas even if you don't know the collection" was one of the comments teachers expressed when asked to suggest ways to improve DocSouth. An ontology will indeed provide a conceptual structure that would reveal the topical coverage and organization of the collection (a way to understand what is and what is *not* there). This would facilitate search decisions and results selection. Moreover, the ontology vocabulary would provide terminology support during the search process for constructing search queries. For example, by suggesting concepts or terms for query formulation the ontology may reduce the cognitive load and the time required to come up with a relevant keyword.

While the ontology has the potential to offer various benefits to the teachers in supporting their information seeking process, it is a complex tool to build. First and foremost, the domain of history is open to a wide range of modeling options and formalization challenges due to the highly interpretative and unstructured nature of the historical content matter. Many different ontologies can be used to describe the knowledge domain of the collection of the learning objects and there is "no one correct way to model a domain" as Noy and McGuinness [16] assert. The approach adopted in this study is to ground the design of the ontology on users' requirements, a perspective little investigated in ontology engineering. Decisions about conceptual modeling of the DocSouth ontology will be informed by the input offered by the targeted community of users.

Toward this end, a series of in-depth interviews on a sample of 6-12 grade social studies teachers will be conducted in the upcoming months. These semi-structured interviews are intended to gather information on the teachers' perspective on the content domain they address in their teaching and their preferences in terms of access and use of the digital content provided by the learning objects. Concepts and strands of themes that teachers use and need when teaching North Carolina history as well as

content characteristics teachers consider relevant for accessing primary source materials will be valuable knowledge capital upon which to build the ontology. Answers to questions about how the dimension of time is best represented (i.e. events vs. dates) or what level of granularity is useful in describing geographical spaces (north and south vs. town and county) will be critical for the ontology developer.

Essentially, the ontology will try to capture the conceptual model of the teachers where pedagogical principles, instructional practices, and curricular standards shape and constrain the use of digital library content. Information gained from the teachers could be pivotal for identifying key ontological concepts, the vocabulary to express these concepts as well as types of relationships to be translated into search facets. Data collected from the interviews will be used to inform modeling decisions and guide the design of the ontology in ways that address the teachers' information requirements down to a granular level. It is believed that by adopting a user-centered approach, the DocSouth ontology has the potential to effectively support the seeking process of teachers of primary source materials for use in the classroom.

## 5. CONCLUSIONS

For digital libraries to truly be useful to the educational community, the design of their curriculum-related tools and services must be grounded in the actual context of the user. The information gathered through the DocSouth users' studies to date has informed the design of a prototype collection of digital learning objects by taking into consideration the teachers' instructional practices, teaching styles and methods, curriculum standards, and pedagogical principles. Teachers' input has also encouraged the investigation of more effective ways to support the indexing, searching and navigation of the learning object collection. The application of a domain-specific ontology to the collection is seen as a promising option that will continue to be explored. It is believed that the ontology will serve as a knowledge service to facilitate teachers when seeking for educational materials for their teaching. As a preliminary step toward the construction of the ontology, a series of interviews will be conducted over the next few months to further identify users' requirements that will inform the ontology model and will ground it into the actual context of use. More research is clearly necessary, but grounding the development of digital library tools and services into the users' context is a compelling step forward.

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