Teachers’ perspectives and contextual dimensions to guide the design of N.C. history learning objects and ontology

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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 University of North Carolina at Chapel Hill (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 applied to the collection to improve teachers’ access to the cultural heritage materials and to facilitate their actual use in the classroom.

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1. Introduction

“...digital libraries should exist not just as collections of resources, but also as sensemaking tools that help those resources to life” (Sumner, Khoo, Recker, & Marlino, 2003, p. 278).

This paper describes 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 users is key to building better digital libraries and library services. This study focuses on a specific segment of digital library users, middle and high-school social studies 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 user-centered approach to the design and the 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

“Digital libraries have become a core ingredient, a collective memory of the educational environment of today and of the future” (Kalinichenko, 2003, p. 57).

Rich collections of cultural heritage resources are being digitized and made available in massive quantities. “What can we do with a million books?” Gregory Crane recently asked referring to the exponential growth of digital library materials, not to mention projects such as Google Library (Crane, 2006). Beyond the sheer magnitude of digital content that is openly accessible, it is important to recognize the wide range of uses that digital libraries support, as well as the number and variety of user communities that may benefit from their resources. Cultural institutions have only recently begun to provide multiple ways 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 demonstrated or expressed users’ needs. Educators at all levels represent a growing and increasingly essential community of digital library users. Re-purposing the digital assets of library collections for educational use is a challenge that builders of digital libraries are slowly beginning to recognize and address. Borgman et al. (2005) point out the disparity between the richness of digital primary source materials and the limited number of tools and services available to support educators in their teaching.

In recent years, efforts have been directed toward building educational digital repositories of teaching and learning resources, primarily in the form of learning objects. One example is the National Science Digital Library (NSDL).\(^1\) The NSDL provides access to collections of science, technology, engineering, and mathematics (STEM) educational resources and services. The development of system requirements to support interoperability and reuse of educational content for different applications and management systems has been at the center of these initiatives. Nonetheless, as Recker, Dorward, and Nelson (2004) point out, little attention has been devoted to understanding the characteristics of learning environments and the role digital learning resources might play in these environments.

Broad availability and open access to educational materials, even on a large scale, do not necessarily translate into easy access and effective use and integration of these materials into instructional practice (Recker et al., 2005). To date, we have little evidence of the effectiveness and the actual use of digital resources in the classroom.

A paradigm shift from a system-centered to a user-centered approach in system development has been occurring since the mid-1980s (Solomon, 2002) and many efforts have been made to factor users into the design, development, and evaluation of information systems (Coleman & Sumner, 2004). However, too often technological concerns still take precedence over the user’s perspective in designing systems, tools, or services. If the “build it and they will come” approach seems to prevail, one reason may be the lack of systematic analysis of users’ requirements (Harley, Henke, Lawrence, Miller, & Perciali, 2006).

As an important publisher of digital content, the library community has become increasingly aware of the need to understand how educators identify and use digital materials in the classroom (OCLC E-learning Task Force, 2003). Gaining a better knowledge of how educators seek, select, and use digital materials in their instructional context is critical for building effective and useful information tools.

Toward this end, the UNC University Library has adopted a user-centered approach to the development of a series of digital resources designed for different communities. The starting point was the re-design of the DocSouth Digital Library (DocSouth) and the re-purposing of much of the digital content. DocSouth, the largest and most notable of the University Library’s growing digital collections, provides access to digitized primary source materials related to US Southern history, literature, and culture (Panitch, 2006). 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

\(^1\) [http://nsdl.org/](http://nsdl.org/).
broad international audience made up of educators, genealogists, amateur historians, and other lifelong learners (Hewitt, 2002). 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.

3. User-centered approach

“Only through knowing our audience, respecting their needs, and imaginatively re-engineering our operations, can we re-vitalize the library’s suite of bibliographic services” (University of California Bibliographic Services Task Force Report, 2005, p. 10).

In an effort to gain a better understanding of how educators seek and use digital primary sources from the UNC digital library collections, a series of user studies are being conducted at the University of North Carolina at Chapel Hill Libraries. Usability tests, focus groups, and personal interviews with educators of different teaching level and grade are underway. Multiple methods of investigating users (Fig. 1), combined with the review of the literature and various informal yet targeted conversations with representatives from the UNC School of Education, will enable researchers to triangulate and consolidate their findings.

Initially, a series of usability tests were conducted in 2003 by the University Library staff aimed at discovering how users interact with the DocSouth digital library interface. Participants were recruited from multiple audiences including K-12 teachers, graduate students and the general public. Four middle and high school teachers from the surrounding area were given a series of hypothetical classes and topics to teach and were asked to find appropriate digital content using both the DocSouth site as well as other digital libraries. The specific focus of the study was the functionality of the site as well as its visual aesthetic. The findings from the K-12 teachers were particularly enlightening for the researchers and they quickly realized many of their assumptions of this specific community were wrong (Norberg, Vassiliadis, Ferguson, & Smith, 2005).

The second phase of the study consisted of a series of focus groups with North Carolina middle and high school teachers attending the DocSouth Summer Institutes in June of 2003, 2004, and 2005. The workshops were designed to introduce North Carolina teachers to the collection of historical resources of DocSouth digital library. Each focus group involved an average of 15–20 participants. The teachers’ feedback not only informed the re-design of the DocSouth website, but helped researchers “understand more about user behavior, and how task oriented and context dependent their use of digital collections are” (Norberg et al., 2005, p. 295).

Both the usability tests and the focus groups identified areas where access and use of DocSouth for instruction was problematic and in general revealed a clear need to make the UNC Library digital collections more

![Fig. 1. Contextual design plan.](image-url)
manageable for the classroom. Working on the assumption that we need to comprehend what problems we are trying to solve before applying a solution, the results of 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 this collection.

While the studies involved multiple audiences that provided a broad and composite view of the user’s perspective, the development of the first collection of learning objects centered on the needs and behavior of the middle and high-school social studies teachers. The teachers’ discussions on their use of historical materials informed the design 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. A subsequent user study is underway to support the construction of an ontology for the learning objects.

3.1. Shaping NC history learning objects from the user’s perspective

Learning objects are becoming a convenient solution for dealing with the exponential increase of information and the parallel decrease of education investments (Metros & Bennett, 2004). Re-purposing content through learning objects derived from the UNC Library’s digital collections was identified by the Library’s Instructional Services Department as a viable means to facilitate access and use of digital primary sources for the education community.

Learning objects are defined by the IEEE LTSC as “any entity, digital or non-digital, which can be used, re-used or referenced during technology supported learning” (IEEE Learning Technology Standards Committee, 2002). Such an open 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. This offers a broad array of design options, but no clue on what characteristics would make learning objects effective in teaching practice. This ambiguity is seen as one of the reasons why this promising educational technology has not yet met expectations in terms of impact on teaching practice and rapid adoption by educators (Metros, 2005).

Shaping the learning objects based on the input of real-world users with their information seeking needs, behavior, experience, and expectations may provide a way to build more effective educational content. The feedback offered by teachers participating in the user studies has been pivotal for guiding the design of the NC history learning objects. The context of access and use of digital educational materials as described by the study participants has laid the groundwork for defining what functional requirements the learning objects should satisfy to suit the instructional needs of their intended community.

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, re-usable, and interoperable as possible to complement and enhance traditional classroom teaching. Further testing of the prototype collection will be needed to understand and assess the level of acceptance, effectiveness and usefulness of the NC history learning objects in the everyday teaching practice.

4. Three dimensions of context

“Contexts are full of props and cues, which serve as learning resources and memory devices for evolving patterns of usage. Many such cues serve as constraints; context rules some things out so that others may receive closer attention” (McCullough, 2004, p. 37).

User studies often underestimate the importance of context when investigating users’ needs and wants (Afzal, 2006). If context is considered, it is often from a simple, one-dimensional perspective, without recognition of its true complexity (Carr, 2006). Thomas and Nyce (2001) argue that “Trading consideration of a universal user for a more multidimensional, human information seeker within the context of everyday activities has proven to be of considerable value to theorists, educators, and practitioners within LIS” (p. 4).

It is important to recognize that teachers operate in a landscape filled with a number of contextual variables. To begin to understand the teachers’ context, a series of in-depth interviews on a sample of 6–12 grade social studies teachers are underway. 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. A complete understanding of the complexity of the interactions of these contextual variables is difficult to capture and certainly beyond the scope to this study. However, three main dimensions emerged from the users studies as central to the teachers’ practice: pedagogical, institutional, and personal.

4.1. Pedagogical aspects of context

The importance of taking into account pedagogical principles and theories when addressing web-based teaching and learning activities has been stressed in the e-learning literature (Govindasamy, 2002). Web-based primary sources represent a new data source that offers an unprecedented opportunity to implement modern pedagogical principles and techniques into the teaching and learning of social studies and history. New technologies can be quite effective in helping students relate to materials (Coventry & Bass, 2003). In recent years, digital collections of primary source materials have become widely available and openly accessible on the web. The Library of Congress’ American Memory Project, the University of Virginia’s Valley of the Shadow, and the Carolifornia Digital Library are just a few examples of the wide array of digital historical resources available.

Digital history has emerged as a specific discipline that studies “the past using electronically reproduced primary source texts, images, and artifact as well as the constructed historical narratives, accounts, or presentations that result from digital historical inquiry” (Lee, 2002). Classroom use of digital documents as primary resources is considered essential to fostering critical thinking skills and promoting an inquiry-based learning. While the implications of using digital primary sources for history and social studies education have not been fully explored, they have the potential to make a deep and meaningful impact on traditional teaching methods that rely on the memorization of facts and recitation. They may, in fact, be the “catalyst to transform teacher education” (Bolick, Hicks, Lee, Molebash, & Doolittle, 2004, p. 200). Current learning theories have also questioned the pedagogical value of textbooks. Textbooks are accused of presenting history as an objective account of reality that contrasts with the principles of inquiry-based learning embraced by today’s pedagogy. Direct analysis of primary sources offers an alternative and more active approach to learning than the rote memorization of a set of one-sided facts (Kobrin, 1996). The use of digital primary sources in the classroom encourages constructive interpretation of historical events and the evaluation of different viewpoints (Tally & Goldenberg, 2005). They facilitate learning by stimulating interest and engaging the students in creative and analytic activities that help them to relate to the past and interpret it based on evidence (Cantu & Wilson, 2003). Through the analysis of primary documents students gain a sense of the past as a complex and constructed reality, thus developing historical thinking skills.

Participants involved in the subsequent and ongoing study, along with those from the earlier DocSouth study, all show a clear awareness and strong endorsement of the pedagogical principles of inquiry-based learning. Teachers highlighted the role that biographies and personal narratives have in piquing students’ interest in history by relating content from the past to their lives. They stressed the fact that students’ interest in history is increased when they interact with firsthand accounts of historical events. Also, primary documents tied to the geographical territory or local community play an important role in connecting students to history. This tenet aligns with current literature where the re-construction of personal stories from the past is seen a powerful way to make students to connect to their community as well as to identify themselves in a broader historical context (Clarke & Lee, 2004). Digital primary sources of local history are particularly useful in creating “meaningful history experiences for students” (p. 84).

The teachers in both studies showed considerable interest in and some experience with developing and using activities that encourage students to raise questions and formulate hypotheses based on the evidence offered by primary sources. They described their efforts and frequent frustrations in developing in their students’ the capabilities of historical analysis and interpretation.

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2 http://memory.loc.gov/ammem/index.html.
3 http://valley.vcdh.virginia.edu/.
4 http://www.cdlib.org/.
Study participants expressed a preference for constructing their own exercises from the digital historical materials available on the web rather than by employing “pre-packaged” activities as the ones offered by many well-known instructional web sites. The general lack of interest towards pre-arranged educational content is consistent with the teachers’ feedback gathered during a pioneering user study on the instructional uses of digital primary sources conducted in the mid-1990s by the Library of Congress (The Library of Congress, 1995).

There was consensus among all participants of the need to “grab student’s attention or somehow “hook them”. Otherwise, they reported, “your average teenager just doesn’t care about history”. Teachers pointed out the importance of visual resources, especially images and photographs, in helping them capture their students’ imaginations. The directive to “never walk into the classroom without a picture” can effectively “move students outside of their own time and place” (Madison, 2004, p. 65). Some teachers indicated their 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, implications of file size and software requirements should be considered before assuming oral histories can easily be used in a classroom setting.

Teacher participants expressed interest in being able to aggregate digitized historical objects through space and time, as well as from personal or familial perspectives (Pattuelli & Norberg, 2006). Such aggregation offers the possibility 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 battlefront roles in the Union and the Confederacy”).

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 (Norberg et al., 2005). This confirms what Artacho has asserted: “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” (van Kasteren, 2003).

4.2. Institutional aspects of context

Teachers consistently expressed concerns about the constraints of putting into action these pedagogical principles and objectives in a broad and effective fashion. They highlighted how their need to incorporate more inquiry into the classroom has been hindered by the boundaries of institutional requirements in the form of teaching standards and standardized tests.

The need to improve the academic standards in public education was the goal behind the creation of various national and state standards. The two major sources of standards for history that have also inspired many states’ standards are the National Standards for History (National Center for History in the Schools, 1996) by the National Center for History in the Schools (NCHS) and the National Council for the Social Studies (NCSS) Curriculum standards for social studies (National Council for the Social Studies, 1994).

By and large, many of the educational objectives outlined in the national history standards and their local derivations can be addressed through the use of primary sources. Similarly, the use of technology is encouraged if not explicitly required (Tally & Goldenberg, 2005). Nevertheless, history curricula, in particular the National History Standards, have been controversial among educators. According to Kobrin (1996), the standards place too emphasis on subject matter and fact-based content or the “what” rather than the “how” of learning.

Teachers are aware of the constraints that teaching standards exert on their teaching strategies. They are used to making compromises between the curricular subject matter to be covered during the academic year and the pedagogical process needed to help students to understand that content. Nevertheless, they expressed an overall feeling of acceptance and even appreciation for these tools. All the study participants specifically refer in their teaching activities to the North Carolina teaching standards. In general, they consider the state history standards a useful guiding tool that helps them to “keep on track”. According to the teachers, the programs and materials designated by the standards allow an adequate level of flexibility in their work. One teacher commented: “I follow the North Carolina curriculum but don’t think about it when I am looking
for things; as long as they correspond to the curriculum. I am looking more at what my kids will be interested in.”

Despite their limitations, state and national teaching standards are the foundation upon which lessons and activities are prepared. Therefore, curriculum standards are an important part of a teacher’s context and must be taken into consideration both for the content of the learning objects and the domain coverage of the ontology. As a result, the content of the learning objects has been primarily based on the curriculum outlined in the NC Standard Course of Study5 for 6–12 grades and the National Standards for History.

Another part of a teacher’s institutional context, one negatively perceived by educators, is standardized testing. Teachers unanimously stressed the disruptive impact that high-stake exams exert on their pedagogical goals. School-based performance award programs put teachers under increasing pressure to “teach to the test” limiting their flexibility in the classroom. 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.

The testing system as practiced in the U.S. today is a “fact-based, multiple-choice tests that dominate the standards and testing movement today” (Risinger, 2002, p. 233). Risinger highlights the discrepancy between the mission of social studies educators to “teach students the content knowledge, intellectual skills, and civic values necessary for fulfilling the duties of citizenship in a participatory democracy” and “the pressures of high-stakes, standardized testing teachers” that promote the acquisition of factual knowledge (p. 231). The cultural impoverishment and conformity that standardized testing is likely to produce when it becomes the dominant measure of academic success is addressed by the president of the American Federation of Teachers, Sandra Feldman who asserts, “when tests are allowed to become the be-all and end-all, they deform, not reform, education” (Feldman, 2000).

As teachers explained, school-based performance award programs and related final tests impose restrictions on their teaching choices. For example, the demand of covering the content that will be tested inevitably leads to a narrowing down of the range of topics addressed by the history and social sciences teaching standards. Teachers are forced to teach students the information they need to pass the tests that are required to take every year and little time remains for activities that promote historical thinking, “Most of our students don’t get social studies until they come to middle school. They went through six plus years and most do so without even knowing what “continents” are. And this is because this basic knowledge has not been taught because of this test – it has just been engulfed and it is basically all math and reading. And the rest is just pushed aside.”

4.3. Personal aspects of context

Another contextual dimension that can impact teachers’ practice is categorized here as personal characteristics. While difficult to capture in their complexity and multiplicity, personal characteristics include such things as attitude toward technology, ability to manage time, knowledge of and experience with the subject matter to be taught.

As Liaw, Huang, and Chen (in press) point out in their discussion of educators and students attitudes toward e-learning, “no matter how advanced or capable the technology is, its effective implementation depends upon users having a positive attitude towards it” (p. 4). The feedback from participants in both studies revealed an overall positive personal attitude toward the use of technology. Several participants had invested in their professional development by taking classes at the UNC School of Education or attending workshops such as the DocSouth Teachers’ Summer Institute. Teaching experience combined with adequate training appeared to be key to a proactive and often inventive use of technology to support teaching and learning. As the literature shows, teachers need time, technical professional development, and a positive attitude towards change to make an effective use of technology in instruction (Vannatta & Fordham, 2004).

While the availability of computers either in the classroom or in school labs varies, all the participants make use of technology on a regular basis for their class preparation and instruction. All of the teachers had a home computer with Internet access and used it frequently to prepare for their classes. Likewise, all spent significant amounts of their personal time, time outside of school, preparing assignments. One teacher described how she

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5 http://www.ncpublicschools.org/curriculum/.
would copy and paste passages from primary sources off the Web into Microsoft Word so she could increase the font size or how she would transcribe handwritten documents onto Word so her students would spend their time reading the text rather than deciphering the handwriting.

Such anecdotes confirm a well-documented and compelling personal constraint many teachers experience – 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 resources 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. This lack of time needed to identify primary sources appropriate for the curriculum, along with a lack of awareness of the availability of materials, have been identified as major obstacles to the broader use of primary sources in the classroom (Bloom & Stout, 2005). 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. One participant lamented, “If I had time to really dig the collection on a subject and find something meaningful for the kids that would be perfect.” Teachers indicated that the manuscripts and other text documents in DocSouth were too large not only for them to sift through, but also 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). These comments greatly influenced the design of the learning objects and the importance of “chunking down” the digital content.

5. Shaping N.C. history learning objects from the user’s perspective

Learning objects are becoming a convenient solution for dealing with the exponential increase of information and the parallel decrease of education investments (Metros & Bennett, 2004). Re-purposing content through learning objects derived from the UNC Library’s digital collections was identified by the Library’s Instructional Services Department as a viable means to facilitate access and use of digital primary sources for the education community.

Learning objects are defined by the IEEE LTSC as “any entity, digital or non-digital, which can be used, reused or referenced during technology supported learning” (IEEE Learning Technology Standards Committee, 2002). Such an open 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. This offers a broad array of design options, but no clue on what characteristics would make learning objects effective in teaching practice. This ambiguity is seen as one of the reasons why this promising educational technology has not yet met expectations in terms of impact on teaching practice and rapid adoption by educators (Metros, 2005).

Shaping the learning objects based on the input of real-world users with their information seeking needs, behavior, experience, and expectations may provide a way to build more effective educational content. The feedback offered by teachers participating in the user studies has been pivotal for guiding the design of the N.C. history learning objects. The context of access and use of digital educational materials as described by the study participants has laid the groundwork for defining what functional requirements the learning objects should satisfy to suit the instructional needs of their intended community.

Teachers’ comments helped to clarify the size and the density of content the learning objects should have. These findings also led to the decisions to provide educators with objects of varying granularity.

In general, the 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. 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. It is hoped that this will facilitate re-usability of the individual objects and flexibility of use across disciplines and in different instructional contexts.

The trade-off between instructional contextualization and re-usability is a hotly debated issue within the community of learning object developers (Wiley, 2003). Learning objects that are highly tied to curriculum standards can serve specific audiences or learning objectives quite well, but their re-use for other audiences or other objectives may be limited. For example, a learning object aimed specifically at teaching eighth grade students about the causes of the Civil War may be ideal for an eighth grade social studies class but too sim-
plastic or inadequate for a twelfth grade history 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.

The intent behind the design of the N.C. history learning objects was not to prescribe how the materials should be introduced or used in the classroom, but to make them as accessible, re-usable, and interoperable as possible to complement and enhance traditional classroom teaching.

The learning objects will be annotated using Dublin Core with the addition of elements from the IEEE Learning Object Metadata (IEEE LOM) schema. Further testing of the prototype collection will be needed to understand and assess the level of acceptance, effectiveness and usefulness of the N.C. history learning objects in the everyday teaching practice.

6. Modeling the N.C. history ontology from the user’s perspective

One way to add context to learning objects without limiting their usability and re-usability is by with content metadata relevant to specific communities of practice. This is the approach adopted for the N.C. history 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. Not surprisingly, Google was their primary search tool and keyword searching their usual approach. Long lists of unrelated results often frustrated teachers who found it difficult to find materials appropriate for their needs. One teacher complained that “if you pop in ‘slavery’ and maybe you want to know about 17th Century Jamestown Slavery as opposed to 19th Century Civil War Slavery you just don’t have time to go through everything to find the right stuff”. In general, they voiced frustration with keyword searching. 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, but there is little to guide them in what may or may not be part of a particular digital library.

Limitations of subject access were also an issue participants pointed out. Teachers identified some of the weaknesses of the metadata and controlled vocabulary associated with the DocSouth collections (specifically, MARC and LCSH) in retrieving images and other types of resources from the collections (Pattuelli, Norberg, & Smith, 2004). 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 users’ viewpoints not only on how the learning objects were constructed, but also on how their content would be described, searched for and retrieved. This triggered the idea to invest the potential that an ontology-driven approach to indexing and retrieving could have for facilitating and enhancing 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 (Sampson, Lytras, Wagner, & Diaz, 2004). An ontology of the domain of North Carolina history designed for and applied to the N.C. history learning object collection may provide some useful functionality. First, the ontology can 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 (Corcho, 2006; Sicilia, 2006). 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 sound which could trigger new instructional 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 the organization of the collection (a way to understand what is and what is not there). This could facilitate the search process and the selection of results. Helping “users form a mental map of the subject areas that are covered and those that are excluded” (Shreeves & Kirkham, 2004) is important for being able to meet the expectations, or at least reduce the frustration, of teachers seeking for primary sources. Moreover, the ontology vocabulary would offer 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 benefit 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 (2001) assert. The importance of re-using knowledge from existing ontologies or other knowledge organization systems pertinent to the domain of interest has been often stressed (Uschold & Gruninger, 1996). However, for history and cultural heritage in general there is a lack of domain-specific ontologies. While the NC history ontology will be developed almost entirely from scratch, it may eventually be mapped into CIDOC Conceptual Reference Mode (CRM), a semantic framework for cultural heritage information.

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 N.C. history ontology will be informed by the input offered by the targeted community of users through a series of semi-structured interviews to North Carolina social studies teachers.

Input on the domain concepts and the 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 or what level of granularity is useful in describing geographical spaces will be critical for the ontology developer. Preliminary results from the interviews indicated that to develop students’ historical thinking skills teachers need to compare and contrast different sets of ideas, personalities, and institutions. “Families split during the Civil War” or “Midwest versus Northeast during the Depression” were among the examples suggested by teacher participants. To address this issue topological and temporal relationships that enable geopolitical comparisons as well as contextualization are important relationships to be modeled in the ontology and eventually exploited in the querying process. In addition, familial and social relationships that may help support teaching activities such as comparisons of personal narratives and re-construction of social identities need to be considered for incorporation in the design of the ontology (Pattuelli & Norberg, 2006).

Essentially, the ontology will try to capture the mental model of the teachers where pedagogical principles, instructional practices, and curriculum 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 N.C. history ontology has the potential to effectively support the seeking process of teachers of primary source materials and facilitate their use by inspiring new combinations or uses of these materials in the classroom.

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6 http://cidoc.ics.forth.gr/who_we_are.html.
7. 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 user studies to date has informed the design of a prototype collection of digital learning objects. The characteristics, including structure, size, format, content coverage, density, and granularity of the learning objects have been determined in response to the teachers’ comments. Their 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 as they seek for educational materials. 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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References


