STUDENTS' CRITERIA FOR COURSE SELECTION: TOWARDS A METADATA STANDARD FOR DISTRIBUTED HIGHER EDUCATION

Kathleen R. Murray, B.A., M.S.

Dissertation Prepared for the Degree of

DOCTOR OF PHILOSOPHY

UNIVERSITY OF NORTH TEXAS

August 2000

APPROVED:

Samantha K. Hastings, Major Professor and Co-Chair
Philip M. Turner, Dean of the School of Library and Information Science and Co-Chair
William E. Moen, Committee Member
Brian C. O'Connor, Committee Member and Program Director of the Interdisciplinary Ph.D. Program in Information Science
Jon I. Young, Committee Member and Chair of the Department of Technology and Cognition
C. Neal Tate, Dean of the Robert B. Toulouse School of Graduate Studies

Murray, Kathleen R., Students' criteria for course selection: Towards a metadata standard for distributed higher education. Doctor of Philosophy (Information Science), August, 2000, 209 pp., 58 tables, 5 figures, references, 132 titles.

By 2007, one half of higher education students are expected to enroll in distributed learning courses. Higher education institutions need to attract students searching the Internet for courses and need to provide students with enough information to select courses. Internet resource discovery tools are readily available, however, users have difficulty selecting relevant resources. In part this is due to the lack of a standard for representation of Internet resources. An emerging solution is metadata. In the educational domain, the IEEE Learning Technology Standards Committee (LTSC) has specified a Learning Object Metadata (LOM) standard.

This exploratory study (a) determined criteria students think are important for selecting higher education courses, (b) discovered relationships between these criteria and students' demographic characteristics, educational status, and Internet experience, and (c) evaluated these criteria vis-à-vis the IEEE LTSC LOM standard. Web-based questionnaires (N=209) measured (a) the criteria students think are important in the selection of higher education courses and (b) three factors that might influence students' selections. Respondents were principally female (66%), employed full time (57%), and located in the U.S. (89%). The chi square goodness-of-fit test determined 40 criteria students think are important and exploratory factor analysis determined five common factors among the top 21 criteria, three evaluative factors and two descriptive. Results indicated evaluation criteria are very important in course selection. Spearman correlation coefficients and chi-square tests of independence determined the relationships between the importance of selection criteria and demographic characteristics, educational status, and Internet experience. Four profiles emerged representing groups of students with unique concerns. Side by side analysis determined if the IEEE LTSC LOM standard included the criteria of importance to students. The IEEE LOM by itself is not enough to meet students course selection needs. Recommendations include development of a metadata standard for course evaluation and accommodation of group differences in information retrieval systems.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

CHAPTER I

INTRODUCTION

Statement of the Problem

For an increasing number of students the real-time learning environment is a technology-mediated experience between student and online learning resources. Graves (1994) predicted a fundamental change in the infrastructure of higher education. Traditional institutions with primarily campus-based students and contact-hour-based teaching will be replaced by institutions whose students, teachers, and campuses are not physically or temporally bound to any location or time. Withrow (1997) asserted that technology is changing the role of educators from resource repositories to resource facilitators. Increasingly, the educator is working behind the scenes with technology professionals to create educational materials. Technologies such as two-way compressed video have enabled connectivity options among educators, students, and institutions that open new avenues of collaboration and instruction between technologists, educators, and educational policy makers (Turner, 1996).

In the future, education will increasingly utilize distributed learning technologies (Pelton, 1996). By 2007, roughly one half of all higher education students are expected to be in some form of distributed learning experience (Kascus, 1997). Market forces are exerting more influence on academia (Graves, 1994, 1997). Colleges and universities are facing competition for distance learners from one another and from for-profit educational enterprises. A study conducted by the National Center for Education Statistics for the

U.S. Department of Education determined that one third of 2-year and 4-year colleges and universities offered distance education courses in 1997-1998 and that an additional 20% intended to offer courses in the next three years (Laws and Hynd, 1999; Lewis, Snow, Farris, Levin, & Greene, 1999). From 1993 to 1997 the number of cyberspace universities or virtual universities increased from 93 to 762 (Gubernick and Ebeling, 1997). To compete in this arena, many universities are developing distributed education courses. These courses must be represented in a networked environment so that potential students are assisted in their course selection processes.

The economic efficiency of traditional colleges has declined (Gubernick and Ebeling, 1997). Between 1980 and 1997, the number of students in colleges and universities increased 24% but the annual cost to educate a student more than doubled in that time, from $5,000 to $11,000 annually. Additionally, between 1967 and 1997, 200 U.S. college campuses closed. Withrow (1997) asserted that online courses might increase the efficiency of education. In some cases, especially where universities develop and host their own courses, distributed education courses cost universities less money to provide than traditional courses (Gubernick and Ebeling, 1997; Krochmal, 1998). It appears that students are willing to pay more tuition and fees for the convenience of distributed learning (Blumenstyck, 1999; Gubernick and Ebeling, 1997). In short, distributed education may improve the economic efficiency of higher education.

Internet technologies, interactive video, and prerecorded video were the most commonly used technologies for distance education in 1997 and universities projected an increased usage of both Internet and interactive video technologies in the three subsequent years (Lewis et al., 1999). Internet resource discovery tools such as search engines are readily available. However, users have difficulty selecting relevant information resources when searching the Internet with search engines (Gudivada, Raghavan, Grosky, and Kasanagottu, 1997). Selecting higher education courses that satisfy students' requirements from an Internet search result list may be equally difficult.

Networked resource discovery and selection problems are in part due to the lack of a standard format for the representation of Internet information resources (Lynch, 1997). Emerging Internet gateways to educational resources, such as the Education Network Australia (EdNA) and the Gateway to Educational Materials (GEM) in the United States, rely on standard resource description formats, or metadata, for the exchange of data between the gateways, which provide information retrieval services to users, and the servers, which provide access to educational resources. Several international educational consortia and standardization groups are proposing metadata specifications to meet the needs of their stakeholders, for example the Alliance of Remote Instructional Authoring and Distribution Networks for Europe (ARIADNE) and the Dublin Core-Education Working Group (DC-Ed). However, the criteria students use to select higher education courses have not been identified. There is a risk that emerging specifications may not address the needs of this critical stakeholder group.

Purpose of Study

The theoretical context for this study was information retrieval (IR) research, which includes several processes. This research was concerned with the selection process, which has been a central focus of IR relevance evaluation research. The objectives of this study were (a) to identify the criteria students think are important for selection of higher education courses, (b) to inform the ongoing specification of educational metadata standards, and (c) to provide design requirements for future information retrieval systems supporting course selection in higher education. Since students may use selection criteria as search elements in the process of discovering higher education courses, this research may provide insight into the design of educational search engines. This study employed both qualitative and quantitative methods to discover the criteria students think are important for selection of higher education courses. Specifically this study (a) determined the criteria students think are important for selecting higher education courses, (b) discovered the relationships between these criteria and students' demographic characteristics, educational status, and Internet experience, and (c) evaluated these criteria vis-à-vis the Institute for Electrical and Electronic Engineers (IEEE), Project 1484 (P1484) - Learning Technology Standards Committee's (LTSC) Learning Object Metadata (LOM) working draft standard version 3.6.

Research Questions

The following research questions guided this research.

1. What criteria do students think are important for selection of higher education courses?

2. Is there a relationship between the criteria students think are important for selection of higher education courses and demographic characteristics, specifically employment status, gender, age, and residential location?

3. Is there a relationship between the criteria students think are important for selection of higher education courses and educational status, specifically, education level, academic classification, enrollment status, and reason for enrolling in courses?

4. Is there a relationship between the criteria students think are important for selection of higher education courses and Internet experience, specifically, years of Internet experience, frequency of Internet access, and Internet skill level?

5. Does the IEEE LTSC Learning Object Metadata Standard include the criteria students think are important for selection of higher education courses?

Significance of the Study

Universities are producing a growing number of distributed educational courses (Blumenstyk, 1999). Discovery and selection of these courses by students is necessary for universities to reap the desired economic benefits of distributed education. Implementation of a metadata standard within universities for the standard representation of distributed courses is expected to support students' selection of educational resources (Marchiori, 1998).

In the educational resources domain, the LOM working group, designated P1484.12, of the IEEE LTSC has approved a Working Draft Standard that defines a consistent structure and syntax for the representation of educational resources on the Internet. The LOM standard is a possible metadata standard suitable for higher education courses within colleges and universities. The LOM is intended to address the needs of a broad range of stakeholders in several educational communities including academia, education, vocational training, commercial training, life long learning, distance learning, and performance improvement. For both conventional and distributed educational resources, the IEEE specification is one of the most comprehensive educational metadata set being considered by an international standards body at this time. The IEEE LOM is an emerging standard and its effectiveness for supporting the course selection requirements of students, as significant stakeholders in a higher education distributed learning environment, has not yet been demonstrated. Identifying the criteria for course selection that students think are important should provide a basis from which to evaluate the utility of the IEEE LOM metadata standard to meet students' requirements. Additionally, once identified, these criteria might be incorporated into proposed technology standards for the representation of educational resources in a networked environment. Representations of resources in an information retrieval (IR) system should be created with the needs of the system's users in mind (Hagler, 1991; Solomon, 1991). Identifying the criteria of importance to students for course selection is a first step in addressing their needs.

Schamber, Eisenberg, and Nilan (1990) identified several research questions regarding user-defined relevance criteria for evaluating the results of IR systems. They suggested future research determine the characteristics of information resources that users either say they want or actually use when seeking information from systems. These characteristics can then be evaluated for inclusion in the design requirements for system output in an IR system. Barry (1994) suggested that if users know their evaluation criteria prior to a search, then it may be worthwhile to add elements to object representations in an IR system that provide clues to the criteria users employ. Additionally, Barry suggested future research examine the relative importance, ranking, or weighting of relevance criteria to users. This would enable the design of systems in consideration of what relevance criteria are most important to users.

Ellis, Ford, and Foerner (1998) suggested that the proximity of an IR system's users and the indexers creating the system's database is an important factor in the success of the system. At great distances indexers are less knowledgeable of users' needs and their conceptual, cultural, and physical environments. Consequently, users are less likely to identify relevant resources from the IR system's database. In a distributed educational environment, metadata creators and students will often be unknown to one another. The detrimental impact of this lack of familiarity can be mitigated by an understanding of the criteria of importance to students and by using these criteria to guide the development of metadata standards, which in turn can guide the creation of databases for educational IR systems.

Several researchers have identified individual differences, including experience and educational status, as important relevance factors in IR system evaluation and suggested that accommodating users' individual differences is an important criterion in the design of IR systems (Borgman, 1996; Harter, 1992; Saracevic, 1991; Wang & Soergel, 1998). Identifying the relationship between the criteria students think are important for course selection and their demographic characteristics, educational status, and Internet experience might provide design criteria for more flexible, user-oriented IR systems. Additionally, identifying differences in students' selection criteria due to demographic characteristics, educational status, and Internet experience might provide a useful context for understanding their course selection criteria.

Wang and Soergel (1998) identified two problems with document retrieval systems: the absence of user relevance related information elements in retrieved records and the inflexible presentation of retrieved records. Identifying the criteria students employ in course selection as well as any significant relationship between these criteria and demographic characteristics, educational status, and Internet experience might inform both educational metadata standards and IR system design.

Ritter and Suthers (1999) stated that researchers play an important role in the development of standards and suggested that investigating user needs vis-à-vis standards within a domain advances the interoperability and reuse of resources within that domain. This study provides metadata implementers and university personnel in policy positions with valuable information regarding: (a) students' criteria for the representation of courses in support of course selection and (b) the utility of the IEEE LTSC LOM standard for selection of higher education courses by students.

Limitations and Delimitations

There is one limitation and two delimitations in this study. The limitation is stated in first and followed by the delimitations.

1. Respondents may have misrepresented the facts about themselves and their opinions and may not have shared a common understanding of the selection criteria listed in the survey.

2. The survey sample was self-selected and not random. It was possible that this sample has characteristics, opinions, and attitudes that distinguish it from the

population of students selecting distributed education classes. This limits the generalizability of the study to the larger population.

3. The study did not measure students' course selection behavior per se. No observations or recordings of students' actual decision-making behavior were included. The survey required respondents to indicate the importance of criteria they would use to select courses or to indicate the importance of criteria they have used in the past. Actual behaviors may differ from self-reported data about behaviors. This adds a further caution to the generalizability of the results.

Assumptions

This study assumed that student's requirements for course selection in a non-networked environment were comparable to student's requirements in a networked environment. That is, some respondents may have primarily based their decisions regarding the importance of course selection criteria on their experience in traditional course selection while other respondents may have used their experience with distance education as the basis for their decisions. The study did not differentiate selection criteria based on their applicability to either a traditional or a distributed education environment.

Definitions

1. Metadata is "'information about data.' Metadata describes an Internet resource: what it is, what it is about, where it is, and so on" (Ianella & Waugh, 1998, p. 1). Metadata "refers to any data used to aid the identification, description and location of networked electronic resources" (International Federation of Library Associations and

Institutions [IFLA], 1999, p. 1). Typically, metadata records are specific to a single resource object or a single collection of objects and consist of a set of data elements and informational values for those elements. In discovery and selection of networked information resources, both descriptive and evaluative metadata elements are involved in users' decision-making processes (Lynch, 1995). In this study metadata refers to a set of descriptive and evaluative criteria that students might employ for course selection subsequent to identifying or discovering a number of possible courses.

2. IEEE LTSC is "a set of working and study groups that seeks to develop standards, guidelines and practices for interoperable educational components" (Roschelle, 1999, p. 1). This study used the LOM version 3.6 specification, a working draft approved by working group 12 of the P1484 committee on September 5, 1999.

3. Distributed learning or distributed education is also called distance education or distance learning. In higher education, distributed learning is simply learning which takes place at a remote (off-campus) site, generally a student's home or another off-campus location. In a broader sense, distributed learning also includes on-campus education in which students are located on multiple campuses and the instructor simultaneously communicates with all locations via some electronic means, usually television broadcast (Laws and Hynd, 1999).

4. Distributed learning technologies include audio (broadcast or prerecorded), video (interactive, live broadcast, or prerecorded), the Internet (electronic mail, chat sessions, and bulletin boards), computer programs and instructional resources

based on disks, CDs, or the Internet, audioconferencing, desktop videoconferencing, fax, telephone, and mail (Laws and Hynd, 1999; Lewis et al., 1999).

5. Cyberspace universities are synonymous with virtual universities. Virtual universities are "institutions that offer most or all of their instruction via technological means and are distinguished by their nearly exclusive use of technology as the educational delivery device" (Lewis et al., 1999, p. 6).

6. NIDR is the acronym for Networked Information Discovery and Retrieval. NIDR systems are "systems that assist users in the processes of discovery and retrieval" (Lynch, 1995, p.3). They are very large-scale information systems operating in the high demand, distributed, Internet network environment, which is characterized by a collection of heterogeneous systems and users globally interconnected by telecommunications networks.

CHAPTER 2

LITERATURE REVIEW

Information Retrieval

This study fits into the larger theoretical context of information retrieval (IR) research. Calvin Moores (1951) first used the phrase "information retrieval". Moores stated that information retrieval "embraces the intellectual aspects of the description of information and its specification for search, and also whatever systems, techniques, or machines that are employed to carry out the operation" (p. 25). The information retrieval process essentially involves matching the representations of information objects with representations of users' information needs (Lancaster, 1986). This process is the raison d'être for an information retrieval system. The need for an automated system to conduct this process is necessitated when the number or location of information objects exceeds any reasonable expectation that this process could be conducted manually by examination of each individual object (Harter & Hert, 1997).

Tague-Sutcliffe (1996) identified the following components of an information retrieval system: collection or database, users, users' queries, searchers (either users or professional intermediaries), search strategies, search output, and evaluation or relevance to users. Since the late 1970s, users and the context in which they seek, search, and retrieve information from a system has been an important focus within IR research (Saracevic, 1991).

R. S. Taylor (1982, 1991) stated that information retrieval system design should be based on the requirements of end users, specifically on the use to which information is employed in users' environments. In the final analysis, it is identifying, selecting, and locating information of value to users that completes their interaction with an information retrieval system.

Three IR system components provide the background for this study: (a) the collection or database of information objects, specifically when the collection or database contains representations of the objects; (b) users, specifically user behavior; and (c) relevance to users, specifically relevance factors and user-defined relevance criteria. Organizing the information in a collection or a database through some form of representation increases the value for users, whose specific information needs should be considered in the organizational process (Hagler, 1991; Solomon, 1991). User-defined relevance criteria are factors users employ in the evaluation of search results. These criteria are "identified by motivated users who are evaluating information within actual information need situations" (Barry & Schamber, 1995, p. 103).

Organization of Information

There is an inextricable link between the organization of information and the retrieval of information in an information system (Rowley, 1996). Information that describes resource objects, for example documents or courseware, is organized into descriptive repositories such as indexes, databases, and catalogs. By comparing users' search requests to the descriptions of the resource objects, information retrieval systems identify resources that may be relevant to users' needs. From an organization of information perspective, this study is relevant to the concepts of representation (both descriptive representation and the representation of information content), classification, and access points. Additionally, this study is concerned with the representation of evaluative aspects of information objects. These might include elements such as the credentials of authors or reviews of information objects (O'Connor & O'Connor, 1998).

Within a collection or database, bibliographic control or the organization of information objects is a critical task. The traditional practice of cataloging in library science organizes information for user access through the process of bibliographic control. In 1904 Charles Cutter described three objectives of a library catalog for a library collection: identifying, collocating, and evaluating. These are functions of every bibliographic tool (A. G. Taylor, 1992). Adapting the process of bibliographic control to an electronic networked environment does not change the essential purpose of this activity, which is to add value to the information in the collection for users. It is, however, helpful to update some of the terms (A. G. Taylor, 1994). Documents, in an electronic environment, are more broadly termed "information-bearing objects", information resources, or information objects. Bibliographic control is more aptly termed "information organization".

Traditional organizational methods distinguish information containers, or physical property, from information content, or intellectual property. The container is generally a physical medium of some sort such as a book, a video recording, or a computer storage device. The content of the container is the manifestation of intellectual or creative ideas or works. Both an object’s container and its content are represented in the process of information organization or bibliographic control. Containers are represented by descriptive categories that uniquely identify a given object. Information content is generally represented by subject categories or subject terms taken from standard listings of subjects, such as the Library of Congress Subject Headings. Together, container categories and subject terms serve as a representation or surrogate record for the information object itself. It is these surrogate records that users primarily interact with as they perform searches and retrievals in an information retrieval system (Levy, 1995).

The distinction between physical and intellectual property allows for two types of representation of information objects: descriptive representation of the container and subject representation of the content. Both types of representation are generally contained in a record, or information object surrogate. Elements within the surrogate record can be designated as access points to information-bearing objects within an IR system. (Rowley, 1996). For example in an educational IR system, the descriptive element "course title" and the content element "syllabus" might be designated as access points for users, who would generally search the course database using their unique values for these elements. The organization process thereby increases the value of the information objects.

Descriptive Representation of Information.

Traditionally called descriptive cataloging, descriptive representation of information objects requires both the identification of the elements to be described and the values for each of the elements (A. G. Taylor, 1992). The descriptive elements are categories that identify characteristics of an object, for example, size, media type, author, date, or title. A category may be subdivided or modified into logical sub-elements. For example, the category “media type” might have sub-elements such as text, videotape, or audio recording and the category “authorship” might be sub-divided into composer, illustrator, or editor.

An information object is characterized by that set of categories and sub-elements appropriate to it. Each categorical value represents a particular dimension of the object. Taken as a whole the values ascribed to the categories and their sub-elements form a unique record for an object that distinguishes one information object from every other information object. The end result of the process of descriptive cataloging is a record, sometimes called the bibliographic record or surrogate record, that represents information objects in such a way that they gain additional usefulness or added value when they are incorporated into an information retrieval system.

The identification of users' needs must be done within the particular context in which they will use the information system. R. S. Taylor (1991) researched what he calls the "information use environments" or IUE's of three groups of users: engineers, legislators, and physicians. He defines the concept of information need as how information is used. His model for analysis of IUE's identified four dimensions: the set of people themselves, the structure of the problems with which they deal, the setting in which problems are experienced, and the manner in which problems are typically resolved. Fundamentally, information retrieval systems should be designed based on an analysis of the IUE of the system's users. This implies that the elements or categories in the surrogate metadata records should reflect the specific needs of the information retrieval system's users.

Moen, Stewart, and McClure (1998) point out that the concept of metadata is similar to the concept of the bibliographic record. In this context, metadata is an electronic surrogate representing information objects in a networked environment in the same manner that bibliographic records are surrogates representing information resources in libraries. Additionally, the purposes of both traditional bibliographic representation and metadata are similar, that is, they both add value to information and assist users in locating, identifying, and selecting information resources that satisfy users' questions and information needs.

Representation of Information Content.

"Representation by definition means that some information will be left behind or left out. Ensuring that the necessary loss of information is not fatal to the search effort is one of the crucial tasks of indexing and abstracting" (O'Connor, 1996, p. 2). Subject analysis or indexing is the traditional library term for the representation of the information content of an object. As with descriptive cataloging, there are two steps in the process of subject analysis. The first step involves conceptually analyzing the information object from two perspectives: the object's content itself and the needs of the information system's users (Ellis, Ford, & Turner, 1998; Lancaster, 1986). The second step requires the translation of the conceptual analysis into a particular vocabulary or indexing language, which is generally standardized.

There are three types of indexing languages: controlled indexing languages, natural indexing languages, and free indexing languages (Rowley,1996). Controlled indexing languages are also known as assigned-term systems and consist of alphabetical indexing languages and classification schemes. Traditionally, a hierarchical list of subject headings, such as the Library of Congress Subject Headings, or a thesaurus of subject terms is used. These headings or terms become values for the subject category in the bibliographic record. Natural indexing languages are also known as derived-term systems. They are distinguished by their lack of a controlled vocabulary. Instead the vocabulary list is based on statistical analysis of the relative frequency of terms within documents and within the collection as a whole. Free indexing languages have no constraints on the terms that can be used in the indexing process.

The administrative bureaucracy and multi-domain usage of subject category lists can become impediments to their goal of increasing information value by enabling access. Bearman (1981) describes an example of this problem in regard to the subject heading "aged" in lieu of "seniors" by the Library of Congress. Personnel at the Library of Congress are chastised for being inflexible and for their focus on the needs of academics rather than senior citizens' needs. Solomon (1991) used qualitative research methods to study the subject term needs of children. He identified problems inherent in information systems using the Library of Congress Subject Headings. Most problems emerged from the fact that the subject headings do not have a context in the language, environment, or problem space of the information system's users. He concluded that only by studying the needs of users in naturalistic settings could users' information problems be understood in sufficient depth to allow for the identification of subject terms.

One advantage of natural language indexing is that the vocabulary better matches the words users employ (Rowley, 1996). However, because of its reliance for indexing terms on the information objects themselves, one potential disadvantage of natural language indexing is the exclusion of specific user needs in the indexing process. Fidel (1994) suggested that natural language indexing, or automated indexing, was better suited to meeting users' needs because of its inherent flexibility to incorporate vocabulary changes and consequently change the representations of objects. Additionally, while IR systems that organize their databases using controlled vocabularies tend to increase the system's precision, IR systems that use natural language indexing tend to increase the system's recall. While many IR systems employ a combination of controlled and natural language indexing (Fidel, 1994), web-based search sites predominantly employ natural language indexing methods (Lynch, 1997).

Classification

Classification, the process of grouping objects that share similarities into classes based on an established scheme, is an important activity within subject analysis. Classification schemes generally have three components: (a) schedules, which list subjects systematically and show their relationships, (b) a notation scheme, which is a self-evident ordering of subjects using numbers and/or letters, and (c) indexes, which list terms alphabetically for first consultation and indicate the placement of subjects within the scheme. The three major classification schemes are the Library of Congress Classification System, the Universal Decimal Classification Scheme, and the Dewey Decimal Classification System (Rowley, 1996).

Notation schemes also provide a systematic way to physically order or file information objects. The Dewey Decimal System is an example of a classification system used to file books on library shelves. Generally, this location information becomes another categorical element in the bibliographic record. The location of an information object accessible via the World Wide Web is generally indicated by its Uniform Resource Locator or URL. While not a classification scheme, URLs do provide a structured method for the identification of web-based information objects and may be included as element values in metadata schemes such as the Dublin Core Metadata Element Set (Dublin Core Metadata Initiative [DCMI], 1999a).

Classification schemes in the networked information environment provide value-added services to standard search services. For example, subject-based classification schemes enable browsing activities and support users in both limiting and enlarging the scope of their information quest (Koch & Day, 1997). Some Internet information providers have implemented traditional classification schemes, such as the Dewey Decimal System. Koch and Day reviewed efforts at classification of Internet resources and organized these efforts into four types: (a) universal classification schemes such as that maintained by the Library of Congress, (b) national general schemes that are limited to national boundaries, (c) subject specific schemes such as the National Library of Medicine Classification, and (d) home-grown schemes such as Yahoo!'s category system.

Frequently classification systems fail to meet users needs because they are not designed to match the language and context of users environments (Solomon, 1991). Borgman (1996) described the complexity of current online catalog systems and the necessity of having professional search intermediaries translate user queries into the classification hierarchies of information systems. She identified the long-term solution to this problem as the design of intuitive systems that are able to directly translate user queries without professional intermediaries.

The diversity of classification schemes creates problems for users seeking information in the Internet environment. Lack of familiarity with an information repository's scheme can result in unfulfilled information needs and unanswered questions. The relative ease of access to information on the Internet can result in any user retrieving information objects that were originally selected, structured, and classified for specific user communities whose characteristics and requirements are quite unique (Ellis et al., 1998). The absence of standard classification schemes, as well as the increasing diversity of "home-grown" schemes being designed for Internet accessible systems, are increasing the problems of information retrieval on the Internet (Buckland et al., 1999). Buckland and other researchers continue to experiment with the automatic creation of indexes that facilitate translation of natural language requests to diverse classification schemes through the combination of linguistic analysis and statistical analysis.

Access Points.

In addition to describing or representing an object's container and content, organizing information involves identifying the points of user access to the object's surrogate record. User access points are specific elements or fields in the bibliographic record available for IR system users to search, for example title, author, subject, or date. Traditionally, access points generally represented a subset of a record's descriptive categories and included subject classification. Hagler (1991) stated the purpose of every activity in bibliographic control as providing "the most direct possible access to the content of a particular document which can satisfy a stated informational need" (p. 64). In an online environment access points may include the full set of elements specified in an object's bibliographic or metadata record.

A range of users in various use environments or end user domains frequently accesses information retrieval systems on the Internet. The challenge in this environment is to identify access points, which may be metadata elements, that both reflect the common information needs of users across domains while being flexible enough to allow unique user needs within any domain to be addressed.

Information Retrieval Systems and User Behavior

Saracevic, Kantor, Chamis, and Trivison (1988) presented a general model of information seeking and retrieving. The model focuses on those system aspects that involve the user and the user's interaction with the system. The model is intended to represent a highly interactive process between all events and variables (see Table 1).

The model differentiates users from searchers and addresses each of their contexts in the information seeking process. The user's context can be characterized both from an external or environmental perspective and from an internal or cognitive perspective. Characteristics of the user and the searcher, if different from the user, can be identified as research variables which measure and describe the users' and the searchers' contexts.

The model identifies eight major interactive events and their corresponding classes of research variables. Events one and eight are largely concerned with cognitive processes within the user while events two through seven are largely concerned with the interactions between the user/searcher and the system. Event one concerns the information seeker, the problem situation, the user characteristics, and the cognitive representation of the problem. Event eight concerns the information seeker's cognitive process of determining the relevance and utility of the search result to solve a problem.

Table 1
A General Model of Information Seeking and Retrieving

Event	Class of Variables
1. User (information seeker) has a problem which needs to be resolved	▪ User Characteristics ▪ Problem statement
2. User seeks to resolve the problem by formulating a question and starting an interaction with an information system	▪ Question statement ▪ Question characteristics
3. Presearch interaction with a searcher i.e., a human or computer intermediary	▪ Searcher characteristics ▪ Question analysis
4. Formulation of a search	▪ Search strategy ▪ Search characteristics
5. Searching activity and interactions	▪ Searching
6. (Possible: initial evaluation of results and reiterative searching)	▪ (Adjusted search)
7. Delivery of responses to user	▪ Items retrieved ▪ Formats delivered
8. Evaluation of responses by user	▪ Relevance ▪ Utility

Note. From "A Study of Information Seeking and Retrieving. 1. Background and Methodology," by T. Saracevic, P. Kantor, A. Y. Chamis, and D. Trivison, 1988, Journal of the American Society for Information Science, 39, p. 164.

This model is characteristic of a focus on user behavior in IR research which began in the 1970s. This focus signaled a change from the systems focus that dominated IR research prior to the 1970's. Dervin and Nilan (1986) characterized this change of focus as a shift from a "traditional" to an "alternative" paradigm. Traditional IR research is objective and trans-situational with a focus on observable variables. Alternative IR research is subjective and situational with a focus on the user. Hert (1997) identified early IR research as conducted under a "match paradigm" characterized by IR system evaluation experiments that focused on matching query terms with document representations and optimizing the algorithms used for this purpose. Beginning in the 1970's, IR research began to extend its research paradigm to incorporate users and their information needs under the larger paradigm of cognitive theory, behavior, and models.

Saracevic (1996) refined his earlier model to more accurately depict IR interaction. The stratified elements in the refined model are divided at an interface between system and user. The system contains computational resources and capabilities as well as informational resources and capabilities. The user elements include the query characteristics, user characteristics, the situation that produced the problem, and environmental characteristics. Interactions are classified into three levels: surface, cognitive, and situational. At the surface level, users present queries to the system, which in turn presents search results to users. At the cognitive level, users interact with information resource objects, which could be objects or representations of objects, such as metadata records. At the situational level users judge a resource object's utility in regard to its usefulness to solve the problem at hand (Wilson, 1973). As in his earlier model, Saracevic suggested classes of research variables for each of the three levels (see Table 2).

Table 2
Research Variables in Saracevic's Stratified Model of IR Interaction

Interaction Level	Classes of Research Variables
Surface	▪ What "things" users do ▪ What "things" systems do ▪ What results systems produce ▪ Effectiveness of interaction
Cognitive	▪ Cognitive processes, such as relevance judgments ▪ Effects of state of knowledge, intent, task(s), beliefs, emotions, etc. ▪ Changes in state of knowledge, intent, task(s), beliefs, emotions, etc.
Situational	▪ Effects of tasks or problems ▪ Tasks or problems ▪ Changes in the problem ▪ Categorization of problems

User behavior in IR research focuses primarily on three areas: (a) relevance, (b) cognition, and (c) process-orientation (Hert, 1997). Relevance research identifies users' relevance criteria, investigates how the criteria are used, and examines the dynamic and situational nature of relevance in the IR interaction. The focus is on a single behavior, relevance judging, and the IR system itself is seen as part of a user's overall context. Research into users' cognitive behaviors employs frameworks and methods from cognitive psychology to study user characteristics, for example individual differences in searching experience or educational status, and their effect on user behavior in IR system interactions. While providing a number of variables that effect the search process, these studies have had little impact on IR system design (Borgman, 1996; Saracevic, 1991). Process-oriented approaches to IR research focus on the user's movement through a process of "sense making". This process begins with an ill-defined or undefined information need and proceeds through stages of ambiguity and clarity in the overall process of resolving the gap between the user's information need and the satisfaction of the need (Belkin, Oddy, & Brooks, 1982). Dervin (1983) identified three stages in a user's sense-making process: selection, evaluation, and use. An actively engaged user's goals and strategies change at various points in the overall process (Harter, 1992). Research into sense-making processes is often done in a naturalistic tradition that results in a holistic description of the process, including cognitive, affective, and environmental characteristics (Hert, 1997; Kuhlthau, 1991). Of the three areas of user behavior research, this study is most related to relevance judgments, specifically the identification of relevance criteria.

Relevance Judgments

Relevance Factors and Traditional IR Research

Saracevic defined the construct of relevance in the context of communications and communication problems "as a measure of the effectiveness of a contact between a source and destination in a communication process" (1975, p. 88). In traditional IR research the source is the IR system and the destination is the user. Traditional IR research is largely concerned with the measurement of IR system effectiveness in terms of the "match paradigm". Such measurement is concerned with topicality, that is, measurement of the degree of relatedness between the user's query topic and the system's retrieved matches. Prior to measuring IR system relevance based on topicality, expert judges determine the relevance of all items within the system. Typical measures of the topical relevance of a given search are recall, the number of relevant documents retrieved relative to the total number of documents prejudged as relevant, and precision, the number of relevant documents retrieved relative to the total number of documents retrieved (Harter, 1996).

Traditional IR research identified factors that affected judge's relevance evaluations (Schamber et al., 1990). Cuadra and Katter (1967) identified 38 factors that influenced relevance judgments and Rees and Schultz (1967) identified more than 40 factors. Cooper (1971, 1973) proposed a wide range of factors that might contribute to a user's sense of the value or utility of retrieved items relative to system output. Each of these researchers shared Saracevic's (1975) view of relevance as a measure of the effectiveness of communication between source and destination, that is, as a measure of the match between IR system output and users' queries. The notion that relevance had a subjective as well as an objective facet was supported by the many individual, situational, affective, and cognitive factors identified. Schamber (1994) presented a table of 80 relevance factors identified in traditional IR research. She grouped the factors into six classes: judges, requests, documents, information system, judgment conditions, and choice of measurement scale.

User-Defined Relevance Criteria

User-defined relevance research focuses on the factors that affect relevance judgments made by real users, as opposed to expert judges. This research examines how real users react to the output of IR systems and on the criteria real users employ to evaluate the output (Harter, 1996). Identifying user-defined criteria is generally done with users outside of the actual IR interaction using qualitative research methods (Hert, 1997).

Schamber et al. (1990) proposed 12 research questions that set a stage for user-defined relevance criteria research. In large part, these questions seek to identify (a) the criteria users employ in assessing the value of information, (b) the characteristics of documents that are contained in users' criteria, (c) the characteristics of documents that users say they want to use in information seeking, and (d) the clues or indicators to the characteristics of documents. Documents include text, images, and presumably any information object. The questions suggest a possible relationship between user-defined relevance criteria, characteristics of information objects, and indicators of an object's characteristics. The inference is that if this relationship does exist, then IR systems may be able to incorporate indicators that match users' criteria for assessing the value of information objects. Users might be able to employ clues in the IR system output that indicate the important characteristics of information objects which users employ when evaluating IR system output.

In an exploratory study, Schamber (1991) investigated the criteria 30 users of weather information employed to evaluate multimedia information sources. An open-ended time-line interview questionnaire elicited recent events in which the respondents had weather-related questions. Respondents identified the information sources they had consulted and the ways in which each source had made a difference in answering their questions or resolving the situation. Content analysis of the responses identified 10 evaluation criteria: currency, geographic proximity, specificity, accuracy, reliability, verifiability, accessibility, presentation quality, dynamism, and clarity. These criteria related to three criteria categories: information, sources, and presentation type. The percentage of the frequencies with which each criterion was mentioned at least once by any of the respondents indicated the relative importance of the three criteria categories: information (41.6%), sources (32.3%), and presentation type (26.1%). The distribution of criteria across respondents suggested a finite range of criteria might exist. Additionally, geographic proximity was the only criterion of the ten criteria not previously identified in traditional IR experimental research in the general category of user-related (versus system-related) factors affecting relevance judgments.

Park (1993) investigated the factors affecting relevance judgments of bibliographic citations in a university setting. Using qualitative research methods in a naturalistic setting, ten participants, either academic faculty or doctoral students, described their reasons for selecting citations that resulted from a search based upon each participants' queries. Elements of citation records that affected participant assessments of relevance were not limited to topicality or subject matter. For example, the elements "publication date" and "institutional affiliation of author" provided information that affected relevance assessments. Park identified four classes of factors affecting relevance assessments: (a) users' perceptions concerning elements of the citation; (b) internal characteristics of users; (c) external context or users' perceptions concerning aspects of the search; and (d) problem context or characteristics of users' information problems.

Barry (1994) suggested that it might be possible "to improve the information retrieval mechanism to some degree by attempting to incorporate clues that users can employ to detect qualities other than topical appropriateness" (p. 152). If document representations contain clues that indicate whether documents contain the topical and non-topical criteria users employ in selection, then IR systems might better serve users' needs. Barry investigated the criteria 18 academic users employed to pursue or to not pursue documents based on document representations. The document representations were retrieved from an IR system in response to actual information needs of the users. Users circled or crossed out areas within the document representations to indicate items that prompted them to pursue or not pursue some aspect of the document. Subsequently, users were interviewed regarding their choices. Content analysis of the interviews identified 23 relevance criteria employed by users. No new criteria were found after the ninth interview, supporting Schamber's (1991) proposition that a finite number of relevance criteria existed across users and use environments. The criteria were grouped into seven classes: information content of the documents, users' previous experience and background, users' beliefs and preferences, other information and sources within the information environment, sources of documents, physical characteristics of documents, and users' situations. All users mentioned criteria beyond topicality or information content in their interviews, indicating that situational, cognitive, affective, and environmental factors influenced their relevance judgments. This supports the assertions of other researchers that information retrieval systems typically fail to include the representation of evaluative relevance factors such as comprehensibility, credibility, importance, timeliness, and style that affect users' satisfaction with an IR system (Maron, 1977; O'Connor & O'Connor, 1998).

Barry and Schamber (1998) compared the relevance criteria identified in their studies (Barry, 1994; Schamber, 1991). The comparison resulted in 10 common categories of criteria: depth/scope/specificity, accuracy/validity, clarity, currency, tangibility, quality of sources, accessibility, availability of information/sources of information, verification, and affectiveness. They suggested these common categories represented a core of criteria characterized as being (a) employed by users across diverse user environments, (b) utilized in diverse information need situations, and (c) pertinent to diverse information types. Criteria that were not commonly employed were assessed as unique to particular situational contexts.

Wang and Soergel (1998) proposed and validated a document selection model that included four components: (a) document representations, which are comprised of document information elements (DIEs), such as title, that provide clues to documents; (b) criteria, which are a set of document evaluation filters; (c) values, which are users' perceptions of the potential utility of documents to satisfy needs; and (d) decisions, which are based on document value. A pilot study had determined two classes of evaluation criteria: document content criteria and situational criteria. Document content criteria included topicality, orientation/level, discipline, novelty, quality, recency, reading time, availability, and spatial requisite. Situational criteria included authority and relation/origin. The content of evaluation transcripts from 25 academic users, professors or graduate students, was analyzed for each of the four components in the proposed model. Relationships between any two adjacent components were suggested by their frequencies of co-occurrence. Relationships between the 11 criteria and 10 of the 17 DIEs were identified, for example, the DIE "publication date" provided a clue to the criterion "recency". Additionally, DIEs not available in the document representations, specifically table of contents, citation status, and author's expertise, were identified as important for providing clues to users' selection criteria. Comparisons of this study's criteria with the user-defined criteria identified by other researchers (Schamber, 1991; Barry, 1994) supported the possibility that a core set of criteria, which goes beyond topicality, exists across users and tasks. Inclusion of information elements that provide clues to user's evaluation criteria in document retrieval systems was suggested.

In agreement with the research agenda outlined by Schamber et al. (1990), Barry and Schamber (1995) suggested that future research regarding user-defined criteria investigate in detail the relationship between criteria and information content. Specifically, they suggested examining representations of information, such as abstracts and citations, to identify the clues they contain to users' relevance criteria. Barry (1998) conducted further analysis of interview data from 18 academic users (Barry, 1994) to determine the relationship between document representations and clues to document relevance. Users' responses were classified into three broad categories: (a) information content only, (b) reference traits, and (c) relevance criteria. Users' responses were also categorized by their relationship to one of eight document characteristics: full text, abstract, title, source traits, indexing terms, note-content, note-references, and document traits. The co-occurrences of response categories and document characteristics indicated that some clues are related to document representations. Certain relevance criteria co-occurred only with specific document representations suggesting that a user's ability to assess the relevance of a document was related to the specific representation of the document.

Networked Information Discovery and Retrieval

Networked Information Discovery and Retrieval (NIDR) systems are "systems that assist users in the processes of discovery and retrieval" (Lynch, 1995, p. 3). They are very large-scale information systems operating in the high demand, distributed, Internet network environment characterized by a collection of heterogeneous systems and users. Lynch identified three generations of research and development projects related to resource discovery in the Internet environment: (a) manually compiled directories, (b) data collection systems, and (c) distributed indexing systems.

The first generation emerged in the late 1980's and consisted of manually compiled directories of Internet resources. The directories were available in text and electronic versions. Obsolescence was a constant problem and the explosive growth of the Internet in the 1990's brought an end to comprehensive human-generated Internet resource directories.

The second generation of research and development projects consisted of data collection systems, many of which remain an integral part of the Internet infrastructure. Table 3 provides a list of projects and applications within this generation. The earlier efforts, notably Archie and Veronica, provided sparse descriptive data and no evaluative data about resources. Later efforts attempted to add evaluative data and richer resource description to assist users in the process of resource selection. The second generation gave rise to a large number of databases and two types of resource discovery problems emerged: database selection and differing search syntax across systems.

Table 3
Second Generation Resource Discovery Systems

System	Description
Archie	Searchable database of files in FTP archives
Veronica	Searchable database of menu entries in Gopherspace and of pages in the World Wide Web
Internet bibliographic cataloging projects	Searchable databases of traditional library catalog records for Internet resources ▪ InterCat project ▪ CATRIONA[a]
Catalog and locator projects	Searchable databases of descriptive records, generally developed for specific domains ▪ GILS (Government Information Locator Service) ▪ Planetary and remote sensing ▪ CIMI[b]
WAIS (Wide Area Information Server)	Distributed client-server information retrieval system, including a directory of WAIS servers
Commercial databases	Searchable databases and cross-database searching ▪ Dialog ▪ Research libraries

[a]Cataloguing and Retrieval of Information Over Networks Applications (CATRIONA) project identified in Woodward (1996). [b]Consortium for the Computer Interchange of Museum Information (CIMI) identified in Vellucci (1998).

The third generation of research and development projects consisted of distributed indexing systems. These systems perform sophisticated indexing of digital objects located at source servers, provide query-processing services, and rank search results. Examples of third generation systems include Harvest, Lycos, and filtering agent services. Descriptions of these systems and the others identified in Table 3 are available from Lynch (1995), Vellucci (1998), and Woodward (1996).

Ward, Wood, Finnigan, and Iannello (1996) identified issues involved in creating a standard interface to queriable networked information resources and evaluated possible solutions. Two existing international standards for information retrieval in a networked environment are the Z39.50 Information Retrieval Protocol and the X.500 Directory Access Protocol (DAP)/Lightweight Directory Access Protocol (LDAP). Three candidates for future solutions are (a) Z39.50 Lite, a stripped-down version of Z39.50; (b) The Stanford Protocol for Internet Retrieval and Search (STARTS); and (c) Common Object Request Broker Architecture (CORBA) object query service. Among the factors affecting the adoption of any standard interface, two are critical: the standard must be "developed quickly and allow for easy migration from existing systems by having adequate tool support" (Ward et al., 1996, p. 1).

Organization of Networked Resources

In a review of Internet information retrieval research, Chowdhury (1999) identified 10 areas of research under the umbrella of NIDR including the organization of information. Representation, classification schemes, and access points remain important in networked information discovery and retrieval systems (A. G. Taylor, 1994). Resource description in a networked environment involves the selection of categories or metadata elements that represent the information needs of one or more stakeholder groups.

Woodward (1996) identified three categories of classification and cataloging projects for the Internet: (a) automatic classification, (b) subject trees, and (c) Internet cataloging. Using Lynch's categories, automatic classification projects, for example the Nordic WAIS/WWW Project and Harvest, would be considered third generation research and development projects. Subject trees and their progeny and Internet cataloging would be considered second generation projects.

The creation of subject-based electronic gateways for Internet information resources is similar to traditional subject analysis for information discovery in libraries. The U. K. Office for Library and Information Networking (UKOLN) participates in seven projects related to resource description (U. K. Office for Library and Information Networking [UKOLN], 1999). One of these is the Resource Organization and Discovery in Subject-based Services (ROADS) project. The ROADS project produces software for the creation of subject gateways for online resources. Several projects, principally in the United Kingdom, have ROADS-enabled subject gateways. The gateways are actually metadata repositories organized within a particular subject domain.

The Electronic Libraries Programme (elib), a project that supports the higher education communities in the United Kingdom, utilizes subject gateways. Each resource object in elib's ROADS subject gateway has embedded Dublin Core (DC) metadata and the ROADS record for each resource includes this DC metadata in addition to the ROADS-specific metadata. A comparative evaluation of subject gateways by the elib project listed four models for subject gateways (Haynes, Streatfield, Cookman, and Wood, 1998). The first model includes general-purpose gateways providing access to a wide-range of Internet resources that have been selected and evaluated. The second model is for gateways specific to resources that have been evaluated for both quality and subject relevance in a particular subject area or a group of disciplines. The third model is for institution-based gateways developed by librarians and specific to an organization or institution. The fourth model includes all-purpose gateways and involves the use of a search crawler and automatic indexing algorithms.

Automatic indexing is the dominant mechanism for the creation of databases developed by Internet search services, commonly called search engines. Search engines are a common method of searching the Internet. In an effort to provide both a consistent nomenclature for research regarding Internet search engines and to clarify the differences between search engines that might impact research results, Nicholson (1998) proposed a category scheme for Internet search engines. He identified five types of search engines or search tools, their characteristics in six dimensions, and their relative advantages. The five types of search tools are: directory-based, for example Yahoo; full-text, for example Alta Vista; abstracting, for example Lycos; subject-specific, for example Achoo; and meta-search, for example Dogpile.

Ellis et al. (1998) reviewed the traditional practice of subject analysis in information retrieval systems and the unique requirements posed by hypertext and Internet environments. They asserted that traditional indexing ideally incorporated resource description in the context of particular purposes and users. The nature of the Internet is such that indexers and users are unknown to one another. They termed this distance and unfamiliarity between the people who index Internet resources and the people using the resources "the problem of indexing for the unknown user" (p. 44).

Lynch (1995) identified some future needs for resource description in the Internet environment. He stated that there is little research regarding information use environments on the Internet and suggested the Internet required a richer resource description than other IR environments, such as the traditional library. Lynch identified three resource description issues in an Internet environment: (a) describing resources at multiple levels of granularity and aggregation, (b) describing databases and integrating these descriptions with individual objects, and (c) combining algorithmically generated data with human generated descriptive and evaluative data.

NIDR Systems and Users

Searching on the Internet is often an unsatisfactory experience for users (Gudivada et al., 1997). In general practice, search engines return very large search result lists that are not ranked. Often, relevant documents are either not retrieved at all or are embedded deep within a long list. Lynch (1997) stated the basic problem emerges amid an Internet information glut with which human indexers cannot cope. Automated indexers, that is spiders, web crawlers, and indexing robots, attempt to deal with this information glut on the Internet. However, automatic indexers have difficulty identifying the overall theme of a document and its genre, for example, a poem versus an advertisement. The result is that search results are often high in volume and low in relevance.

One solution is attaching metadata elements representing information objects to web pages. Lynch (1997) suggested the library community's expertise at classification and selection be combined with the computer science community's information storage and indexing expertise. Metadata could be created either by an automated process, by catalogers working with subject matter experts, or a combination of both methods. Reflecting R. S. Taylor's (1991) concept of information use environments, Lynch stated that metadata creation will depend on users' needs. For example, communities of scholars will need organized collections similar to the digital library concept while general information seekers may like the "democratic" style of the search engines. Both of these approaches were identified in the subject gateway models previously discussed (Haynes et al., 1998). A core issue in the selection of approaches is economics. Lynch concluded that

> users willing to pay a fee to underwrite the work of authors, publishers, indexers and reviewers can sustain the tradition of the library. In cases where information is furnished without charge or is advertiser supported, low-cost computer-based indexing will most likely dominate -- the same unstructured environment that characterizes much of the contemporary Internet. Thus, social and economic issues, rather than technological ones, will exert the greatest influence in shaping the future of information retrieval on the Internet. (Lynch, 1997, p. 1)

Metadata

At the center of any discussion of networked resource description and discovery is the concept of metadata. Metadata "refers to any data used to aid the identification, description and location of networked electronic resources (IFLA, 1999). Dempsey and Heery (1997) defined metadata as "data associated with objects which relieves their potential users of having to have full advance knowledge of their existence or characteristics" (p. 3). The extension of traditional library cataloging concepts and techniques to include electronic objects has necessitated a broadening of the concept of cataloging to include the concept of metadata for networked information resources (McCue, 1996).

There is a range of metadata specifications, some quite meager and some quite rich in their ability to represent information resources. Both the International Federation of Library Associations and Institutions (IFLA, 1999) and UKOLN (Dempey & Heery, 1997; Heery, 1996) published a list of metadata standards and specifications implemented in projects and trials. The sheer number of metadata projects may be the biggest stumbling block in the way of the coordinated development of metadata standards (Milstead & Feldman, 1999a).

Metadata projects typically specify a set of elements, each of which describes an attribute of the resource, its management, or its use (Vellucci, 1998). Taken together, these elements comprise a "record" that represents a resource. Dempsey and Heery (1997) suggested three broad categories or bands for metadata sets based on the characteristics of their metadata records. Records in the first band are typically unstructured data, employing simple formats, and created by automatic indexing of full-text objects. These records do not support searching by specific elements or fields and the record format is typically proprietary. Examples in band one include Lycos and Altavista. Band two metadata records are typically structured in format providing a set of elements or fields that support fielded searching and user evaluation of the utility of a resource without the user needing to retrieve or connect to it. The Dublin Core Metadata Initiative is an example of a band two metadata set. Band three metadata records provide rich descriptive formats for resources. These sets typically support the location, discovery, and evaluation requirements of specific communities, particularly scholarly or research communities, such as the geospatial or museum communities.

Types of Metadata

The creation of various metadata sets is a function of many factors, including (a) purpose, for example traditional descriptive information or information employed by client applications regarding resource format; (b) types of users, for example customers and researchers; (c) types of resources, for example temporary and fleeting versus valuable scholarly and commercial resources; (d) complexity of resources, for example simple versus complicated; (e) information providers, for example different organizational structures, target audiences, and products; and (f) links to resources, for example metadata intrinsically coupled with objects or decoupled (Dempsey & Heery, 1997).

Vellucci identified four broad classes of stakeholders interested in metadata:

> . . . computer scientists and engineers who develop Internet search engines and create standards for Internet documents, the scholars in specific disciplines who develop Internet texts and image documents and databases, the librarians and archivists who organize and provide access to electronic resources, and the general Internet users who want to improve web site retrieval. (1998, p. 187)

Lagoze (1996) described seven classes of metadata required by various applications within an information infrastructure: descriptive cataloging, terms and conditions, administrative data, content ratings, provenance, linkage or relationship data, and structural data. In describing the Resource Description Framework (RDF), a framework for metadata that provides for the exchange of machine-understandable metadata among Web-based applications, Berners-Lee and Swick (1999) stated that metadata can serve a number of different purposes. Specifically, metadata supports several application areas, including resource discovery, cataloging, intelligent software agents, content rating, collection description, and intellectual property rights. In order to support diverse applications, metadata beyond that which describes networked information resources for discovery purposes is required, for example, metadata about people, about courses, about research departments, and about other types of objects (Dempsey & Heery, 1997).

Lynch (1995) broadly classified metadata into two types: descriptive and evaluative. Descriptive metadata is similar to the data resulting from traditional library cataloging efforts. Evaluative metadata may be required by users in a networked environment in order to make a selection decision. Examples of evaluative metadata might include resource reviews or the number of times a resource was selected by previous users.

Ip, Currie, Morrison, and Mason (1999) propose a three-tier model for distributed resource discovery. Different types of data are associated with each tier. Type 1 data are the resources users discover and use, such as web pages, lesson plans, or Computer

Assisted Instruction packages. Type 2 data are derived from Type 1 data and sometimes function as surrogates for Type 1 resources in an IR system. Automatically indexed terms and metadata are Type 2 data. Type 2 metadata is defined from two perspectives: descriptive and evaluative. In an educational subject gateway service, for example, the Education Network Australia (EdNA) subject gateway, evaluative metadata data might include the level of student for whom a resource is intended or a resource creator's recommended pedagogy. Type 3 data is external to Type 1 and Type 2 data. For example, Type 3 data may include some elements specified in a metadata standard whose values are not derived from the resource itself, for example, a "keyword" metadata element whose values are selected from a classification scheme.

Vellucci (1998) organized metadata element sets into four categories: (a) early metadata and the Internet community; (b) MARC and the library community; (c) SGML-based metadata and the scholarly, archival, and museum communities; and (d) domain-specific metadata. Her review is a companion to Woodward's 1996 review of strategies for organizing and accessing resources on the Internet. Taken together, these two reviews provide descriptions of a wide array of metadata projects from 1900 to 1998.

Vellucci identified one metadata scheme, the Dublin Core (DC), as emerging in a cooperative international effort to design and test standards for metadata content in support of interoperability of metadata in a networked environment. The Dublin Core is also described as the "leading candidate for achieving the goal of simple resource description for Internet resources" (Weibel, 1999, p. 1). Milstead and Feldman (1999b) identified the Dublin Core as the best candidate for a lingua franca for metadata.

The Dublin Core

The Dublin Core metadata set is a specification for the description of resources in support of cross-disciplinary resource discovery (Weibel, Kunze, Lagoze, & Wolf, 1998). This 15-element set of descriptors is explained in the Internet Engineering Task Force (IETF) Request for Comment number 2413 (RFC 2413) and is implemented in a wide range of production information retrieval systems and test projects principally in North America, Europe, and Australia (DCMI, 1999b). The elements fall into three general classes: content, intellectual property, and instantiation (see Table 4).

Table 4
Dublin Core Metadata Element Set

Content	Intellectual Property	Instantiation
Title	Creator	Date
Subject	Publisher	Format
Description	Contributor	Identifier
Type	Rights	Language
Source		
Relation		
Coverage		

One overarching goal of the DC effort is to facilitate interoperability among various metadata schemes across domains. The DC specification will be compliant with the Extensible Markup Language (XML), the standard replacing the Hypertext Markup Language (HTML) as the markup language for the World Wide Web (World Wide Web Consortium [W3C], 1998). Additionally, the DC specification works within the World Wide Web Consortium's (W3C) RDF, enabling resource discovery using the DC metadata specification across diverse communities of interest.

The Dublin Core Metadata Initiative sponsors a number of working groups to address problems in the ongoing maintenance and elaboration of the DC specification (Weibel, 1999). As communities of interest implement the DC standard, they typically identify extensions to the 15 core elements to meet their particular requirements and qualifications to the elements tailored to needs of their community. An Education Working Group was established with the following charter in August of 1999.

> The objectives of the working group are to discuss and develop a proposal for the use of Dublin Core metadata in the description of educational resources. The scope includes educational resources applicable for many national education communities and cross-sectoral communities (e.g., K-12, further and higher education and lifelong learning).
>
> The working group will develop qualifiers and/or extensions to the Dublin Core element set that will describe educational material for the purpose of enhancing resource discovery. It is expected that the resulting metadata will include educational qualifiers that fall within the scope of existing Dublin Core elements and potentially some that are specific to the domain of education. (Mason & Sutton, 2000, p. 1)

As a first step in identifying education-specific DC elements and element qualifiers, the DC Education Working Group analyzed five educational metadata sets used in metadata projects for education and training resources. These projects included the Gateway to Educational Materials (GEM), Education Network Australia (EdNA), the European Schoolnet (EUN), the Victorian Educational Channel (VEC), the Virtual

European School (VES), and the IEEE Learning Technology Standards Committee (LTSC). The DC Education Working Group also identified three projects as major contributors to and implementers of the IEEE LTSC LOM standard, which includes the 15 DC elements: the Instructional Management System (IMS), the Alliance of Remote Instructional Authoring and Distribution Networks for Europe (ARIADNE), and Getting Educational Systems Talking Across Leading-Edge Technologies (GESTALT). The IEEE LTSC LOM standard and these contributing organizations are described later in this document.

Each of the five DC-based project's metadata specifications incorporates the 15 core DC elements, however, most projects also extend the element set to reflect the needs of their stakeholders. For the most part, the metadata specifications are based on requirements elicited from the sponsoring or contributing member representatives, usually educational professionals, and from educators themselves. A brief description of each project follows and a listing of the Uniform Resource Locator (URL) for each project is in Appendix A.

In April of 2000 this working group proposed five additional metadata elements, two of which have qualifiers, for DC-based educational metadata (Sutton, 2000). These are listed in Table 5.

Table 5
Draft Recommendation for DC Education-specific Elements and Element Qualifiers

Element & Element Qualifiers	Definition
Audience[a]	A category of user for whom the resource is intended.
Mediator	An entity that mediates access to the resource.
Standard	Organization, state (province), national, or international content or process standard to which the resource being described is mapped.
Identifier	A notation that serves to uniquely identify the standard being referenced.
Version	Information identifying the version of the standard being referenced (e.g., a year of publication, a version number, etc.).
InteractivityType[b]	The flow of interaction between this resource and the intended user.
InteractivityLevel[b]	The degree of interactivity between the end user and this resource.
TypicalLearningTime[b]	Approximate or typical time it takes to work with this resource.

[a]Element also recommended for consideration as a 16th element to the DC element set.
[b]IEEE LTSC LOM elements.

Educational Metadata Projects

Education Network Australia (EdNA)

This project is funded by the government within Australia and provides education resource discovery tools and discussion forums for educators and learners within the country. The network operates a subject gateway server which includes metadata records for educational resources from 8,300 sites representing all sectors of the Australian educational community, including schools, vocational education and training, adult community education, and higher education. Each sector is represented in the EdNA project through an Advisory Group. These groups, comprised of educators and professional involved in Australian educational sectors, provide input regarding the requirements of their sectors. Learners are not formerly involved in establishing EdNA's direction and standards. Organizations wishing to contribute educational content to the network develop compliant metadata that is harvested by the EdNA gateway server and made available on the Internet to educators and learners. The EdNA metadata set includes 9 elements in additional to the 15 DC elements (see Table 6).

Table 6
Extensions to DC: EdNA Elements

#	Element	Description
1	Entered	Date item was entered as an entry in the EdNA item database (used for management purposes)
2	Approver	Email of person or organization approving the item for inclusion in EdNA.
3	Reassessment	The recommended date when the resource should be reassessed.
4	User Level	Typical level of user for which the content would be most appropriate.
5	Categories	Categories in the EdNA Directory.
6	Conditions	Do conditions apply to access to the resource?
7	Indexing	To what extent should the EdNA software resource indexer follow links from this page?
8	Review	A third-party review of the resource.
9	Version	EdNA Metadata Standard version for the metadata set in document.

Note. From "Edna metadata standard: Version 1.01." by J. Mason, 1998, September 22, Educational Network Australia [Online]. Available: http://www.edna.edu.au/EdNA/ [2000, April 21].

European Schoolnet (EUN)

The European Schoolnet is a consortium composed of Ministries of Education within Europe. The goal of the consortium is to ensure the interoperability of school networks throughout Europe and to offer teachers and students access to high quality information and services. The project has a multimedia resources focus and is building an educational server, the European Treasury Browser (ETB), that will enable identification of and access to educational resources in schools throughout Europe. Initially the project is comprised of a testbed of 500 schools. The project plan calls for an evaluation of the server by February 2002. It is not clear if learners, as well as educators and educational professionals will be formally involved in the evaluation. In the first half of 2000, 200 institutions on national, regional, and local levels throughout Europe were asked to participate in a study to identify existing metadata repositories and their use of metadata. The goal of the study is to build an interoperable layer for educational resources repositories, thereby enabling resource location on European-wide basis.

The European Schoolnet metadata standard is based on DC and was influenced by EdNA, DBS/GER, and GEM. In addition to the 15 DC elements, the metadata set includes three elements, one of which has six sub-elements (see Table 7).

Table 7
Extensions to DC: European Schoolnet Elements

#	Element	Sub-Element	Description
1	User Level		The intended users of the resource.
2	Version		A numeric indicator of the resource's or the product's version.
3	Metadata	Approver.PersonalName Approver.PersonalName.Address CorporateName CorporateName.Address Date-LastModified Release	An identifier of the metadata tool, its version number and a numeric indicator of the release number of the EUN metadata system. Also the date of last modification of the metadata, and the approver of the metadata.

Note. From "The EUN Data Handbook and Publication Guidelines", by M. Kluck, 1999, September 30, European Schoolnet [Online]. Available at http://www.educat.hu-berlin.de/~kluck/datahandbook_V_300.htm#_Toc454889610 [2000, April 26].

Gateway to Educational Materials (GEM)

The GEM consortium is located within the ERIC Clearinghouse at Syracuse University under the auspices of the US National Library of Education and the US Department of Education. The project is attempting to produce a national standard for educational resource discovery in a networked environment (Sutton, Lankes, Small, and Eisenberg, 1998). The discovery by educators of educational materials on the Internet has been the major focus of GEM. To that end, teachers were included in addition to metadata professionals in determining the metadata specification (Sutton, 1999).

The consortium has two principal membership groups: a users group and a collection holders group. To date, the project has extended the DC metadata set (see Table 8), developed a platform-independent tool for generating and harvesting metadata, and created "The Gateway", an Internet server with both browsing and searching capabilities (Sutton, 1999).

Table 8
Extensions to DC: GEM Elements

#	Element	Description
1	Audience	Information from a GEM controlled vocabulary that most closely identifies the specific audience of the resource being described
2	Cataloging Agency	The person/organization responsible for creating the metadata record
3	Duration	Time needed to effectively use the resource
4	Essential Resources	Resources essential to the effective use of the entity
5	Educational Level	Grade, grade span, or educational level of the entity's audience
6	Pedagogy	Denotes the teaching methods, student instructional groupings, assessment methods, and learning prerequisites
7	Quality Assessments	An assessment of the quality of the resource
8	Educational Standards	State and/or national academic standards mapped to the entity being described

Note. From " Networked information discovery and retrieval for educational materials on the Internet: Metadata development, deployment, and evolution", by S. A. Sutton, R. D. Lankes, R. V. Small, & M. B Eisenberg, 1998, ASIS '98: Information Access in the Global Information Economy. Pittsburgh, PA: Information Today, Inc.

Victorian Educational Channel (VEC)

The Victorian Department of Education's Curriculum Development and Learning Technologies Department within Australia funds this project. The principal output is an educational server called SOFWeb, which serves two major functions for the educational community within Victoria: access to educational resources and communication with other members of the community. The SOFWeb targets its resources for K-12 teachers and students, parents, and the wider community. The resources in SOFWeb's databases are also accessible through the EdNA server. This project utilizes only the 15 DC elements.

Virtual European School (VES)

Commercial educational publishing houses from Austria, Italy, Greece, and the United Kingdom fund this project. The goal of the project is to develop commercial teaching materials for secondary school education. The project provides teachers with intelligent agent software to discover learning resources and to compose lessons. The educational resources are multimedia in format and students are provided with a 3-D virtual environment interface to work with the resources. Evaluation and user trials of the products and services conducted in mid-1999 were a collaboration between educational publishers and educators and students at nine test schools. In November 1999, VES entered its pilot phase with 100 schools. During this phase, educators and students can provide feedback regarding features of the systems and tools.

EdNA (Education Network Australia, 1999) mapped the VES elements to the 15 DC elements. These 15 elements as well as 17 additional elements are organized into six groups that were influenced by the ARIADNE and IMS projects. Table 9 lists the groups and the 17 additional elements. Table 54 in Appendix B provides descriptions of the 17 additional elements.

Table 9
Extensions to DC: Virtual European School Elements

#	Group	Elements	
1	Bibliographic data		
2	General description		
3	Didactic data		
4	Technical information	• Content type • Document handle • File format • Size	• Data update on system • Time of download - • 28.8k/ISDN • Other requirements
5	Economic data	• Reserved rights	• Price
6	Meta-metadata	• Meta - author name • Meta - creation date • Meta - last modified date • Meta - language	• Meta - validator name • Validation date • Automatic expiring data • Check date

Note. Group and elements were identified in Rohatschek, H. (1999, September 10). VES metadata summary. DC-Education Listserv [Online]. Available: http://www.mailbase.ac.uk/lists/dc-education/1999-09/0006.html [1999, September 16].

IEEE LTSC: Learning Object Metadata Standard

IEEE P1484: Learning Technology Standards Committee (LTSC)

The Institute of Electrical and Electronics Engineers (IEEE) produces standards in several technology areas. One of the most commonly known set of standards is the group related to local area networks maintained by IEEE Project 802. The LTSC, Project 1484, is structured to support the specification of standards necessary for the implementation of an architectural and reference model for component-based computer aided instruction systems. This goal is carried out in a number of working groups, which develop standards and specifications. The committee has approved a Working Draft metadata standard developed within working group P1484.12, the Learning Object Metadata Working Group.

Table 10 identifies the nine categories in the base scheme of the LOM and provides an explanation of each. Appendix C provides a detailed list and explanations of the elements in the LOM version 3.6 working draft standard.

The IEEE LTSC LOM specifies "the syntax and semantics of learning object metadata, defined as the attributes required to fully and adequately describe a learning object" (Institute of Electrical and Electronics Engineers [IEEE], 1999, p. 4). The LOM supports the management, location, and evaluation of learning objects. One of its 12 purposes is "to enable learners or instructors to search, evaluate, acquire, and use learning objects" (IEEE, 1999, p. 4). The LOM also enables content delivery, performance tracking, resource sharing and exchange, and the personalization of content across a distributed object-oriented learning environment. While the LOM includes the 15 DC elements and makes explicit reference to them, its scope is broader than the scope of the DC Education Working Group, whose metadata is targeted at educational resource description to enhance resource discovery.

Four consortia have adopted the IEEE LTSC LOM specification: IMS, ARIADNE, GESTALT, and General Networked Teaching and Learning Environments (GENTLE). IMS and ARIADNE are described in the Stakeholder section that follows. GESTALT is conducting (a) user-based trials of a broker service for information on courses, modules, and available resources; (b) online access to these items; and (c) network performance trials (Fretwell Downing Education, 1999). GENTLE provides a set of tools for the delivery of multimedia courseware enhanced by digital library resources, annotation facilities, and discussion groups. GENTLE also provides management assistance for administrative functions and for developing courseware, as well as capabilities for individually customizing learning materials and evaluating the success of teaching (Maurer & Dietinger, 2000).

Table 10
IEEE P1484 LOM Categories in Working Draft Standard Version 3.6

#	Category	Definition
1	General	Context-independent features of the resource.
2	LifeCycle	Features related to the life cycle of the resource.
3	MetaMetaData	Features of the description rather than the resource.
4	Technical	Technical features of the resource.
5	Educational	Educational or pedagogic features of the resource.
6	Rights	Conditions of use of the resource.
7	Relation	Features of the resource in relationship to other resources.
8	Annotation	Comments on the educational use of the resource.
9	Classification	Description of a characteristic of the resource by entries in classifications.

Stakeholders

Stakeholders in the IEEE LTSC include corporations, industry groups, government entities, and academia. An architecture for learning technology systems has been specified by IEEE P1484.1, the Architecture and Reference Model Working Group. This architecture is the framework for the specification of the Learning Object Metadata standard. Significant contributions to the architecture were made by the organizations and projects listed in Table 11. IEEE LTSC shapes international learning technology standards by submitting its standards to the International Organization for Standardization (ISO) International Electrotechnical Committee (IEC) Joint Technical

Committee 1 (JTC1) - Information Technology, Subcommittee 36 (SC36) on Learning Technology.

Table 11
LTSA Specification Collaborators: Learning Technology Systems Architecture

Collaborator	Description
Department of Defense Advanced Distributed Learning Initiative (ADL)	A US Department of Defense organization, including industry and institutions, that is defining sharable course objects.
Aviation Industry Computer-Based Training (CBT) Committee (AICC)	A consortium of users and vendors in the aviation industry that has developed specifications for computer-based training.
European Committee for Standardization (CEN), Information Society Standardization System (ISSS), Learning Technologies (LT) Workshop	A work program requested by the European Commission from CEN/ISSS in support of the development of Europe's Learning Society.
ARIADNE	A European Union project on telematics for education and training; tools and methodologies for producing, managing and reusing computer-based pedagogical elements; learning technology metadata.
IMS	A cooperative of commercial, institutional, and government organizations developing technology for the education industry.
Promoting Multimedia access to Education and Training in European Society (PROMETEUS)	European education and training, interchange and interoperability, open and distance learning, for primary, secondary, higher education, and corporate environments.

Note. Adapted from "LTSA Specification: Learning Technology Systems Architecture, Draft 5," by F. Farance and J. Tonkel, 1999, Learning Technology Standards Committee [Online]. Available: http://www.edutool.com/ltsa.

The IEEE LTSC LOM specification was largely developed through collaboration between the IMS and ARIADNE projects. Stakeholders from three communities are involved in these two projects: government, corporate, and academia. Also substantial contributions to the specification came from the AICC, the ADL, and GESTALT (Wason, 1999).

IMS Global Learning Consortium (IMS)

IMS is an EDUCAUSE project funded under its National Learning Infrastructure Initiative (NLII), an organization dedicated to the mission of creating new collegiate learning environments. The U.S. Department of Defense works indirectly with IMS through its ADL initiative. IMS is a major partner in the development of standards for the ADL initiative. As a result of its relationships with EDUCAUSE and the ADL Initiative, the interests of military and collegiate institutions come together in the IMS project. Additionally, IMS has a number of commercial partners participating as both development members and as users.

The IMS project goals are (a) to define specifications for "interoperability of applications and services in distributed learning" and (b) to support "the incorporation of the IMS specifications into products and services worldwide" (IMS Global Learning Consortium, Inc. [IMS], 2000, p. 1). The objective is to enable interoperability of instructional systems and content by facilitating online distributed learning activities including "locating and using educational content, tracking learner progress, reporting learner performance, and exchanging student records between administrative systems" (IMS, 2000, p. 1). IMS is a consortium with two classes of members: investing members from academic, corporate, non-profit, and government organizations and the IMS developers network.

IMS specifications, based in part on requirements from meetings and focus groups with IMS members, are developed to meet interoperability requirements in international learning markets. Specifications are tested through technical interoperability trials conducted by investment and developer members, who themselves may be users of systems implementing the specifications. Once tested and refined, specifications are approved by the IMS Technical Board and are made available to the public at no cost. IMS is working with the U.S. National Institute of Standards and Technology (NIST) to develop conformance-testing procedures to certify software products as "IMS-compliant".

Alliance of Remote Instructional Authoring and Distribution Networks for Europe (ARIADNE).

ARIADNE is supported financially by the European Union Commission and by the Swiss Federal Office for Education and Science (OFES). The goal of this research and development project is to create tools and methodologies for producing, managing and reusing computer-based pedagogical elements and telecommunication-supported training curricula within the European Community. ARIADNE has seven sponsoring partners, 24 contractors, and two user groups: a corporate user group comprised of representatives from sponsoring organizations and an academic users' group open to members of all European public service universities and higher education institutions. The European Union Commission funds ARIADNE as a research and technology development project pertaining to the "Telematics for Education and Training" sector of the 4th Framework Program for Research and Development. Academic and corporate entities across Europe are involved in validation trials of the project's tools and specifications. Three classes of users are involved in the validation trials.

1. Authors of pedagogical documents: faculty, education managers, and students;

2. Producers and administrators of training courses: trainers, training managers, and pedagogical engineers;

3. End users: researchers, students, trainees, and open and distance learners.

Both IMS and ARIADNE have developed metadata specifications. Additionally, IMS has had some limited trials of its specification while ARIADNE has ongoing validation trials. Given the participation of both IMS and ARIADNE in the IEEE LOM specification, this standard may be well informed by the needs of higher education, especially the needs of instructors and administrators in a distributed learning environment.

Formative Evaluation

Evaluation is associated "with how effective or ineffective, how adequate or inadequate, how good or bad, how valuable or invaluable, and how appropriate or inappropriate a given action, process, or product is in terms of the perceptions of the individual who makes use of the information provided by an evaluator" (Isaac & Michael, 1995, p. 8). Design and development of new things, whether educational resources, information retrieval systems, or international standards, often involves two types of evaluation: formative and summative.

Harter and Hert (1997) identified the inclusion of formative evaluation, in addition to summative evaluation, as an emerging theme in IR evaluation research. They distinguished these two evaluation types.

> Summative evaluation is defined as post hoc, or evaluation at an end point in order to assess a completed system or project. Formative evaluation occurs as the process or product develops, with the intent of assessing and often changing that process in real time. As the speed at which systems change increases (one needs only to think of the Internet), there is a concomitant increase in inability to freeze the system in order to perform a summative evaluation. (p. 52)

Harter and Hert suggested an increased blurring of the distinction between design and evaluation was occurring. The Alexandria Digital Library project is one example of this blurring (Hill et al., 2000). The project is implementing an IR system for a collection that focuses on georeferences such as maps and images. Design of three user interfaces to the system was preceded by user needs assessments. Ongoing development involves systematic user evaluations that are used as input to the design and refinement of the system.

Allen (1996) critiqued the design-evaluate-redesign cycle that characterizes most IR system development on the grounds that evaluation occurs post hoc if at all, that redesign is only capable of incremental improvement, and that the quality of the base system design is dominant. He suggested an integrated, user-centered approach to design and evaluation to address these problems. In this approach, system-independent assessment studies of user needs, tasks, and resources precede design. This type of assessment provides a baseline from which to evaluate changes in user needs, tasks, and resources on an ongoing basis. In this manner, IR system evaluation would include user-centered criteria, or usability criteria, in addition to the traditional evaluation measures of retrieval effectiveness and device performance.

Formative evaluation is an important stage in the design of computer based instructional (CBI) materials (Smith & Ragan, 1993). Three types of instructional analysis precede the design of CBI materials: learning context, learners, and learning task. These analyses inform design activities. Formative evaluation occurs prior to completion of the materials for the purpose of identifying weaknesses in the instruction that can be eliminated in order to improve the effectiveness and efficiency of instruction.

Discussing program evaluation, Isaac and Michael (1995) differentiate needs assessment, program planning, formative evaluation, and outcome evaluation. Formative evaluation has two components: implementation evaluation, which discovers discrepancies between a plan and reality, and progress evaluation, which monitors indicators of progress toward objectives. In both types of formative evaluation, problems are identified and corrected prior to final implementation of the program.

Summary

The tradition of information retrieval research is empirical and the measurements of experimental outcomes are largely quantitative and system-performance based. This tradition is grounded firmly in the early Cranfield experiments of the 1950's and 1960's and continues with the current TREC experiments. There are alternative approaches within information retrieval research. Ingwersen (1994) identifies three schools of current information retrieval research: (a) statistical approach, (b) linguistically based, and (c) user-oriented. The first two of these derive from a mainstream information science system-driven tradition. The latter school is often characterized as representing a paradigm shift within information science research (Dervin and Nilan, 1986). This research study is concerned with users of an educational information retrieval system and is more closely aligned with the user-centered tradition of information retrieval research, especially user-defined relevance criteria research.

Interaction in the information retrieval process is "the interactive communication and seeking processes that occur during the retrieval of information by involving all the major participants" (Ingwersen, 1994). Ingwersen identifies these areas of study within Information Retrieval research: aboutness, representation or indexing, retrieval technique development and performance, interface functionality and request model building, relevance and informativeness. This research is concerned with the areas of representation and relevance.

It is sensible to view metadata and the creation of metadata as continuations of the work of traditional catalogers. In a networked information environment, metadata specifications enable the development of applications and services to identify, locate, and evaluate information resources. In order to fulfill these important functions, metadata must be sufficiently comprehensive to be useful to the range of stakeholders within any domain. In the higher education domain, students are significant stakeholders. In order to meet students' needs for identification, location, and subsequent evaluation of higher education courses, it is important to identify the metadata elements that represent students' criteria for course selection. One important reason for doing so is illustrated by the difference between courses and documents. Higher education courses are experiential objects that require commitments of time and money once selected while documents are often available at little or no cost and generally have no temporal requirements for their use. In the absence of experiencing the course itself, students may rely in large part upon metadata for course selection.

In addressing the subject classification needs of users, Solomon (1991) states that "demands put on the classification scheme by real people having real information needs will at times diverge from the expectations of designers." Similarly, users' real world requirements for both descriptive and evaluative elements in a metadata scheme might differ from the elements a scheme's designers create. In order to keep users' information needs visible in the design of systems and standards, formative evaluation activities are undertaken. This study evaluated the IEEE LTSC LOM metadata specification vis-à-vis students' course selection criteria.

The participation of IMS and ARIADNE in the IEEE metadata specification provides some indication that the metadata requirements for the higher education community will be addressed in the IEEE LTSC LOM standard. EDUCAUSE, the project sponsor of IMS, has a particular focus on higher education and ARIADNE has several universities involved in validation trials. However, it appears that neither ARIADNE, IMS, nor any of the educational metadata projects identified within the DC Education working group, solicited requirements from students prior to establishing their metadata sets. Perhaps educators, universities, publishers of educational materials, educational software developers, commercial training organizations, and government educational entities are well positioned to define the metadata which reflects the criteria students use in the selection of higher education courses. On the other hand, for the explicit purpose of students selecting higher education courses, the developers of educational metadata standards may not have fully considered students' needs. It is obvious that students are an important stakeholder group within the higher education community and the exploration of the criteria they use in the selection of higher education courses is a much needed research area.

CHAPTER 3

METHOD

The objectives of this study were (a) to identify the criteria students think are important for selection of higher education courses, (b) to inform the ongoing specification of educational metadata standards, and (c) to provide design requirements for future information retrieval systems supporting course selection in higher education. This exploratory study employed both qualitative and quantitative methods, specifically content analysis, survey questionnaire, and side by side analysis. This section specifies the study's research questions, research design, instruments, population and sample, data collection methods, and data analysis.

Research Questions

This exploratory study discovered the criteria students think are important for selection of higher education courses and the relationships between these criteria and students' demographic characteristics, educational status, and Internet experience. The criteria were used to evaluate the IEEE LTSC Learning Object Metadata Working Draft Standard version 3.6 for its inclusiveness of students' selection criteria. The following research questions guided this research.

1. What criteria do students think are important for selection of higher education courses?

2. Is there a relationship between the criteria students think are important for selection of higher education courses and demographic characteristics, specifically employment status, gender, age, and residential location?

3. Is there a relationship between the criteria students think are important for selection of higher education courses and educational status, specifically, education level, academic classification, enrollment status, and reason for enrolling in courses?

4. Is there a relationship between the criteria students think are important for selection of higher education courses and Internet experience, specifically, years of Internet experience, frequency of Internet access, and Internet skill level?

5. Does the IEEE LTSC Learning Object Metadata Standard include the criteria students think are important for selection of higher education courses?

Research Design

Conceptual Framework

This study is concerned with two concepts: relevance, specifically relevance factors and relevance criteria, and metadata, specifically educational metadata and the IEEE LTSC LOM specification. Additionally, this study is concerned with three underlying factors that influence the process of relevance evaluation: demographics, experience, and education.

Figure 1 situates these concepts and factors in an information retrieval framework. This conceptual framework incorporates the constructs of event space and milieu from O'Connor's (1999) Representation Context Web and elements of Lancaster's (1986) representation of the major components of an information retrieval system in a non-networked environment.

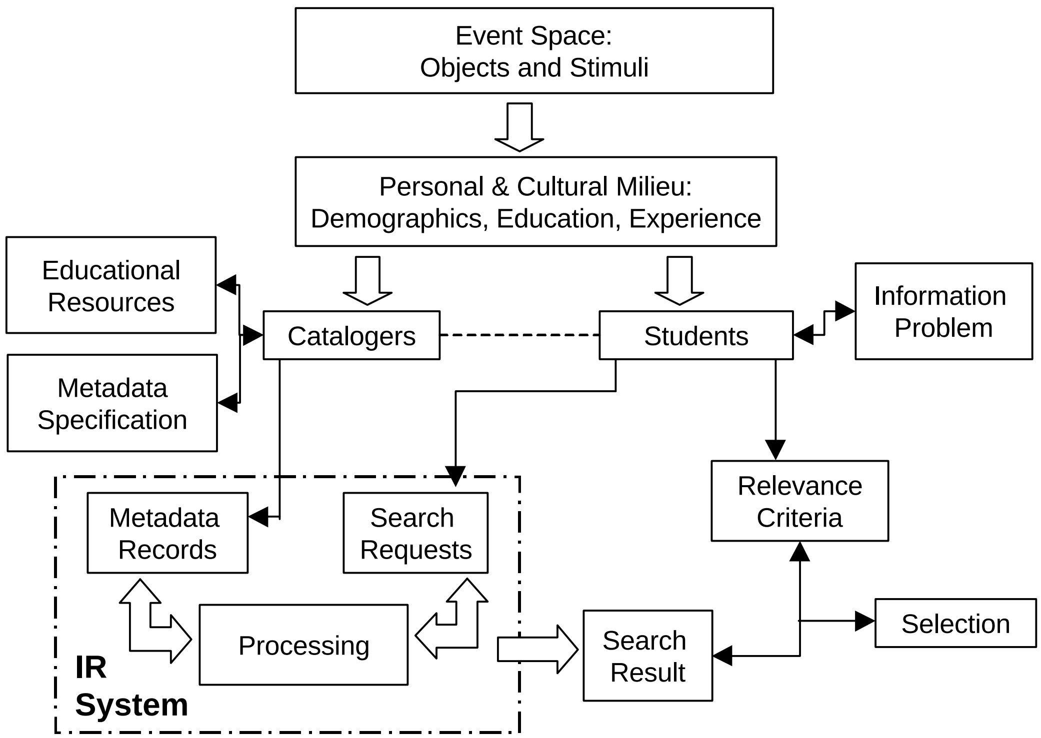

Figure 1. Conceptual framework of metadata and relevance in an IR environment.

Both catalogers and students exist as individuals within the context of their social and cultural milieu, through which objects and stimuli in an event space are filtered. The result of the filtration is a unique individual view of the world and its resource objects, with which the individuals interact. This unique individual view is manifest in the creation of metadata records by catalogers, who attempt to characterize educational resources using both their perceptions of students and standardized schemes, such as the IEEE LTSC LOM specification. Individual students uniquely (a) identify and interact with their information problems and (b) generate search requests and relevance criteria specific to themselves at a given point in time. The IR system attempts to match students' search requests with the metadata records representing educational resources. Students evaluate the results of the matching process for relevance to their information problems using relevance criteria. The end result is the selection of educational resources deemed to be relevant by users.

It is possible that users' information seeking process will include iterative search interactions with an IR system resulting from or informed by interim relevance evaluations. However, the relevance evaluation process itself is often isolated for research purposes (Barry, 1994; Hert, 1997; Park, 1993; Schamber 1991; Wang & Soergel, 1998).

The conceptual framework can be extended to a future networked information discovery and retrieval environment for educational resources (see Figure 2). The concepts of resource sites and search sites are discussed by Ip et al. (1999) who identify three layers of metadata in this framework: resource metadata, resource site metadata, and search site metadata.

Resource sites might include universities, corporations, or government entities. These sites create metadata records for the representation, evaluation, and management of educational resources such as courses. Resource sites may provide either the full set or a subset of this metadata to one or more search sites. Search sites might include both education gateways and public gateways. Gateways typically harvest standard metadata from participating resource sites. Students can interface with one or more resource sites and with one or more search sites. Matching students' search requests with metadata records for educational resources might be facilitated via a standardized communication rule set or protocol, for example the ANSI-NISO Z39.50 protocol specification for information retrieval. The protocol would specify the syntax and semantics for information requests and exchanges between clients and servers, for example between students' local browsers and resource and search sites.

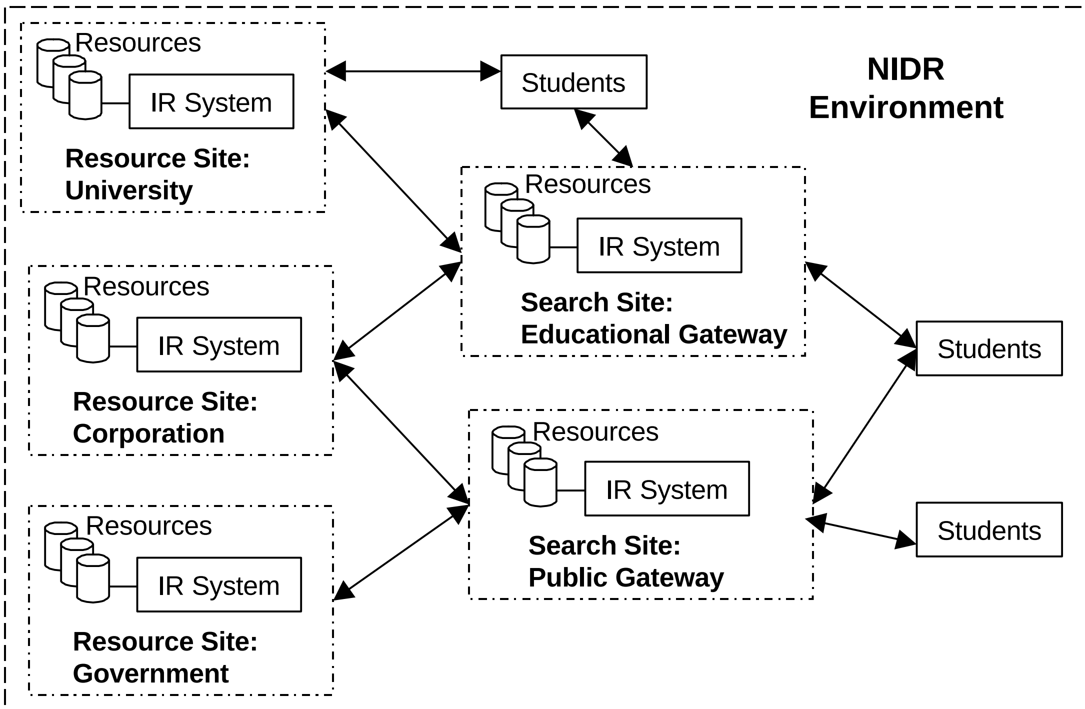

Figure 2. Future educational NIDR environment.

In an NIDR environment resource discovery involves three phases. Users must (a) discover the best databases for the resources they need, (b) interact with the resource sites or search sites to discover specific resources, and (c) merge the results and select relevant resources (Lynch, 1995; Ward et al., 1996). The results at each of these three phases are different: sites, search results, and relevant resources. This study investigated the criteria students think are important in the process of evaluating and selecting higher education courses from a range of possible options. Wang and Soergel (1998) developed a document selection model that differentiated this filtering process from the decision-making process per se. In the model, users interpret the elements representing documents based on their individual knowledge and their relevance criteria. The criteria, for example topicality or quality, are used to assess document values, for example functional or emotional value to the user. Document values form the basis for decisions regarding the final selection of documents.

In the resource discovery process, students' criteria for course selection, as well as factors such as experience and education that might influence the selection process, are used to filter search results as one part of the selection process. In this study, students were provided with an information problem and a list of possible relevance criteria. Factors that might influence the evaluation and selection process were measured.

Relevance Criteria

The possible criteria students use in course selection were determined by content analysis of web-based course information from higher education institutions, including course catalogs, and web-based student course evaluations. An attempt was made to include criteria that might be available to higher education students in traditional as well as distributed environments, for example course catalogs and class schedules. Both descriptive and evaluative criteria relative to higher education courses were included. Lynch (1995) stated that there "is growing evidence that some of the decision-making information required by users is evaluative rather than merely descriptive (p. 10)." He suggested users want a short list of good resources and access to various sources of evaluative information regarding these resources. This may be particularly true in the selection of higher education courses considering the commitment of finances and time generally required subsequent to course selection.

Educational metadata projects generally include stakeholders in the development of their specifications. One aspect of determining the elements to include in the GEM project's metadata specification involved the identification of the essential elements of the most common types of instructional resources on the Internet by content analysis of Internet-based instructional resources (Small, Sutton, Eisenberg, Miwa, & Urfels, 1998). Both the IMS and ARIADNE projects have involved educators and system developers in their metadata specification efforts.

Several research studies have investigated user-defined relevance criteria (Barry, 1994; Park, 1993; Schamber, 1991; and Wang & Soergel, 1998). This study did not elicit relevance criteria from students. Rather, this study investigated the importance to students of predetermined criteria.

Demographics, Education, and Internet Experience

The demographic characteristics measured in this study were employment status, gender, age, and residential location. Education level, academic classification, enrollment status, and reason for enrolling in courses measured educational status. Internet experience was measured by years of Internet experience, frequency of Internet access, and Internet skill level.

Traditional IR research investigated the concept of relevance in regard to IR system effectiveness. Researchers identified factors, including experience, education, and task specification, that influenced relevance judgments (Cuadra & Katter, 1967; and Rees

& Schultz, 1967). Since the late 1970s, users and the context in which they seek, search, and retrieve information from a system have been an important focus within IR research (Saracevic, 1991). Borgman (1986, 1991) discovered differences based on age, prior computer use, and education major in the performance of students using an IR system. In a distributed higher education environment, adult learners have characteristics and needs which distinguish them from traditionally aged students (Neeley, Niemi, & Ehrhard, 1998). Zhang (2000) compared survey respondents who completed surveys by mail or via the Web for differences based on age, gender, Internet experience, self-perceived overall ability to use the Internet, frequency of Web use, and access to the Web.

Relevance criteria include a range of non-topical factors (Barry & Schamber, 1998). Among the non-topical factors underlying relevance judgments are background, education, and experience as well as the particular problem situation the user is seeking to resolve. Park (1993) categorized the factors underlying users' selection of citations based on their experience, perception, and knowledge of the information problem. Barry (1994) categorized user-defined relevance criteria into seven groups. One group was criteria pertaining to the user's previous experience and background.

Metadata

This research identified the criteria students think are important for the selection of higher education courses and evaluated the inclusion of these criteria in the IEEE LTSC LOM metadata specification. It was conducted in the spirit of formative evaluation, that is, identifying discrepancies between the working draft standard and its stated objectives prior to formal adoption of the standard. The IEEE LTSC LOM

Working Draft Standard version 3.6 was the educational metadata specification evaluated in this study. It is an emerging international standard for educational resource object metadata in a distributed environment. Learning objects are entities, "digital or non-digital, which can be used, re-used or referenced during technology supported learning" (IEEE, 1999, p. 4). Examples of learning objects include multimedia content, instructional content, persons, or organizations. The standard specifies a minimal set of elements to support management, evaluation, and location of learning objects. The standard can be extended for use in particular settings. The 11 objectives of the standard are listed below (IEEE, 2000, p. 1). This study relates to objectives 1 and 10 in so far as learners in higher education are concerned.

1. To enable learners or instructors to search, evaluate, acquire, and utilize Learning Objects.

2. To enable the sharing and exchange of Learning Objects across any technology supported learning system.

3. To enable the development of learning objects in units that can be combined and decomposed in meaningful ways.

4. To enable computer agents to automatically and dynamically compose personalized lessons for an individual learner.

5. To complement the direct work on standards that are focused on enabling multiple Learning Objects to work together within an open distributed learning environment.

6. To enable, where desired, the documentation and recognition of the completion of existing or new learning & performance objectives associated with Learning Objects.

7. To enable a strong and growing economy for Learning Objects that supports and sustains all forms of distribution; non-profit, not-for-profit and for profit.

8. To enable education, training and learning organizations, both government, public and private, to express educational content and performance standards in a standardized format that is independent of the content itself.

9. To provide researchers with standards that support the collection and sharing of comparable data concerning the applicability and effectiveness of Learning Objects.

10. To define a standard that is simple yet extensible to multiple domains and jurisdictions so as to be most easily and broadly adopted and applied.

11. To support necessary security and authentication for the distribution and use of Learning Objects.

Instrument Development

A survey instrument was used to measure the criteria students think are important in the selection of higher education courses and to measure the three factors that might influence students' relevance judgments: demographic characteristics, educational status, and Internet experience. The final survey was based on the results of a content analysis of college and university websites and on a pilot study.

Content Analysis

In order to identify possible relevance criteria for evaluating higher education courses, a content analysis of university and college course information available on the World Wide Web was conducted. In an effort to include additional evaluative criteria of possible importance to students, online student course evaluations were also analyzed. Course information typically consisted of a course catalog, course descriptions, a schedule of classes, and an academic calendar. Other course information sometimes available included instructor information, instructor websites, course websites, course discussion or listserv groups. Course websites might include a syllabus, problem sets, reading lists, notes, and exams. While it was not always possible to view the specific contents of evaluations, the evaluation criteria were available.

Initial relevance criteria were identified from an analysis of three websites selected because they represented rich online sources of information that might be available to higher education students. Two websites provided course information about traditional university courses and distributed education courses. These two sites were the University of North Texas (http://www.unt.edu) and the Electronic Campus of the Southern Regional Education Board (http://www.srec.sreb.org). The third site was Course Evaluation Systems (CES) (http://www.exmsft.com/~aarons/CES). This site provided initial course evaluation criteria.

The University of North Texas is a large public university in Texas offering both traditional and distributed education courses. The Electronic Campus of the Southern Regional Education Board is a 16-state electronic marketplace in which students can (a) identify programs and courses that are available electronically, (b) search by college, university, discipline, level and state for more detailed information, and (c) connect to a college or university to learn about registration, enrollment and cost. Course Evaluation Systems produces course evaluation guides to "assist students in the course selection process by providing for them a source of objective information about courses and professors" (Course Evaluation Systems, 1998, p.1).

Six broad categories of information were identified. Three of the categories emerged from the online course information and three from the online course evaluation guide (see Table 12). Table 56 in Appendix D lists the forty-six criteria initially identified. These criteria were used to analyze 16 university websites, nine for online course information exclusive of course evaluations and seven for course evaluation information (see Table 57 in Appendix D). Nine U.S. colleges and universities were selected from the 2000 College Rankings of U.S. News (U. S. News, 1999). Specifically, the top five national liberal arts colleges and the top four national universities were selected. An Internet search resulted in seven colleges and universities in the United States offering online course evaluation forms.

Table 12
Categories of Course Information and Number of Criteria per Category

Source	Categories	No. Criteria
Online course information	General course characteristics	14
	Logistics of course	6
	Technology aspects	6
Online course evaluation catalog	Instructor evaluation ratings	10
	Course evaluation ratings	7
	Assignment evaluation ratings	3

Course information and course evaluation forms available at the 16 sites were printed. The researcher and a trained assistant analyzed the content at each website vis-à-vis the 46 criteria. The analysis included an indication of the presence or absence of each criteria, the specific words interpreted by the coder to indicate the presence of the criteria and any uncertainties that precluded assignment to a particular criteria. Table 13 shows the agreement between the coders for each of the criteria.

Table 13
Intercoder Agreement Results for 46 Criteria

Criteria n=26	Agreement No. of 9	Percent Agreement	Criteria n=20	Agreement No. of 7	Percent Agreement
G_DESC	8		I_CONTRB	4	
G_TITLE	9		I_EFFECT	6	
G_NUMBER	9		I_INTRST	7	
G_COREQ	9		I_GRDING	7	
G_PREREQ	9		I_ENTHUS	6	
G_NAME	9		I_STIMIN	5	
G_CREDIT	5		I_PARTCP	5	
G_LEVEL	5		I_QUESTN	6	
G_COSTS	9		I_AVAIL	6	
G_INSTIT	7		I_OVRALL	7	
G_DEADLN	8		n = 10	59	84%
G_SIZE	8				
G_ADPROG	9		C_CNTNT	6	
G_ADINST	9		C_OVRALL	7	
n = 14	113	90%	C_AMT	7	
			C_READ	7	
L_LOCATE	9		C_LOAD	6	
L_DAYS	9		C_DIFF	7	
L_DATES	8		C_COMP	7	
L_TIMES	9		n = 7	47	96%
L_DELVRY	7				
L_ATTEND	9				
n = 6	51	94%			

Table 13 continued
Intercoder Agreement Results for 46 Criteria

Criteria n=26	Agreement No. of 9	Percent Agreement	Criteria n=20	Agreement No. of 7	Percent Agreement
T_HDSFT	9		A_APROP	7	
T_SKILL	8		A_FDBCK	7	
T_LIB	9		A_PROMPT	7	
T_TEXTS	9		n = 3	21	100%
T_ADMIT	9		N =	127	
T_REGSTR	9				
n = 6	53	98%			
N =	217				

Pilot Study

A pilot study using a paper-based version of the initial survey was conducted in November of 1999. One hundred surveys were returned from students in the School of Merchandising and Hospitality Management at the University of North Texas and in the Engineering School of Southern Methodist University, a private university in Dallas, Texas. Of these 100 surveys, four were omitted from the pilot test due to response set answers, yielding 96 usable surveys. The respondents included 80 undergraduates and 20 graduate students. About half (49%) of the respondents were female and just over half (51%) were male. Eighteen percent of the respondents were less than 20 years old, 58% were between ages 21 and 25, and 24% were between ages 26 and 45. The cover letter for the survey included the following instructions to respondents.

> If you wish to participate in this study, please complete the survey. It should take about 10-15 minutes and your participation is optional and anonymous. As you are completing the study, please make any comments you wish regarding the

questions themselves. For example: Was the question hard to understand? Did you find any typos? Could you find an answer that matched you among the choices? Feel free to write anywhere on the form. Your feedback is important!

The results of the pilot test were analyzed using SPSS® version 8.0. The Kolmogorov-Smirnov test for normality, with Lilliefors significance correction, determined that none of the criteria were normally distributed ($p < .001$). Therefore, the median score for each of the 46 criteria was used as a measure of central tendency. Only one of the criteria, "course number", had a median score less than three. None of the criteria had a median score of 1, which would indicate that a criterion was not important to students. Therefore none of the criteria were deleted based on median scores in the pilot study.

Reliability and Validity

Intercoder reliability measured the reliability of the content analysis. The percentage of agreement between the two coders was determined by the ratio of the number of agreements between the two coders divided by the number of possible agreements. Intercoder reliability was 92%, which exceeds the 80% minimum standard for content analytic exploratory research studies (Krippendorff, 1980).

Internal consistency reliability of sections B and C of the survey, which measured the importance of the selection criteria, was determined by alpha (α). Nunnally, as cited in Huck and Cormier (1996), suggested scores greater than 0.70 were acceptable for reliability estimates. Alpha scores for each of the six groupings and the entirety of the criteria measure for both the pilot study and the actual study exceeded 0.70 indicating high internal consistency reliability (see Table 14).

In the final study, internal consistency of the measure of the importance of criteria was also tested by Spearman rank correlation coefficients (r_s). The correlation between respondents' scores on the last six questions in survey section C and the sum of their scores for each of the six criteria groupings was calculated (see Table 15). All six correlations were significantly positive ($p < .01$) indicating good internal reliability for the measure.

Table 14
Alpha Coefficients for the Importance of Selection Criteria Measure

	Pilot study		Final study	
Criteria group	N	α	N	α
General course characteristics	90	.8257	199	.7870
Logistics of Course	92	.7106	204	.8436
Technology aspects	95	.9065	203	.8847
Instructor evaluation ratings	94	.9185	202	.9010
Course evaluation ratings	92	.8172	201	.8929
Assignment evaluation ratings	96	.8025	205	.8280
Overall measure	84	.9331	180	.9408

Table 15
Spearman Rank Coefficients for the Importance of Selection Criteria Measure

Criteria group	N	r_s
General course characteristics	209	.256**
Logistics of course	209	.490**
Technology aspects	209	.567**
Instructor evaluation ratings	207	.472**
Course evaluation ratings	208	.617**
Assignment evaluation ratings	207	.527**

** $p < .01$

Content validity of the relevance criteria included in the survey was established based on their origination in the content analysis of course information generally available to college and university students. Additionally, a "talk aloud" session was conducted with a professor experienced in survey research both to identify any aspects of the survey and cover letter that were unclear or structurally weak as well as to review the validity of the content. Lastly, the content of the survey was reviewed in a pilot test with 96 university students.

Based on the content analysis of the 16 websites, feedback from the "talk aloud" review, and the pilot study, modifications and deletions to the initial survey were made for clarity (see Table 56 in Appendix D). Additionally, two criteria of importance to students regarding instructor evaluation ratings were included in the final web-based survey used in the study: (a) easy to approach and (b) instructor's experience in the field.

The Web-based Survey Instrument

The final survey was entitled "Decision Criteria for Course Selection: A Survey of Students." The stated purpose of the survey was "to identify the information students need in order to evaluate and select courses via the Internet." The survey consisted of five sections and 75 questions. Appendix E includes a paper-based version of the final online survey instrument. Each of the sections is discussed below.

Section A: Educational Status

Section A consisted of one question that identified how respondents heard about the survey and five questions that measured each respondent's educational status. The instructions to this section stated: "In order to understand your needs better, your current circumstances are important. Please describe your circumstances." Educational status was measured by four variables.

1. The highest level of education the respondents completed was measured by selection of one of 10 ordinal data categories: grammar school, high school, vocational/technical school (2 year), some college, community college graduate (2 year), college graduate (4 year), master's degree, doctoral degree, professional degree, and other.

2. Respondents' indicated their university classification by selecting one of seven ordinal data categories: freshman, sophomore, junior, senior, masters level, doctoral level, or not classified.

3. Respondents' enrollment status was measured by selection of one of three nominal data categories: full-time student, part-time student, or not enrolled at an institution.

4. Respondents' selected their primary reason for enrolling in courses at the time the survey was completed from one of nine nominal data categories: major/minor master's, or doctoral requirement, major/minor master's, or doctoral elective, university requirement, general elective, personal interest, certification requirement, career development, not enrolling in courses at this time, or other.

<u>Section B: Relevance Criteria</u>

Section B of the survey measured the importance to respondents of 25 criteria organized into three categories: general course characteristics, logistics of the course, and technology aspects of the course. The instructions to this section presented respondents with a situation that (a) students in general could relate to and (b) provided a specific context or situation for judging the importance of criteria to the respondent. The instructions to section B stated:

> Assume that you have identified several courses that satisfy your requirements or possibly one course with several sections. What are the factors you use to select a specific course or section? Indicate the importance to you of each factor below by selecting the button that best represents how important each factor is to you.

Responses were measured on an ordinal scale with five categories: not important, a little important, somewhat important, very important, and extremely important.

Section C: Relevance Criteria

Section C of the survey measured the importance to respondents of 21 criteria organized in three categories: instructor evaluation ratings, course evaluation ratings, and assignment evaluation ratings. Once again, respondents were presented with the same situation as in section B, however they were asked to focus their judgments on information from previous students' evaluations. No attempt was made to identify the source of these evaluations, leaving students open to considering a range of input from previous students, for example published results of structured evaluations or word-of-mouth opinions. The instructions to this section stated:

> Again, assume that you have identified several courses that satisfy your requirements or possibly one course with several sections. What factors from past students' evaluations do you use to select a specific course or section? Indicate the

importance to you of each factor below by selecting the button that best represents how important each factor is to you.

Responses were measured on an ordinal scale with five categories: not important, a little important, somewhat important, very important, and extremely important.

An additional question in this section listed the six categories in sections B and C of the survey and asked students to "think of either an elective course you have taken or of a required course that had several sections and instructors. What influenced your choice? Select the button that best represents how much each category influenced your choice." Responses were measured on an ordinal scale with five categories: not influential, a little influential, somewhat influential, very influential, and extremely influential. The intent of this question was to measure the general importance of each of the six categories of criteria to each respondent. Responses to this question were used as a measure of the internal consistency the survey instrument.

Section D: Internet Experience

Section D of the survey consisted of three questions and measured respondents' Internet experience. These questions were taken from the Graphic, Visualization, and Usability (GVU) Center's 10th WWW User Survey, which is produced and managed by the Georgia Tech Research Corporation (Graphic, Visualization, & Usability Center [GVU], 1999a). The GVU survey is available for non-income producing research efforts. The instructions to this section stated: "Please describe your experience with the Internet."

Internet use was measured by the selection of one of five ordinal categories: less than six months, six to twelve months, one to three years, four to six years, and seven or more years. The frequency with which respondents access the Internet from home, work, school, public terminal, or other places, was measured by selecting one of five ordinal values: never, less than one month, monthly, weekly, and daily. Internet skill was measured by the sum of the number of Internet-based activities respondents indicated they had done. Twelve activities were listed, for example "created a web page" and "listened to radio broadcast online." Possible ordinal values for the summed score ranged from one to twelve, with one indicating a low Internet skill level and twelve indicating a high level.

Section E: Demographic Characteristics

Section E of the survey consisted of four demographic questions pertaining to respondents. The instructions to this section stated: "Please describe yourself." Current employment status was measured by selection of one of four nominal categories: full time, part time, retired, or not employed. The respondent's gender was measured nominally by their selection of male or female. Age was measured by selection of the age interval into which a subject's age belonged and a category labeled "rather not say" was included. The 11 age intervals began at age 18 and included five years, with the exception of the last interval that specified 68 plus years of age.

Two questions were taken from the GVU Center's 10th WWW User Survey. Respondent's location was measured by selection of one of 12 nominal values: Africa, Antarctica, Asia, Oceania, Europe, USA, Canada, Mexico, Central America, South

America, Middle East, and West Indies. Respondents selected one of three nominal values to indicate the area in which they lived: urban, suburban, or rural.

Sample and Population

Sampling bias is a major issue that researches must deal with in Internet research (Coomber, 1997; Zhang, 2000). No central registry of Internet users exists from which to draw a random sample. The limitations of generalizing the research results and of applying inferential statistics that ensue from non-random sampling in an Internet environment are akin to those arising from convenience sampling in traditional research studies. Convenience sampling involves the selection of a sample that suits the purpose of the study and the inference of a population that this sample represents and to which the study's results might generalize (Gall, Borg, & Gall, 1996).

Typical techniques for sample selection in an Internet environment include the use of postings to discussion groups and email announcements sent to listserv mailing lists (Coomber, 1997; Zhang, 2000). The GVU surveys have employed non-probabilistic sampling since they pioneered web-based surveying in 1994. The GVU has identified five sampling techniques to solicit a broad sample of Internet users (GVU, 1999a).

1. Announcements on Internet related newsgroups
2. Banners randomly rotated through high-exposure sites
3. Banners rotated through advertising networks
4. Announcements made to the www-surveying mailing list composed of people interested in surveys
5. Announcements made in popular media

Since no central registry of students selecting higher education courses via the Internet existed from which to draw a random sample, purposeful sampling was used. Assuming the posture of a student looking for courses via the Internet, the researcher conducted an Internet search using Dogpile, a metasearch engine that submits a user's search request to 10 Internet search engines. A list of possible sites containing higher education courses was compiled. Requests to participate in the study via posting a link from their websites to the survey site were sent via email to three possible participants, two of whom agreed to participate: About.com Distance Learning Guide and the Center for Distributed Learning at the University of North Texas. A third educational site, Regents College, agreed to participate subsequent to an invitation resulting from a request for survey results. A fourth educational site, the Global Network Academy (GNA), provided a link from their site to the survey site. However, the researcher was unaware that they had done so until she received email in which a survey respondent stated they had discovered the survey site from a link at GNA.

Additionally, postings requesting participation in the study and providing the survey site location were made to two educational newsgroups: alt.education.distance and misc.education. Finally, the owner of the Online Learning Listserv contacted the researcher and subsequently included a story about the study in the newsletter mailed to list members.

The sample included self-selected visitors to the educational websites, readers of the newsgroup and listserv announcements, and others who arrived at the survey site in an unknown fashion. Table 16 identifies the source of respondents in the sample. In all

215 students participated, from which 209 usable surveys resulted. Six surveys were eliminated, three because they were duplicate submissions and three because they were largely incomplete. The inferred population to which the results of this research are generalizable is existing or potential students making selection decisions regarding higher education courses in a networked information environment.

An additional concern with Internet-based survey research is determining the sample due to a lack of control of the number of responses a single respondent can submit. Some researchers attempt to control this problem by selecting a well-defined sample and issuing access identifications to each respondent (Zhang, 2000). However, anonymity of respondents is not possible in that case. Coomber (1997) suggested that in cases where the study will not be jeopardized by the elimination of duplicate responses, doing so alleviates a potentially enormous sampling problem. Duplicate responses in this study were controlled to some extent. Upon submittal of each survey, the server recorded the submission time and date as well as the network address from which the survey was sent. In cases where more than one survey was submitted in close time intervals from the same network address, only one survey was included in the study.

Table 16
Sources of Study Respondents

Source	*f*	%
About.com Distance Learning Guide	34	16.3
Regents College Electronic Peer Network	24	11.5
University of North Texas - Center for Distributed Learning	52	24.9
Friend	32	15.3
Other	64	30.6
No source selected	3	1.4
N =	209	

Data Collection

A survey website was created in November 1999 for data collection. Respondents discovered the site in one of several ways: (a) via a hyperlink from one of the four educational websites participating in the study, (b) via the URL posted in announcements to one of the two educational newsgroups or the one listserv, or (c) via word of mouth or some other method.

The survey website consisted of three pages: a homepage, a cover letter, and the online survey. The homepage stated the following:

> Thanks for coming to this survey site. This study is being conducted by Kathleen Murray, a Doctoral Candidate in Information Science at the University of North Texas. The purpose of this study is to identify the information students need in order to evaluate and select college or university courses via the Internet. It takes about 10 minutes to complete! First, read the cover letter. Next, complete the survey!

This page included hyperlinks to the cover letter and the online survey. Additionally, the researcher's email address was listed for questions or comments persons might wish to send.

The cover letter briefly described the problem the study was addressing and stated the purpose of the study. It included an assurance that the study was both optional and anonymous. Respondents were thanked in advance for their participation and welcomed to contact the researcher to ask questions or to obtain the research results. The researcher's name and affiliation were stated. The letter concluded with a statement that the study was approved by the University of North Texas committee for the Protection of Human Subjects. Hyperlinks to the survey homepage and to the online survey were provided.

Responses to the survey questions were selected in one of three ways: by selecting an option from a pull-down menu, by selecting a radio button corresponding to an option, or by selecting one of more check boxes corresponding to options. Two action buttons were at the end of the survey: Submit Survey and Redo Survey. Upon respondents' completion of the survey and selection of "Submit Survey", responses were collected by the server, which appended the submission date, time, and the network address of the respondent. Alternately, selecting "Redo Survey" erased any selections respondents had made and did not submit the survey to the server. The server wrote all responses to both a file and a backup file on the server and each response was sent via email to the researcher.

Data Analysis

The sample itself is characterized by the demographic measures using descriptive statistics including frequencies and percents. The sample is further characterized by descriptive statistics regarding how respondents heard about the study, their educational status, and their Internet experience.

The first research question in this study asked: What criteria do students think are important for selection of higher education courses? For this question, each criterion was characterized using median scores, ranges, and minimum and maximum values. Because of the ordinal nature of the data for each criterion, the chi square goodness-of-fit test was used. Chi-square values determined the criteria students think are important for the selection of higher education courses. Expected frequencies for a normal distribution were used to test if the observed frequencies differed significantly from a normal distribution. Significance level used was 0.05. In order to assess the relative importance of the significant criteria, certain frequencies were combined in a second chi square goodness-of-fit test. Specifically, the observed frequencies for category one, "Not Important", and for category two, "A Little Important", were combined and the observed frequencies for category four, "Very Important", and category five, "Extremely Important" were combined. This resulted in three categories of importance: low, moderate, and high. The observed frequencies were tested by the second chi square goodness-of-fit test using expected frequencies from a normal distribution. Standardized residuals (R) for the high importance category were calculated for each of the criteria. The criteria were rank ordered according to the magnitude of their standardized residuals. This ranking determined the relative importance to students of each of the significant criteria. Criteria ranked above the median were considered more important to students in their course selection processes. Exploratory principal components factor analysis determined the common factors underlying the more important criteria. Exploratory factor analysis enables a researcher to group related variables or criteria from among a range of criteria. In exploratory research, groups of related criteria or factors are useful to understand the themes or categories underlying the range of criteria.

The second research question in this study asked: Is there a relationship between the criteria students think are important for selection of higher education courses and demographic characteristics, specifically employment status, gender, age, and residential location? Spearman rank correlation uses the rank orders of ordinal data values for two variables to test the relationship between the variables. Chi square tests of independence use nominal or categorical values for two variables to test the association between the variables. Spearman rank correlation coefficients and chi-square values determined the relationships between each of the demographic characteristics and the selection criteria.

The third research question in this study asked: Is there a relationship between the criteria students think are important for selection of higher education courses and educational status, specifically, education level, academic classification, enrollment status, and reason for enrolling in courses? Spearman rank correlation coefficients and chi-square values determined the relationships between the four educational status variables and the selection criteria.

The fourth research question in this study asked: Is there a relationship between the criteria students think are important for selection of higher education courses and Internet experience, specifically, years of Internet experience, frequency of Internet access, and Internet skill level? The five frequency of access categories were scored by weighted values as follows: 0 = never; 0.5 = less than once per month; 1 = monthly; 4 = weekly; and 30 = daily. Respondents' weighted scores for all access locations were summed to yield a single frequency of access score per respondent. Internet skill level was measured by the sum of the number of tasks respondents indicated they had done on the Internet. Spearman rank correlation coefficients determined the relationship between the three measures of Internet experience and the selection criteria.

The fifth research question in this study asked: Does the IEEE LTSC Learning Object Metadata Standard include the criteria students think are important for selection of higher education courses? Side by side analysis compared the significant criteria resulting from the survey analysis with the IEEE LTSC Learning Object Metadata specification. McClure, Moen, and Bertot (1999) described the use of side by side analysis for qualitative comparison of government policy documents. The criteria resulting from the analysis of research question one were compared to the metadata element descriptions contained in the IEEE LOM version 3.6 specification by two coders. Intercoder reliability was determined by dividing the sum of agreements between the two coders by the possible number of agreements. The analysis involved each coder becoming familiar with the IEEE metadata standard by studying the element set's explanations for each element and with the selection criteria listed in the context of the initial six groupings. Coders were given a scoring sheet listing each of the criteria and asked to indicate in spaces provided next to each criteria if they found the criteria in the IEEE element set and if so, in what element. Additionally, coders were told to identify any possible matches about which they were uncertain and to suggest an element category within the standard that seemed appropriate for a criteria even if there was no good match with an element.

CHAPTER 4

RESULTS

Introduction

The objectives of this study were (a) to identify the criteria students think are important for selection of higher education courses, (b) to inform the ongoing specification of educational metadata standards, and (c) to provide design requirements for future information retrieval systems supporting course selection in higher education. To achieve these objectives this study measured the importance of course selection criteria to students, as well as their demographic characteristics, educational status, and Internet experience, using a five part web-based questionnaire.

This section includes the results of both the descriptive and inferential statistical analyses. The description of the sample is based on demographic factors, educational status, and Internet experience. Descriptive results are also presented for the importance of the 46 criteria students might use in selecting higher education courses. Finally, the results of the inferential statistical analyses that answered the study's five research questions are provided. Interpretation of the statistical results and their implications are discussed in chapter five.

Description of Sample

Demographic Characteristics

The sample consisted of 215 self-selected respondents to a web-based questionnaire between November 29, 1999 and May 5, 2000. Respondents discovered the survey website subsequent to (a) visiting one of three educational websites that provided a hyperlink to the survey site (n = 110), (b) hearing about it from a friend (n = 32), or (c) via some unidentified means such as reading an announcement posted to two educational newsgroups and one educational listserv (n = 67). Two hundred nine usable surveys resulted. Only respondents who answered the question under analysis were included.

Respondents were characterized by four demographic characteristics: geographic location, gender, age, and employment status. Respondents were overwhelmingly located in the United States (89.3%). Five respondents or 2.4% from both Canada and Europe constituted the next largest geographical location. The remaining 5.9% of respondents were located in Africa, Antarctica, Asia, Oceania, Mexico, the Middle East, or the West Indies. Table 17 identifies the locations of all respondents.

Females represented 66% of the respondents, while 34% were males. The largest number of respondents was in the 18-22 year age range, which comprised 21% of the sample. The next largest number of respondents was in the 38-42 year age range (15.6%) and the 23-27 year age range (15.1%). Over one half of the sample (56.6%) worked full time and 24.4% worked part time. Table 18 summarizes the demographic characteristics of the sample.

Table 17
Frequency of Respondents by Geographic Location

Location	*f*	%
United States	183	89.3
Europe	5	2.4
Canada	5	2.4
Oceania	4	1.9
Asia	2	1.0
West Indies	2	1.0
Africa	1	0.5
Antarctica	1	0.5
Mexico	1	0.5
Middle East	1	0.5
	N= 205	

Table 18
Demographic Characteristics of the Sample

Demographic Characteristic	*f*	%
Gender		
Female	134	66.0
Male	69	34.0
	N = 203	
Age		
18 - 22	43	21.0
23 - 27	31	15.1
28 - 32	22	10.7
33 - 37	17	8.3
38 - 42	32	15.6
43 - 47	23	11.2
48 - 52	21	10.2
53 - 57	10	4.9
58 - 62	2	1.0
63 - 67	2	1.0
> 68	2	1.0
	N = 205	
Employment status		
Full time	116	56.6
Part time	50	24.4
Not employed	33	16.1
Retired	6	2.9
	N = 205	

Education Status

Forty percent of the sample had completed some college studies while just over ten percent had not completed any college level studies (11.6%). The remaining respondents had completed a higher education degree: 2-year college (8.0%), 4-year college (27.1%), or advanced degree (12.1%) (see Table 19).

Table 19
Highest Level of Education Completed

Educational Level	*f*	%
Grammar school	1	0.5
High school or equivalent	20	10.1
Vocational/technical school (2 year)	2	1.0
Some college	80	40.2
Community college graduate (2 year)	16	8.0
College graduate (4 year)	54	27.1
Master's degree	20	10.1
Doctoral degree	3	1.5
Professional degree	1	0.5
Other	2	1.0
	N= 199	

Over forty percent of respondents were full time students (42.6%). The remaining respondents were almost equally divided between those with part-time student status (30.4%) and those not formally enrolled in any institution (27.0%). Approximately one-fifth of the sample did not indicate any university classification (21.8%). A small percentage (5.8%) of the sample were doctoral students. There were roughly equal numbers of students at each of the following levels: freshman or sophomore undergraduates (19.9%), junior level undergraduates (16.5%), senior level undergraduates (18.9%), and master's level graduate students (17.0%). Table 20 summarizes the enrollment status and university classification of respondents.

At the time they completed the survey, respondents enrolled in courses for two principal reasons: (a) as a requirement in either their undergraduate major or minor program, their master's program, or their doctoral program (29.8%) or (b) for career development (25.8%). Table 21 summarizes the reasons students enrolled in courses. Twelve respondents provided brief textual reasons for enrolling in courses. The two reasons with the highest frequencies were career change (f=4) and disability (f=2).

Table 20
Educational Status of Respondents

Educational Status	f	%
Enrollment Status		
Full time	87	42.6
Part time	62	30.4
Not enrolled	55	27.0
	N = 204	
University Classification		
Freshman	19	9.2
Sophomore	22	10.7
Junior	34	16.5
Senior	39	18.9
Masters level	35	17.0
Doctoral level	12	5.8
Not classified	45	21.8
	N = 206	

Table 21
Respondents' Reasons for Enrolling in Courses

Reason	*f*	%
Major/minor, masters, or doctoral requirement	61	29.8
Career development	54	26.3
Personal interest	27	13.2
University requirement	17	8.3
Not enrolling in courses	14	6.8
Other	12	5.9
Major/minor, masters, or doctoral elective	10	4.9
General elective	5	2.4
Certification requirement	5	2.4
	N = 205	

Internet Experience

Over one half of the respondents were Internet users with either seven years or more experience (n = 28, 13.7%) or between four and six years of experience (n = 81, 39.7%). Another 34.8% (n = 71) had been Internet users between one and three years. The remainder had used the Internet for less than one year (n = 24, 11.8%). The most frequent Internet access was on a daily basis from respondents' homes (66.2%). Almost fifty percent (48.5%) of respondents accessed the Internet daily from their workplace. Access from public terminals was infrequent; 67.7% of respondents never accessed the Internet from public terminals. Approximately thirty percent (29.3%) of respondents accessed the Internet from school daily while 36.9% of respondents never accessed the Internet from school. Table 22 summarizes the frequency of access from each of five locations: home, work, school, public terminal, and other places.

Table 22
Respondents' Internet Access by Location

Location	*f*	%
Home		
Never	16	7.7
Less than once per month	9	4.3
Monthly	5	2.4
Weekly	40	19.3
Daily	137	66.2
	N = 207	
Work		
Never	77	37.4
Less than once per month	9	4.4
Monthly	2	1.0
Weekly	18	8.7
Daily	100	48.5
	N = 206	
School		
Never	73	36.9
Less than once per month	16	8.1
Monthly	15	7.6
Weekly	36	18.2
Daily	58	29.3
	N = 198	
Public terminal		
Never	136	67.7
Less than once per month	36	17.9
Monthly	17	8.5
Weekly	4	2.0
Daily	8	4.0
	N = 201	
Other places		
Never	120	60.6
Less than once per month	46	23.2
Monthly	22	11.1
Weekly	4	2.0
Daily	6	3.0
	N = 207	

A gauge of Internet skill was determined by the number of Internet-based activities respondents did from a list of 12 activities. Table 23 lists the activities and the frequency of respondents who had done each one.

Table 23
Performance of Internet-based Activities[a]

	Activity	Yes		No	
		f	%	*f*	%
1.	used a nationwide online directory to find an address or telephone number	151	72.2	58	27.8
2.	ordered a product/service from a business, government or educational entity by filling out a form on the web	145	69.4	64	30.6
3.	participated in an online chat or discussion (not including email)	138	66.0	71	34.0
4.	changed your browser's "startup" or "home" page	104	49.8	105	50.2
5.	listened to a radio broadcast online	101	48.3	108	51.7
6.	made a purchase online for more than $100	88	42.1	121	57.9
7.	changed your "cookie" preferences	80	38.3	129	61.7
8.	bought a book to learn more about the Web or Internet	78	37.3	131	62.7
9.	created a web page	75	35.9	134	64.1
10.	customized a web page for yourself (e.g. MyYahoo, CNN Custom News)	72	34.4	137	65.6
11.	taken a seminar or class about the Web or Internet	70	33.5	139	66.5
12.	made a telephone call online	38	18.2	171	81.8

Note. N = 209.
[a]This Internet use scale is taken from the GVU's 10th WWW User Survey produced by the Graphic, Visualization, and Usability Center at the Georgia Tech Research Corporation [Online], available http://www.cc.gatech.edu/gvu/user_surveys/survey-1998-10.

Approximately 50% of respondents had done six or less of the 12 activities and 50% had done seven or more (Mdn=6). Most respondents had done either three or seven of the activities. The top three activities respondents engaged in were (a) using a nationwide online directory to find an address or telephone number (72.2%), (b) ordering a product/service from a business, government, or educational entity by filling out a form on the web (69.4%), and (c) participating in an online chat or discussion (66.0%). The least frequent Internet-based activity in which respondents engaged was making a telephone call online (18.2%).

Descriptive Results of Selection Criteria

Sections B and C of the survey instrument listed 46 possible criteria students might use in the selection of higher education courses (see Appendix E). The criteria were grouped into (a) three descriptive categories (general course characteristics, logistics of course, and technology aspects) and (b) three evaluative categories (instructor evaluation ratings, course evaluation ratings, and assignment evaluation ratings). Survey respondents were asked to assume they had identified either several courses that satisfied their requirement or a single course with several sections. Within this context, respondents were asked to indicate the importance to them in their selection process of each of the 46 categories. Each of the possible responses was labeled as follows: not important, a little important, somewhat important, very important, and extremely important. These labels corresponded to values from one to five respectively.

Table 58 in Appendix F summarizes the frequencies and percentages for 45 of the criteria. No responses for the criterion "Level" were recorded due to an error in the

HTML code of the web-based questionnaire. The frequencies indicate a generally negative skew in the distributions for all but five criteria. Three of these five had a fairly normal distribution: course title, class size, and competitive atmosphere. Two criteria had a positive skew: course number and instructor name.

The medians for each of the criterion are listed in Table 24. Five criteria had median scores lower than four. Four of these five criteria had a median score of three: course title, instructor name, class size, and competitive atmosphere. One criterion had a median score of two: course number. The 40 remaining criteria had median scores of four. No criterion had a median score of five.

Table 24
Descriptive Statistics for Criterion Responses

Criterion	N	Mdn
Course description	208	4
Course title	208	3
Course number	207	2
Prerequisites	208	4
Instructor name	209	3
Number of credits	208	4
Tuition and fees	209	4
Offering institution	206	4
Enrollment deadlines	205	4
Class size	206	3
Admission to program required	204	4
Admission to institution required	203	4
Location	209	4
Meeting days of the week	209	4
Meeting dates	209	4
Meeting time of day	207	4
Method of instructional delivery (video broadcast, Internet, etc.)	209	4
Attendance requirements	206	4

Note. Range = 4. Minimum = 1. Maximum = 5.

Table 24 continued
<u>Descriptive Statistics for Criterion Responses</u>

Criterion	N	Mdn
Computer hardware & software requirements	209	4
Computer & Internet skills required	208	4
Remote access to library resources	208	4
Remote access to texts and course material	206	4
Admission to program available on Internet	208	4
Registration available on Internet	207	4
Instructor effectiveness	207	4
Instructor interest	207	4
Grading techniques	206	4
Instructor enthusiasm	207	4
Ability to stimulate interest	207	4
Attitude toward class participation	207	4
Availability to students	206	4
Responsiveness to questions	207	4
Easy to approach	206	4
Instructor experience in field	205	4
Past students' overall rating	205	4
Course Content	206	4
Amount students learned	205	4
Quality of assigned readings	206	4
Workload	206	4
Degree of difficulty	207	4
Competitive atmosphere	208	3
Students' overall course rating	206	4
Appropriateness of assignments	207	4
Instructor feedback	207	4
Prompt return	205	4

Note. Range = 4. Minimum = 1. Maximum = 5.

The overwhelming majority (n = 39) of the 45 criteria had a mode of four. Six criteria had modes less than four. Five of these six criteria had a mode of three: course title, instructor name, class size, competitive atmosphere, and computer hardware and software requirements. One criterion had a mode of one: course number. For each criterion the range was four, with a minimum score of one and a maximum score of five.

Statistical Analysis

The data were analyzed using SPSS® version 8.0 and Microsoft® Excel 97. Chi square goodness-of-fit values determined the criteria students think are important. A level of significance of $p < .05$ was required to identify criteria as important to students. Exploratory principal components factor analysis determined the common factors among the more important criteria. Factor loadings greater than 0.40 were required for inclusion of a criterion within a common factor. Spearman rank correlation coefficients and chi-square values determined the relationships and associations between the importance of criteria to students and students' demographic characteristics, educational status, and Internet experience. A level of significance of $p < .05$ was required to identify any relationship or association as significant. Side by side analysis determined if the IEEE LTSC LOM version 3.6 standard for educational metadata included the criteria of importance to students.

Research Question One

The chi square goodness-of-fit test was used to determine the criteria students think are important for the selection of higher education courses. Expected frequencies for a normal distribution were used to test if the observed frequencies differed significantly from a normal distribution. The chi-square value was significant for each of the 45 criteria (p .001). In order to assess the relative importance of the criteria, certain frequencies were combined. Specifically, the observed frequencies for category one, "Not Important", and for category two, "A Little Important", were combined and the observed frequencies for category four, "Very Important", and category five, "Extremely

Important" were combined. This resulted in three categories whose observed frequencies were tested by a second chi square goodness-of-fit test using expected frequencies from a normal distribution. The chi-square value was significant for 44 of the 45 criteria (p .05) indicating that the distribution for each of the 44 criteria differed from a normal distribution. One criterion, class size, was not significant (χ^2 (2, N = 206) = 2.629, p .05) indicating that the importance of this criterion to the students in the sample was not significantly different than what would be expected from a normal distribution.

Standardized residuals (R) for the third category, that is the cell containing the combined frequencies for the "Very Important" and the "Extremely Important" categories, were calculated for each of the criteria and the criteria were rank ordered according to the magnitude of their standardized residuals (see Table 25). This ranking determined the relative importance to students of each of the 45 criteria.

Table 25
Rank Order of Importance for Selection Criteria based on Standardized Residuals

Criteria	R	Rank
(Instructor's) Responsiveness to questions	14.5	1
Course description	13.9	2
Meeting time of day	13.0	3
Instructor enthusiasm	12.5	4
Method of instructional delivery	12.3	5.5
Instructor experience in field	12.3	5.5
Instructor's effectiveness	12.1	7
Meeting days of the week	11.8	8.5
Easy to approach (the instructor)	11.8	8.5
(Instructor's) Ability to stimulate interest	11.6	10
Instructor interest	11.2	11
Availability to students	10.9	12
Instructor feedback	10.8	13
Meeting dates	10.6	14

Table 25 continued

Rank Order of Importance for Selection Criteria based on Standardized Residuals

Criteria	R	Rank
(Students evaluation of) Workload	9.9	15
Appropriateness of assignments	9.8	16
(Students evaluation of) Course content	9.6	17.5
Amount students learned	9.6	17.5
Remote access to texts and course material	9.4	19
Tuition and fees	9.3	20.5
Location (of course)	9.3	20.5
Quality of assigned readings	8.9	22
(Students evaluation of) Degree of difficulty	8.8	23
Prompt return (of assignments)	8.7	24
Remote access to library resources	7.9	25
Attitude toward class participation	7.8	26
Prerequisites	7.4	27
Offering institution	7.3	28
Registration available on Internet	7.1	29.5
(Instructor's) Grading techniques	7.1	29.5
Number of credits	6.8	32
Admission to institution required	6.8	32
Attendance requirements	6.8	32
Enrollment deadlines	6.6	34
Admission to program required	6.5	35
Admission to program available on Internet	6.2	36.5
Past students' overall rating	6.2	36.5
Students' overall course rating	5.6	38
Computer & Internet skills required	5.3	39
Computer hardware & software requirements	5.2	40
Course title	2.7	41
Competitive atmosphere	2.1	42
Class size	0.8	43
Instructor name	-0.6	44
Course number	-2.3	45

The five lowest ranking criteria were determined to be of relatively little importance to students in their course selection process: course title, competitive atmosphere, class size, instructor name, and course number. This determination was primarily based on two measures: median values for the criteria and standardized residuals. These five criteria were the only criteria with median values less than four and with standardized residuals less than three for the category containing the "Very Important" and "Extremely Important" combined frequencies. Additionally, the chi-square value for the criterion "class size" was not significant. For these reasons, the five lowest ranking criteria were dropped in the analyses of the other four research questions.

The median of the remaining 40 ranked criteria was used to differentiate the criteria in terms of their relative importance to students in the course selection process. Criteria above the median were deemed more important to students in their course selection process than criteria below the median. Due to a tie in the ranks of two criteria at the median, 21 criteria were identified as above the median and 19 below the median. Exploratory principal components factor analysis of the top 21 criteria suggested five common factors or dimensions underlying the 21 criteria. Table 26 identifies the factor loadings for the five common factors. The factor loadings indicate the correlation of the criteria with their respective factors. Factor loadings range in value from zero to one, with zero indicating no correlation and one indicating a perfect correlation. Loadings that exceed 0.600 are generally considered high and sometimes researchers consider loadings greater than 0.400 high (Sharma, 1996). Factor loadings greater than 0.40 were required for inclusion of a criterion within a common factor.

The criterion "tuition and fees" did not clearly load on a single factor. Communalities, which report the proportion of variance explained by the five common factors for each criteria, are lowest for two criteria: "instructor experience in field" (0. .437) and "tuition and fees" (0.500). With the exception of these two criteria, all criteria loaded on a single factor with a loading greater than 0.600, indicating high correlation between the criteria and their respective factors.

Table 26
Common Factor Loadings for the Top 21 Selection Criteria

	Component				
Criteria	1	2	3	4	5
Course content	.812				
Amount students learned	.808	.293			
Appropriateness of assignments	.797	.215			
Workload	.732	.257	.210		
Instructor feedback	.601	.247		.421	
Instructor enthusiasm	.204	.790		.251	
Instructor interest	.275	.785			
(Instructor's) Ability to stimulate interest	.229	.770			
Instructor effectiveness	.384	.745			
Instructor experience in field		.530		.302	
Meeting date of the week			.932		
Meeting time of day			.902		
Meeting dates			.893		
Location			.784		
(Instructor's) Availability to students	.223	.295		.743	
(Instructor's) Responsiveness to questions	.291	.361		.698	
Remote access to texts & course materials				.643	.367
Easy to approach (the instructor)	.384	.394		.605	
Method of instructional delivery				.211	.689
Course description		.221			.638
Tuition and fees				.415	.546

Note. Factor loadings less than 0.20 are not listed. Varimax rotation with Kaiser normalization was used.

Almost 70% (68.55%) of the variance in the top 21 criteria is explained by these five factors. Labels representing the underlying constructs of the five common factors were identified (see Table 27).

Table 27
Factors Underlying the Top 21 Criteria

Factor	Description
Instructional Activities Course Content Amount students learned Appropriateness of assignments Workload Instructor feedback	From a student's perspective these criteria describe the overt learning activities in the course, that is, the amount of work required, the assignments, and the instructor's interactive evaluation of students' work, vis-à-vis the topics covered and the amount students feel they learned.
Instructor Expertise Instructor enthusiasm Instructor interest (Instructor's) Ability to stimulate interest Instructor effectiveness Instructor experience in field	These criteria include characteristics of an instructor that contribute to her or his expertise. A few are affective qualities: enthusiasm and interest. The rest relate to the instructor's skills and experience.
Logistics Meeting date of the week Meeting time of day Meeting dates Location	These criteria are temporal and locative details about a course.
Accessibility (Instructor's) Availability to students (Instructor's) Responsiveness to questions Remote access to texts & course materials Easy to approach (the instructor)	These criteria all relate to accessibility, principally of the instructor to students. One criterion relates to the remote accessibility of course materials.
Fundamentals Method of instructional delivery Course description Tuition and fees	These are fundamental "make it or break it" type criteria relative to students' (a) personal preferences for delivery method or subject area and (b) technical or financial constraints.

Research Question Two

The second research question asked if there was a relationship between the criteria students think are important for the selection of higher education courses and four demographic characteristics: residential location, gender, age, and employment status. Chi-square values determined the association between the criteria and both location and gender. Standardized residuals with an absolute value greater than the 2.0 indicated if a cell was a major contributor to significant chi-square values (Hinkle, Wiersma, & Jurs, 1998). Spearman correlation coefficients determined the relationship between the criteria and both age and employment status.

The Association between Criteria and Residential Location

To achieve the expected cell frequencies required for the chi square analysis, certain categories of the raw data were combined. Specifically, respondents from all locations other than the United States were combined into a single non-U.S. category yielding two location categories. Of the five categories measuring the importance of criteria, categories one and two were combined into a single category indicating low importance and categories four and five were combined into a single category indicating high importance. This yielded three categories of importance: low, moderate, and high. The resulting two-by-three contingency table for each criterion contained six cells. However, 23 of the 40 criteria did not meet the chi square test requirement that not more than 20% of expected cell frequencies in the contingency table be less than five. Further combining of the frequencies would not have resulted in meaningful analysis of the data because it would have required that the importance categories be further combined which would have diluted the meaning of any significant results.

Three of the remaining 17 criteria did have significant chi-square values: instructor overall rating, workload, and degree of difficulty (see Table 28). However, "instructor overall rating" had no cells with standardized residuals greater than 2.0. Therefore, no firm conclusion regarding each cell's contribution to the significance of the chi-square value could be made for this criterion (see Table 29).

Table 28
Significant Chi-Square Values for Geographic Location

Criterion	N	df	Actual χ^2	Critical χ^2
Instructor overall rating	201	2	8.504*	5.991
Workload	202	2	11.343**	5.991
Degree of difficulty	203	2	7.293*	5.991

Note. $\alpha = .05$.
*$p < .05$. **$p < .005$.

Table 29
Frequencies and Standardized Residuals for Instructor Overall Rating by Location

	Importance of Criteria				
Location	Low	Moderate	High	n	%
Non-U.S.					
Observed Frequency	7	8	5	20	10.0
Expected Frequency	3.6	5.5	10.9		
Standardized Residual	1.8	1.1	-1.8		
U.S.					
Observed Frequency	29	47	105	181	90.0
Expected Frequency	32.4	49.5	99.1		
Standardized Residual	-.6	-.4	.6		
n	36	55	110	201	
%	17.9	27.4	54.7		100.0

The cell tabulating the frequencies for non-U.S. respondents' ratings of little or no importance had a standardized residual greater than 2.0 for both "workload" and "degree of difficulty". It is noteworthy that this same cell in both contingency tables (see Tables 30 and 31) had expected values less than five. It is highly doubtful that any conclusion of an association between geographic location and the importance of selection criteria can be drawn from this analysis.

Table 30
Frequencies and Standardized Residuals for Workload by Location

Location	Importance of Criteria				
	Low	Moderate	High	n	%
Non-U.S.					
Observed Frequency	5	6	10	21	10.4
Expected Frequency	1.5	5.1	14.5		
Standardized Residual	2.9	.4	-1.2		
U.S.					
Observed Frequency	9	43	129	181	
Expected Frequency	12.5	43.9	124.5		
Standardized Residual	-1.0	-.1	.4		
n	14	49	139	202	
%	6.9	24.3	68.8		100.0

Table 31
Frequencies and Standardized Residuals for Degree of Difficulty by Location

Location	Importance of Criteria				
	Low	Moderate	High	n	%
Non-U.S.					
Observed Frequency	5	5	11	21	10.3
Expected Frequency	1.8	5.7	13.6		
Standardized Residual	2.4	-.3	-.7		
U.S.					
Observed Frequency	12	50	120	182	
Expected Frequency	15.2	49.3	117.4		
Standardized Residual	-.8	.1	.2		
n	17	55	131	203	
%	8.4	27.1	64.5		100.0

The Association between Criteria and Gender

To achieve the expected cell frequencies required for the chi-square analysis, certain categories of the raw data were combined. Specifically, of the five categories measuring the importance of criteria, categories one and two were combined into a single category indicating low importance and categories four and five were combined into a single category indicating high importance. This yielded three categories of importance: low, moderate, and high. The resulting two-by-three contingency table for each criterion contained six cells. Thirteen of the 40 criteria had significant chi-square values (see Table 32).

Table 32
Significant Chi-Square Values for Gender

Criterion	N	Actual χ^2	Critical χ^2
Prerequisites[a]	202	11.419**	5.991
Location (of course)	203	10.582**	5.991
Meeting days of the week	203	10.177**	5.991
Meeting times[a,b]	201	8.498*	5.991
Instructor effectiveness[a]	201	6.071*	5.991
Instructor enthusiasm	201	9.640**	5.991
Ability to stimulate interest[a]	201	9.331**	5.991
Instructor availability[a,b]	200	6.312*	5.991
Instructor experience in field[a,b]	199	9.124*	5.991
Amount students learned[a,b]	199	6.954*	5.991
Quality of assigned readings[a]	200	7.661*	5.991
Workload	200	16.399***	5.991
Degree of difficulty[a,b]	201	6.739*	5.991

Note. $df = 2$. $\alpha = .05$.
[a]Contingency table cells for criterion contained no standardized residual greater than 2.0.
[b]Contingency table contained one cell with a value of 2.0: males rating criterion of low importance.
*$p < .05$. **$p < .01$. ***$p < .001$.

No standardized residual for any cell in nine of the 13 contingency tables was greater than 2.0. Therefore, it was not possible to conclusively interpret the significant association between gender and the importance of these criteria. It is noteworthy that five of these nine criteria did have one standardized residual value of 2.0 in their contingency tables. In each case it was for the cell of the contingency table related to males indicating the criterion was of low importance. This suggests that more males rate these five criteria as having little or no importance in their course selection process than would be expected by chance.

Four of the criteria had one or more standardized residuals greater than 2.0: location (of the course), meeting days of the week, instructor enthusiasm, and workload.

With the exception of "workload", one cell in the respective contingency tables for these criteria contained a standardized residual greater than 2.0 (see Tables 33, 34, and 35). That cell in each table was for males rating the criterion of low importance. Significantly more males than would be expected by chance consider "location of the course", "meeting days of the week", and "instructor enthusiasm" of little or no importance in their course selection process.

Table 33
Frequencies and Standardized Residuals for Location of Course by Gender

	Importance of Criteria				
Gender	Low	Moderate	High	n	%
Female					
Observed Frequency	15	21	98	134	66.0
Expected Frequency	23.1	21.1	89.8		
Standardized Residual	-1.7	.0	.9		
Male					
Observed Frequency	20	11	38	69	34.0
Expected Frequency	11.9	10.9	46.2		
Standardized Residual	2.3	.0	-1.2		
n	35	32	136	203	
%	17.2	15.8	67.0		100.0

Table 34
Frequencies and Standardized Residuals for Meeting Days of Week by Gender

Gender	Importance of Criteria: Low	Moderate	High	n	%
Female					
Observed Frequency	6	18	110	134	66.0
Expected Frequency	11.9	19.1	103		
Standardized Residual	-1.7	-.3	.7		
Male					
Observed Frequency	12	11	46	69	34.0
Expected Frequency	6.1	9.9	53.0		
Standardized Residual	2.4	.4	-1.0		
n	18	29	156	203	
%	8.9	14.3	76.8		100.0

Table 35
Frequencies and Standardized Residuals for Instructor Enthusiasm by Gender

Gender	Importance of Criteria: Low	Moderate	High	n	%
Female					
Observed Frequency	3	18	112	133	66.2
Expected Frequency	7.3	20.5	105.2		
Standardized Residual	-1.6	-.6	.7		
Male					
Observed Frequency	8	13	47	68	33.8
Expected Frequency	3.7	10.5	53.8		
Standardized Residual	2.2	.8	-.9		
n	11	31	159	201	
%	5.5	15.4	79.1		100.0

The contingency table for the criterion "workload" contained two cells with standardized residuals greater than 2.0 (see Table 36). One was the same cell as for the three criteria discussed immediately above, that is, males rating the criterion of low importance. Significantly more males than would be expected by chance rated workload of little or no importance in their course selection process. The other cell was for females rating the criterion of low importance, only with the opposite result. That is, significantly fewer females than would be expected by chance rated workload of little or no importance in their course selection process.

Table 36
Frequencies and Standardized Residuals for Workload by Gender

	Importance of Criteria				
Gender	Low	Moderate	High	n	%
Female					
Observed Frequency	2	32	98	132	66.0
Expected Frequency	8.6	32.3	91.1		
Standardized Residual	-2.2	-.1	.7		
Male					
Observed Frequency	11	17	40	68	34.0
Expected Frequency	4.4	16.7	46.9		
Standardized Residual	3.1	.1	-1.0		
n	13	49	138	200	
%	6.5	24.5	69		100.0

The Relationship between Criteria and Age

Spearman correlation coefficients (r_s) measured the relationships between respondents' ages and their ratings of the importance of the 40 criteria. Thirteen of the 40 criteria were significantly related to respondents' ages (see Table 37).

Seven criteria were positively correlated with respondents' ages. Older ages were significantly related to higher ratings of importance in respondents' course selection processes for seven criteria: remote access to library resources, tuition and fees, remote access to texts and course materials, admission to program available on the Internet, method of instructional delivery, computer and Internet skills, and computer hardware and software requirements. Younger ages were significantly related to lower ratings of the importance for these seven criteria.

There was a negative correlation between respondents' ages and their ratings of the importance of six selection criteria: grading techniques, students' overall course rating, degree of difficulty, meeting time of day, past students' overall rating of instructor, and workload. Older ages were significantly related to lower ratings of importance in respondents' course selection processes for these criteria. Conversely, younger ages were significantly related to higher ratings of importance for these six criteria.

Table 37
Correlations between Ratings of Criteria Importance and Respondents' Ages

Criteria	N	r_s
Grading techniques	206	-.241**
Remote access to library resources	208	.228**
Students' overall course rating	206	-.218**
Tuition and fees	209	.217**
Remote access to texts & course materials	206	.213**
Degree of difficulty	207	-.189**
Admission to program available on Internet	208	.183**
Meeting time of day	207	-.181**
Method of instructional delivery	209	.180**
Past students' overall rating (of instructor)	205	-.173*
Workload	206	-.161*
Computer & Internet skills required	208	.161*
Computer hardware & software requirements	209	.156*

*$p < .05$. **$p < .01$.

The Relationship between Criteria and Employment Status

Spearman rank correlation coefficients (r_s) measured the relationships between respondents' employment status and their ratings of the importance of the 40 criteria. Three of the 40 criteria had a significant positive correlation with respondents' employment status (see Table 38). Full time workers were related to higher ratings of the importance of three criteria: meeting dates, remote access to texts and course materials, and registration available on the Internet. Likewise unemployed respondents were related to lower ratings of the importance of these three criteria.

Table 38
Correlations among Ratings of Criteria Importance and Respondents' Employment Status

Criteria	N	r_s
Meeting dates	199	.145*
Remote access to texts and course materials	196	.142*
Registration available on Internet	197	.142*

*$p < .05$.

Research Question Three

The third research question asked if there was a relationship between the criteria students think are important for the selection of higher education courses and four measures of respondents' educational status: the highest level of education completed, university classification, enrollment status, and the primary reason for taking courses at the time respondents completed the survey. Spearman correlation coefficients determined the relationship between the criteria and respondents' highest level of education completed, university classification, and enrollment status. Chi-square values determined the association between the criteria and the primary reasons for taking courses.

The Relationship between Criteria and Highest Level of Education Completed

Spearman correlation coefficients (r_s) measured the relationships between the highest level of education respondents completed and their ratings of the importance of the 40 course selection criteria. Two of the 40 criteria were significantly correlated to respondents' educational level (see Table 39). Higher levels of completed education were significantly related to higher ratings of the importance of "computer hardware & software requirements" and "remote access to texts and course materials". Conversely, lower levels of completed education were significantly related to lower ratings of the importance of these two criteria in the course selection process.

Table 39
Significant Correlations among Ratings of Criteria Importance and Highest Level of Education Completed

Criteria	N	r_s
Computer hardware & software requirements	197	.151*
Remote access to texts and course materials	194	.173*

*$p < .05$.

The Relationship between Criteria and University Classification

Spearman correlation coefficients (r_s) measured the relationships between respondents' university classification, for example, freshman, senior, or master's level, and their ratings of the importance of the 40 course selection criteria. Respondents who indicated they were not classified ($n = 45$) were not considered in this analysis. Significant negative correlations were found between university classification and the importance of six of the 40 selection criteria: degree of difficulty, workload, number of credits, course content, grading techniques, and amount students learned (see Table 40).

Lower ratings of the importance of these six criteria were related to respondents at higher university classification levels. Conversely, higher ratings of the importance of these three criteria were related to respondents at lower classification levels.

Table 40
Significant Correlations between Ratings of Criteria Importance and University Classification

Criteria	N	r_s
Degree of difficulty	159	-.283**
Workload	159	-.253**
Number of credits	160	-.198*
Course content	158	-.186*
Grading techniques	160	-.182*
Amount students learned	158	-.168*

*$p < .05$. *$p < .01$.

The Relationship between Criteria and Enrollment Status

Spearman correlation coefficients (r_s) measured the relationships between respondents' enrollment status, for example, part time or full time, and their ratings of the importance of the 40 course selection criteria. Five of the 40 criteria were significantly correlated to respondents' educational level (see Table 41). Enrollment status was negatively correlated to the importance of three criteria: admission to the program available on the Internet, remote access to texts and course materials, and remote access to library resources. Lower ratings of the importance of these three criteria were related to full time students. Conversely, higher ratings of the importance of these three criteria were related to part time students or students not enrolled in a college or university.

Enrollment status was positively correlated to the importance of two criteria: grading techniques and number of credits. Higher ratings of the importance of these two criteria were related to full time students. Conversely, lower ratings of the importance of these two criteria were related to part time students or students not enrolled in a college or university.

Table 41
Correlations among Ratings of Criteria Importance and Enrollment Status

Criteria	N	r_s
Admission to program available on Internet	203	-.174*
Remote access to texts and course materials	201	-.172*
Grading techniques	201	.153*
Number of credits	203	.145*
Remote access to library resources	203	-.143*

*$p < .05$.

The Association between Criteria and Primary Reason for Enrolling in Courses

To achieve the expected cell frequencies required for the chi-square analysis, certain categories of the raw data were combined or excluded. Regarding the primary reasons respondents enrolled in courses, two combined categories were created: (a) program requirement, university requirement, and certification requirement were combined into a single "required" category and (b) the four categories related to program elective, general elective, personal interest, and career development were combined into a single "elective" category. Additionally, two of the categories were excluded from the analysis: "not enrolling in courses" and "other." This resulted in two categories for the primary reason respondents enrolled in courses at the time they completed the survey: required or elective. Of the five categories measuring the importance of criteria, categories one and two were combined into a single category indicating low importance and categories four and five were combined into a single category indicating high importance. This yielded three categories of importance: low, moderate, and high. The resulting two-by-three contingency tables for each of the 40 criteria contained six cells. Chi-square values for each of the criteria did not indicate a significant association between the reason respondents were enrolling in courses at the time they completed the survey and their ratings of the importance of the 40 course selection criteria.

Research Question Four

The fourth research question asked if there was a relationship between the criteria students think are important for the selection of higher education courses and three measures of respondents' Internet experience: length of time using the Internet, frequency of Internet access, and Internet skill level. Spearman correlation coefficients determined the relationships between the criteria and each of these measures.

The Relationship between Criteria and Length of Internet Use

Spearman correlation coefficients (r_s) measured the relationships between the length of time respondents had used the Internet and their ratings of the importance of the 40 course selection criteria. Four of the 40 criteria were significantly correlated to the length of time respondents had used the Internet (see Table 42). Length of Internet usage was positively correlated to the importance of three criteria: appropriateness of assignments, instructor feedback, and the instructor's responsiveness to questions. Higher ratings of the importance of these three criteria were related to longer time lengths of Internet usage. Conversely, lower ratings of the importance of these three criteria were related to shorter lengths of time that respondents had used the Internet.

The importance of prerequisites was negatively correlated with the length of time respondents had used the Internet. Higher ratings of the importance of prerequisites in respondents' selection processes were related to shorter time lengths. Conversely, lower ratings of importance were related to longer time lengths.

Table 42
Significant Correlations between Ratings of Criteria Importance and Length of Internet Use

Criteria	N	r_s
Appropriateness of assignments	203	.174*
Instructor feedback	203	.172*
Prerequisites	203	-.155*
(Instructor's) Responsiveness to questions	202	.140*

*$p < .05$.

The Relationship between Criteria and Frequency of Internet Access

Spearman rank correlation coefficients (r_s) measured the relationships between the frequency with which respondents accessed the Internet and their ratings of the importance of the 40 course selection criteria. Frequency of Internet access was positively correlated to the importance of eleven criteria: instructor feedback, instructor's responsiveness to questions, meeting dates, meeting days of the week, workload, registration available on the Internet, instructor's availability to students, prompt return of assignments, location of course, past students' overall rating of the instructor, and remote access to library resources (see Table 43). Higher ratings of the importance of these eleven criteria were related to higher frequencies of Internet access. Conversely, lower ratings of the importance of these eleven criteria were related to lower frequencies of Internet access.

Table 43
Significant Correlations between Ratings of Criteria Importance and Frequency of Internet Access

Criteria	N	r_s
Instructor feedback	206	.250**
(Instructor's) Responsiveness to questions	206	.223**
Meeting dates	208	.205**
Meeting days of the week	208	.171*
Workload	205	.168*
Registration available on Internet	206	.164*
(Instructor's) Availability to students	205	.154*
Prompt return	204	.148*
Location of class	208	.145*
Past students' overall rating of instructor	204	.144*
Remote access to library resources	207	.138*

*$p < .05$. **$p < .01$.

The Relationship between Criteria and Internet Skill Level

Spearman correlation coefficients (r_s) measured the relationships between respondents' Internet skill level and their ratings of the importance of the 40 course selection criteria. Five of the 40 criteria were significantly correlated to respondents' Internet skill level (see Table 44).

Table 44
Significant Correlations between Ratings of Criteria Importance and Internet Skill Level

Criteria	N	r_s
Registration available on Internet	197	.237**
Course description	198	.180*
Admission to program available on Internet	198	.172*
Remote access to texts and course materials	196	.152*
Method of instructional delivery	199	.145*

*$p < .05$. **$p < .01$.

Internet skill level was positively correlated to the importance of five criteria: registration available on the Internet, course description, admission to a program available on the Internet, remote access to texts and course materials, and method of instructional delivery. Higher ratings of the importance of these five criteria were related to higher levels of Internet skills. Conversely, lower ratings of the importance of these three criteria were related to lower levels of Internet skills.

Research Question Five

The fifth research question asked if the IEEE LTSC Learning Object Metadata version 3.6 standard included the criteria students think are important for selection of higher education courses. Side by side analysis by two persons, the researcher and a trained coder, determined if the 40 criteria were included in the IEEE standard. Discussions between the two coders to resolve differences in their initial coding resulted in agreement on all but two of the criteria yielding an intercoder reliability score of 95%.

In the process of resolving differences between the coders' evaluations of the IEEE LTSC LOM standard, three key differences between the coders emerged. The first difference is that the trained coder initially classified many of the criteria relating both to general course characteristics and to logistics of the course as potentially describable by several of the general elements in the IEEE standard. For example, this coder decided that the criteria "meeting time of day" might be classified in the "description" element. The second difference was that the researcher initially classified the logistics criteria, such as "meeting dates" and "location", in the "coverage" element of the IEEE standard. Discussions between the trained coder and the researcher resulted in a more strict classification rule, that is, there must be an obvious, not an inferred, match between the selection criteria and one or more specific elements in the standard to classify the criteria as included in the IEEE standard. In most cases of disagreement, there was not an obvious match and the classifications were modified to reflect this. Thirdly, the researcher initially classified several of the criteria in one of the three previous student evaluation criteria groups as included in the IEEE standard whereas the trained coder did not. For example, the researcher classified the criteria "instructor feedback" as "interactivity type". This difference between the coders relates to a difference in the definition of what resource was being described: the course or the instructor. It was agreed between the coders that the course was the resource, not the instructor, and the classifications were changed in accord with that agreement. The two criteria that remained in disagreement were "location" of course and "degree of difficulty". Table 45 lists the 40 criteria in order of importance to students and the results of the side by side analysis.

The analysis determined that 15 of the 40 selection criteria were included in the IEEE LTSC LOM version 3.6 standard. Additionally, five of the top 21 criteria were included. Of the nine element categories in the IEEE standard, 15 criteria were found in five categories. The two categories with the highest frequencies of selection criteria were "technical" and "rights" (see Table 46).

Table 45
Results of Side by Side Analysis: IEEE LTSC LOM and Selection Criteria

Criteria	IEEE element number	IEEE category and element name
Responsiveness to questions	-	-
Course description	1.5	General: Description
Meeting time of day	-	-
Instructor enthusiasm	-	-
Method of instructional delivery	4.1	Technical: Format
Instructor experience in field	-	-
Instructor's effectiveness	-	-
Meeting days of the week	-	-
Easy to approach (the instructor)	-	-
(Instructor's) Ability to stimulate interest	-	-
Instructor interest	-	-
Availability to students	-	-
Instructor feedback	-	-
Meeting dates	-	-
(Students evaluation of) Workload	-	-
Appropriateness of assignments	-	-
(Students evaluation of) Course Content	-	-
Amount students learned	-	-
Remote access to texts and course material	4.4	Technical: Requirements
Tuition and fees	6.1	Rights: Cost
Location (of course)	4.3	Technical: Location
Quality of assigned readings	-	-
(Students evaluation of) Degree of difficulty	5.8	Educational: Difficulty
Prompt return (of assignments)	-	-
Remote access to library resources	4.4	Technical: Requirements
Attitude toward class participation	-	-
Prerequisites	5.10	Educational: Description
Offering institution	2.3	LifeCycle: Contribute
Registration available on Internet	-	-
(Instructor's) Grading techniques	-	-

Table 45 continued

Rank Order of Importance for Selection Criteria based on Standardized Residuals

Criteria	IEEE element number	IEEE category and element name
Number of credits	-	-
Admission to institution required	6.2	Rights: Copyright & other restrictions
Attendance requirements	6.3	Rights: Description
Enrollment deadlines	6.3	Rights: Description
Admission to program required	6.2	Rights: Copyright & other restrictions
Admission to program available on Internet	-	-
Past students' overall rating	-	-
Students' overall course rating	-	-
Computer & Internet skills required	5.6	Educational: Learning context
Computer hardware & software requirements	4.4	Technical: Requirements

Table 46

IEEE LTSC LOM Category Frequencies and Selection Criteria

Category (category number)	*f*
Technical (4) Technical features of the resource.	5
Rights (6) Conditions of the use of the resource.	5
Educational (5) Educational or pedagogic features of the resource.	3
General (1) Context-independent features of the resource.	1
LifeCycle (2) Features related to the life cycle of the resource.	1
MetaMetaData (3) Features of the description rather than the resource.	0
Relation (7) Features of the resource in relationship to other resources.	0
Annotation (8) Comments on the educational use of the resource.	0
Classification (9) Description of a characteristic of the resource by entries in classifications.	0

Closing

This section presented the results of the statistical analyses. Descriptive analyses characterized the sample along three dimensions (demographic characteristics, educational status, and Internet experience) as well as the 45 selection criteria. Inferential statistics answered the five research questions. A discussion of the results and their implications are included in chapter five. This discussion includes the discovery of student profiles based on the significant characteristics that resulted from the statistical analyses in response to research questions two, three, and four.

CHAPTER 5

DISCUSSION

This research focused on the identification of selection or relevance criteria within the resource selection process, which has been one focus of IR relevance evaluation research. Additionally, since students may use selection criteria as search criteria in the process of discovering higher education courses, this research relates to design requirements for educational information retrieval systems. This section includes a summary of the major findings for each of the research questions that guided the study. After this summary, a discussion of the results and their implications is presented. The chapter concludes with recommendations, ideas for future research, and closing remarks.

Summary

The objectives of this study were (a) to identify the criteria students think are important for selection of higher education courses, (b) to inform the ongoing specification of educational metadata standards, and (c) to provide design requirements for future information retrieval systems supporting course selection in higher education. In the absence of an understanding of the criteria students use to select higher education courses there is a risk that emerging specifications may not address their needs.

This exploratory study employed both qualitative and quantitative methods to discover the criteria students think are important for selection of higher education courses. Specifically this study (a) determined the criteria students think are important for selecting higher education courses, (b) discovered the relationships between these criteria and students' demographic characteristics, educational status, and Internet experience, and (c) evaluated these criteria vis-à-vis the IEEE LTSC LOM working draft standard version 3.6. Two of the eleven objectives of the LOM relate to the purpose and significance of this research. The first objective is to "enable learners or instructors to search, evaluate, acquire, and utilize learning objects." The second objective is to "define a standard that is simple yet extensible to multiple domains and jurisdictions so as to be most easily and broadly adopted and applied." Five research questions guided this research.

1. What criteria do students think are important for selection of higher education courses?

2. Is there a relationship between the criteria students think are important for selection of higher education courses and demographic characteristics, specifically employment status, gender, age, and residential location?

3. Is there a relationship between the criteria students think are important for selection of higher education courses and educational status, specifically, education level, academic classification, enrollment status, and reason for enrolling in courses?

4. Is there a relationship between the criteria students think are important for selection of higher education courses and Internet experience, specifically, years of Internet experience, frequency of Internet access, and Internet skill level?

5. Does the IEEE LTSC LOM standard include the criteria students think are important for selection of higher education courses?

A web-based survey instrument measured (a) the criteria students think are important in the selection of higher education courses and (b) three factors that might influence students' relevance judgments: demographic characteristics, educational status, and Internet experience. The survey data was collected between November 29,1999 and May 5, 2000. The self-report questionnaire included five sections, A through E. Section A included four measures of educational status: the highest level of education respondents had completed, respondents' university classification, their enrollment status, and their primary reason for enrolling in courses at the time they completed the survey. Section B included three categories of descriptive course selection criteria determined from a content analysis of web-based university and college course information. The three categories were (a) general course characteristics with thirteen criteria, (b) logistics of courses with six criteria, and (c) technology aspects of courses with six criteria. Section C included three categories of selection criteria determined from a content analysis of web-based student course evaluation forms. The three categories were previous students' (a) instructor evaluation ratings with 11 criteria, (b) course evaluation ratings with seven criteria, and (c) assignment evaluation ratings with three criteria. The importance to respondents of the 46 criteria in sections B and C in their course selection processes was measured using a five-point scale, which ranged from not important to extremely important. Section D included three measures of respondents' Internet experience: length of time using the Internet, frequency of Internet access, and Internet skill level. Section E measured four demographic characteristics of respondents: employment status, gender, age, and location.

A total of 215 surveys were submitted from which 209 usable surveys resulted. Descriptive statistics of respondents' demographic characteristics, educational status, and Internet experience characterized the sample. Respondents were principally females (66%) who were employed full time (57%) and who were located in the United States (89%). Approximately forty percent of respondents were between ages 33 and 53 and about fifty percent were between ages 18 and 33. Forty percent of the respondents had completed some college and another forty percent were college graduates. Full time students comprised about 40% of respondents and part time students comprised about 30%. Students were fairly evenly distributed across university classification levels from undergraduates through master's level. Almost 40% of respondents were enrolling in courses at the time they completed the survey in order to meet requirements of their university or degree program. Over one fourth of respondents were taking courses for career development. In excess of one half of respondents had used the Internet for more than four years and two-thirds accessed the Internet daily from their homes. Approximately 50% of the respondents had relatively high Internet skill levels.

The study used SPSS® version 8.0 and Microsoft® Excel 97 to analyze the data. The chi square goodness-of-fit test determined the criteria students think are important. The level of significance required to identify each criterion as important to students was $p < .05$. Rankings of standardized residuals for the combined categories of "very important" and "extremely important" determined the criteria that were more important to students. Exploratory principal components factor analysis determined the common factors among the top 21 criteria. Spearman rank correlation coefficients and chi-square tests of independence determined the relationships and associations between the importance of criteria to students and students' demographic characteristics, educational status, and Internet experience. A level of significance of $p < .05$ was required to identify any relationship or association as significant. Side by side analysis determined if the IEEE LTSC LOM version 3.6 standard for educational metadata included the criteria of importance to students. This summary reports the major findings in the study. The discussion that follows the summary interprets their relative importance, which informed the resultant recommendations.

Research Question One

The first research question asked what were the criteria of importance to students in their course selection processes. Chi-square values determined 40 of the 46 selection criteria were important and 21 criteria were of relatively more importance to students than the other 19 criteria. Table 47 identifies the factors underlying the top 21 criteria.

Table 47
Five Factors Underlying the Top 21 Selection Criteria

Factor	Criteria
Instructional Activities	Course Content
	Amount students learned
	Appropriateness of assignments
	Workload
	Instructor feedback
Instructor Expertise	Instructor enthusiasm
	Instructor interest
	(Instructor's) Ability to stimulate interest
	Instructor effectiveness
	Instructor experience in field

Table 47 continued
Five Factors Underlying the Top 21 Selection Criteria

Factor	Criteria
Logistics	Meeting date of the week Meeting time of day Meeting dates Location
Accessibility	(Instructor's) Availability to students (Instructor's) Responsiveness to questions Remote access to texts & course materials Easy to approach (the instructor)
Fundamentals	Method of instructional delivery Course description Tuition and fees

Research Question Two

The second research question asked if there was a relationship between the criteria students think are important for the selection of higher education courses and four demographic characteristics: residential location, gender, age, and employment status. There were three important findings in this study regarding the relationship between demographic characteristics and the importance of selection criteria.

The first was that age was the most significant demographic characteristic in terms of the number of significant relationships to selection criteria. Older students place more importance on technology-related criteria than younger students. Likewise, older students do not place importance on previous students' evaluations of the instructor or the course. In contrast, younger students place more importance on previous students' evaluations of the instructor and the course. Younger students were also more concerned with how hard the course is and what time of day the course is offered.

The second important finding was that the criterion "workload", as evaluated by previous students, was the most significant criteria related to gender. More males and fewer females than would be expected rate "workload" of low importance. In short, workload matters more to females than to males in their course selection process. The third important finding was that employment status was not significantly related to any criteria in regard to previous students' evaluations of the instructor or the course. However, full time workers do place more importance on logistic criteria and remote access criteria than part time workers and unemployed persons.

Research Question Three

The third research question asked if there was a relationship between the criteria students think are important for the selection of higher education courses and four measures of respondents' educational status: the highest level of education completed, university classification, enrollment status, and the primary reason for taking courses at the time respondents completed the survey. There were four important findings regarding the relationships between educational status and the importance of selection criteria.

The first was that undergraduates in the lower classification ranks, that is, freshman and sophomore, place more importance on previous students' evaluations of the instructor and the course. These undergraduates were concerned with what other students' think and with how hard the course is. They were also concerned with an assessment of the value of the course, that is, the perceived tradeoff between the amount of work required and the amount students learned.

The second important finding was that whether students were enrolling in courses to satisfy a requirement or as an elective was not related to the importance of selection criteria. The third important finding was that students at higher education levels place more importance on criteria related to technology. This is consistent with the importance of technology-related criteria to older students and to students who are employed full time. The fourth important finding in regard to educational status was the criterion "number of credits" was more important to lower level undergraduates and to full time students.

Research Question Four

The fourth research question asked if there was a relationship between the criteria students think are important for the selection of higher education courses and three measures of respondents' Internet experience: length of time using the Internet, frequency of Internet access, and Internet skill level. There are three important findings regarding the relationships between Internet experience and the importance of selection criteria.

The first is that frequency of Internet access is significantly related to more criteria than either length of time using the Internet or Internet skill level. The 11 criteria with significant positive correlation coefficients roughly fall into four categories: interactions with instructor, course logistics, previous students' assessments, and access technology.

Significant positive correlations between the importance of two selection criteria related to interaction with an instructor and two Internet experience measures (length of time using the Internet and the frequency of Internet access) was the second important finding. Students with more years of Internet experience and who access the Internet daily place more importance on instructor feedback on assignments, responsiveness, availability to students, and prompt return of assignments. The third important finding regarding Internet experience was that students with higher levels of Internet skill place more importance on technology and access criteria than students with lower skill levels.

Research Question Five

The fifth research question asked if the IEEE LTSC LOM version 3.6 standard included the criteria students think are important for selection of higher education courses. Side by side analysis by the researcher and a trained coder determined that 15 of the 40 selection criteria were included in the IEEE LTSC LOM version 3.6 standard (see Table 48). Of the 15 criteria, five were in the top 21 criteria.

Table 48
Selection Criteria Included in the IEEE LTSC LOM Standard

Criteria	IEEE category: Element	
Course description[a]	1.5	General: Description
Offering institution	2.3	LifeCycle: Contribute
Method of instructional delivery[a]	4.1	Technical: Format
Location of course[a]	4.3	Technical: Location
Remote access to texts and course material[a]	4.4	Technical: Requirements
Remote access to library resources	4.4	Technical: Requirements
Computer hardware & software requirements	4.4	Technical: Requirements
Computer & Internet skills required	5.6	Educational: Learning context
Students evaluation of degree of difficulty	5.8	Educational: Difficulty
Prerequisites	5.10	Educational: Description

Table 48 continued
Selection Criteria Included in the IEEE LTSC LOM Standard

Criteria	IEEE category: Element	
Tuition and fees[a]	6.1	Rights: Cost
Admission to institution required	6.2	Rights: Copyright & other restrictions
Admission to program required	6.2	Rights: Copyright & other restrictions
Attendance requirements	6.3	Rights: Description
Enrollment deadlines	6.3	Rights: Description

[a] = Included in the top 21 selection criteria.

Discussion

This section interprets the study's results and discusses the implications of the results. Four subsections are included: (a) demographics, education, and experience of the respondents, (b) criteria for course selection, (c) educational metadata, and (d) Internet-based survey research.

Demographics, Education, and Experience

Research questions two, three, and four in this study were concerned with identifying the relationships between the importance of selection criteria to respondents and respondents' larger context. It is possible to combine these three research questions and rephrase them as: "Do the results drive the development of respondent profiles based on demographic characteristics, educational status, and Internet experience?" One intention in posing this question is to begin to articulate any differences between students that might exist in regard to the importance of the selection criteria. Eleven characteristics of the respondents were measured in this study. Two of them were not significantly related to any criteria: location of respondents and respondents' primary reason for taking courses at the time they completed the survey. Two characteristics were related to more selection criteria than the other seven characteristics: age and the frequency of Internet access. Among the significant relationships that were discovered between nine of the characteristics and the importance of criteria, four profiles emerge that cluster around criteria groups: technology profile, course logistics profile, opinion poll profile, and interaction profile (see Table 49). Additionally, the criteria groups suggest the underlying concerns that users had. Each of these profiles is discussed in the following sections.

Table 49
Student Profiles Based on Demographics, Education, and Experience

Profile	Characteristics	Concerns
Technology	▪ Older ▪ Employed full time ▪ Higher levels within university ▪ Higher levels of education ▪ Not enrolled in university ▪ Higher Internet skill levels	▪ Can I register online? ▪ Can I access texts, course materials, and library resources online? ▪ What computer skills do I need? ▪ What hardware and software is required?
Course Logistics	▪ Employed full time ▪ Higher frequency of Internet access	▪ Is the course online? ▪ Does the course fit my schedule?
Opinion Poll	▪ Younger ▪ Lower levels within university ▪ Higher frequency of Internet access	▪ What do other students think of the course or the instructor? ▪ How much work is involved?
Interaction	▪ Longer time using Internet ▪ Higher frequency of Internet access	▪ Is the instructor available to me? ▪ Is the instructor responsive? ▪ Does the instructor return assignments promptly and provide feedback?

Technology Profile

The first of these criteria groups are those criteria related to technology and remote access to resources. A profile of respondents who place more importance on these criteria includes (a) older students, (b) students who are employed full time, (c) students at higher levels of university classification, (d) students who have completed higher education levels, (e) students who are not enrolled in an educational institution, and (f) students with higher Internet skill levels. Although beyond the scope of this study to verify, it seems reasonable that several of these characteristics are related to one another. For example, by virtue of comparative longevity, older persons might well be employed full time rather than part time, have completed more education, be at higher levels within universities, be done with formal education and not enrolled in an institution, and have higher Internet skill levels. It is interesting that the criteria of importance to this group answer accessibility questions such as: Can I register online? Can I get to texts, course materials, and library resources online? What computer skills do I need to have? What hardware and software is required?

Course Logistics Profile

The second significant criteria group includes those criteria related to course logistics. The profile of students who place more importance on these criteria includes students with a high frequency of Internet access and students who are employed full time. Additionally, males place lower importance on these criteria. On the surface, students who access the Internet daily and students who work full time are not readily related to each other, although they may be. It is possible that these two groups of students have different motives for rating these criteria important. For example, students who access the Internet frequently might prefer online course meetings and be looking only for online courses. Knowing if the course meets at a physical location and when it meets might be important to them in order to exclude courses in their selection process. It is easier to understand the time and location concerns of full time workers, because they would generally have temporal boundaries on their availability to meet for classes.

Opinion Poll Profile

A third significant criteria group includes those criteria related to pervious students' evaluation of either the course or the instructor. Two characteristics comprise the profile of students who place more importance on these criteria: younger students and students at lower university classification levels, such as freshmen and sophomores. To a lesser extent, students with a higher frequency of Internet access are also included in this profile. As with the profile of students who place importance on technology-related criteria, the characteristics of age and university classification in this second profile appear related to one another. That is, younger persons might reasonably be expected to be freshman and sophomores in universities. It is interesting that the criteria of importance in this profile answer questions such as: What do other students think of the course or the instructor and how much work is involved? It may be that undergraduates have relatively less freedom of choice in their course selection and that their requirements are fulfilled in several departments within the university. This might explain their need for more specific information regarding courses and instructors. Conversely, once students are taking the majority of their courses in their major concentration, they become more familiar with individual courses and instructors and have less need of other students' opinions.

Interaction Profile

The fourth significant criteria group includes those criteria related to students' interactions with instructors. While these criteria fall under the umbrella of previous students' evaluations of the instructor or the assignments, they were not significantly related to the younger students in the second profile. Instead, the profile of students who place importance on these criteria are students who have used the Internet for longer lengths of time and students who access the Internet more frequently. Perhaps these students have come to value and expect the immediacy of interaction characteristic of the Internet. It is interesting that the criteria of importance to these students answer questions such as: Is the instructor available to me? Is the instructor responsive? Does the instructor return assignments promptly and provide feedback?

Discussion of the Profiles

These four profiles suggest an understanding of the differences between the criteria of importance to students evaluating courses based largely on demographic and cognitive differences. The endeavor to profile users finds a home in IR research within the genre of user studies. User studies include cognitive IR research, which has studied individual differences in searching experience related to such constructs as cognitive strategies and educational status (Chowdhury, 1999; Hert, 1997). Borgman (1986) determined that prior experience either with a particular database, with searching, or with computer systems in general, contributed to the variance in users' relevance judgments.

Additionally, she found that academic discipline and age were important differentiating factors. R. S. Taylor's (1991) concept of "information use environments" suggests that users of information systems can be understood in the context of their common characteristics and problems. Users make choices about what information is useful to them based in part on the subject or content of the information and in part on other elements in their lives and work. R. S. Taylor suggested that this understanding could provide input to design of information systems. His profile of any information use environment includes the common characteristics of a group of people and the setting within which they experience problems and use information.

User-oriented qualitative research on relevance criteria has identified the criteria users employ in making relevance judgments and suggested criteria groupings (Barry, 1994; Park, 1993; Schamber, 1991). The current study used quantitative analysis to identify those user characteristics that related to the importance of selection criteria to users. Based on these relationships, user profiles clustered around common criteria were suggested. While one of Barry's classes of criteria was "users' background and experience" and Park's classes of factors affecting relevance judgments included internal characteristics of users and their external context, neither of these researchers attempted to differentiate users' relevance criteria based on demographic, educational, or experiential factors.

The development of technical standards, for example the international standard for educational metadata evaluated in this study, proceeds along a different path than the development of information systems. However, it is reasonable to assume that both technical standards and information systems processes include the common element of specification of requirements. Both Saracevic and R. S. Taylor were concerned with providing user-based requirements to the design of information retrieval systems. After reviewing the IR literature on individual differences, Saracevic (1991) asserted that the amount of agreement among individuals, whether involved in resource representation or relevance judgment, was about 25% or less. Despite this variance among individuals, Saracevic was concerned that IR system design and development did not accommodate individual differences. R. S. Taylor (1991) acknowledged individual differences among users but asserted that individuals functioned in common contexts or groups, which could provide valuable input to IR system design. Future research might determine if it is feasible to accommodate group differences in regard to the importance of selection criteria in both an educational metadata standard and educational information retrieval systems. One important question for stakeholders is "What are the costs and benefits in terms of metadata creation and system design of accommodating group differences?"

In the future view of higher education, which is characterized in part by a competitive global market for educational products and services, strategically targeting course development for specific market segments will require effective mechanisms to enable individuals within those targeted markets to evaluate courses of interest to them. It may be possible to have a common educational metadata standard that represents educational resources in an educational IR system and to have unique system features related to specific user groups, such as the groups suggested in the profiles that emerged in this study. Figure 3 depicts an educational information system whose features include

(a) an interactive module that elicits user's characteristics and creates user profiles, (b) a knowledge base of group profiles that determines a user's group profile, (c) a search interface that includes the metadata criteria of importance to a user's group, and (d) the presentation of search results based on a user's group metadata criteria preferences.

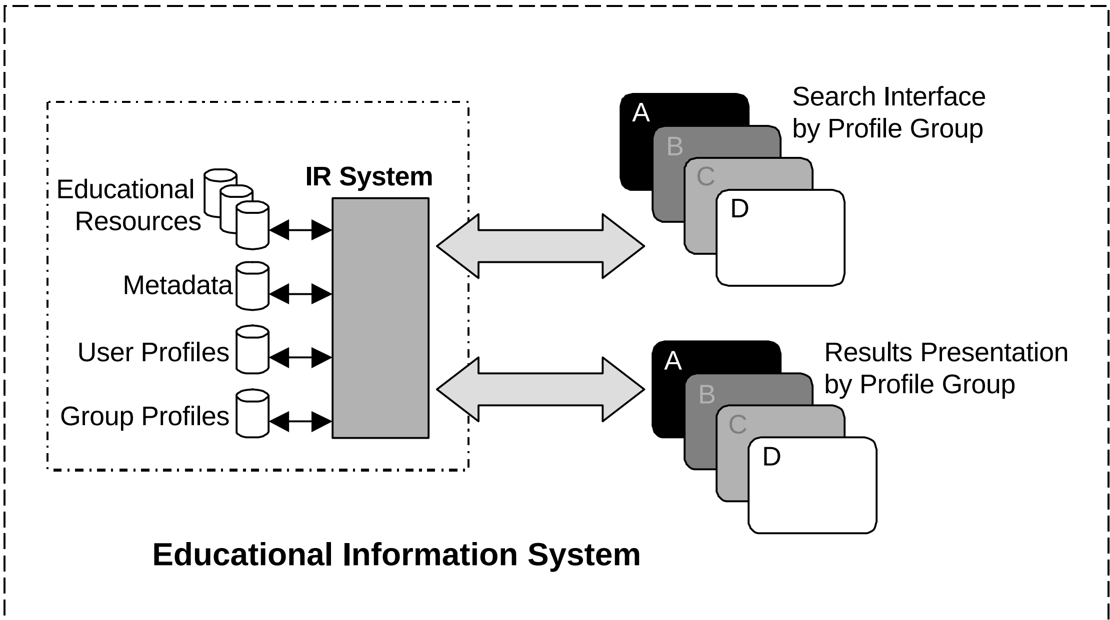

Figure 3. An educational information system customized by user group profiles.

Metadata can serve an important marketing role, linking the product to the targeted consumer, the course to the student. In this view, the value of metadata to the university can in part be measured by the financial return generated from the investment in metadata creation efforts and educational information systems, both of which can include the criteria of interest to specific groups of students in their design specifications. At a basic level, the view proposed in Figure 3 accommodates the needs of the groups that emerged in this study.

Selection Criteria

The first research question determined the criteria of importance to students in their course selection process. The survey instrument grouped the selection criteria into six categories, three categories were of a descriptive nature (general course characteristics, logistics, and technology aspects) and three categories were of an evaluative nature (previous students' evaluations of the instructor, the course, and the assignments). Their degree of importance to students determined the rank order of the 40 significant criteria. Only one of the six criteria in the technology aspects category made the cut for the top 21 selection criteria (see Table 50).

Table 50
Frequency of the Top 21 Criteria by Questionnaire Category

Category	No. Criteria	Top 21 Criteria	
		f	%
Descriptive criteria			
General course characteristics	12	2	17
Logistics of the course	6	5	83
Technology aspects	6	1	17
		n = 8	
Evaluative criteria			
Instructor evaluation	11	8	73
Course evaluation	7	3	43
Assignment evaluation	3	2	67
	N = 45	n = 13	

Because the factor analysis only considered the top 21 criteria, it is not surprising that no underlying technology-related factor was identified. Yet, technology criteria were the basis of one of the four student profiles that emerged in this study. This raises a caution for making decisions regarding what criteria should inform the selection of standard metadata elements: in the case of this study, deciding to use the top 50% of criteria would exclude the criteria of importance to a particular group of students. It is evident that these students' selection processes would be impaired and that the institution would be ill-served if only the top 50% of the criteria had formed the basis for standard metadata elements.

Almost equal numbers of descriptive (n = 24) and evaluative criteria (n = 21) were included in the questionnaire. However, the three descriptive-related categories from the survey instrument accounted for 38% of the criteria in the top 21 while the three evaluative-related categories accounted for 62%. The evaluative categories are clearly outside of the bounds of purely objective, content-related, and topical selection criteria and firmly inside the bounds of subjective, user-related, and non-topical criteria.

The finding that these evaluative criteria are of significant importance to students in their selection process supports previous findings regarding the factors that affect relevance judgments both from the traditional IR school (Cuadra & Katter, 1967; Cooper, 1971, 1973; Rees & Schultz, 1967) and from the user-oriented IR school (Barry, 1994; Park, 1993; Schamber, 1991; Wang and Soergel, 1998). The finding also supports Lynch's (1995) prediction that users in a networked information retrieval environment would want to employ both descriptive, content-related criteria as well as evaluative criteria in their resource selection processes. It is clear that previous students' evaluations provide important information to students in the process of selecting higher education courses. Metadata standards that intend to meet the needs of students engaged in this process should include evaluative elements.

Barry (1994) suggested that users' ability to predict the criteria they would use to both search and evaluate information in an IR system be investigated. She wondered if users could predict these criteria. If they could, then incorporating user's non-topical criteria into the representations of information objects would be worth the effort. Additionally, Barry recommended researching the importance of relevance criteria to users in order to establish design and implementation priorities for the development of IR systems. This study investigated the importance of students' selection criteria. It seems reasonable that these same criteria would be useful access points to course metadata records during students' resource identification or searching processes. It remains to be investigated if students would employ the criteria identified in this study in a "real world" course selection process involving a networked IR system.

This study also identified five factors underlying the top 21 criteria: instructional activities, instructor expertise, logistics, accessibility, and fundamentals. Three of these factors consist of subjective criteria originating from previous students' evaluations and two factors consist of objective criteria. The factor analysis supports the previous finding that students use evaluations from previous students as a basis for making course selections. The factor analysis also supports the implications that both educational metadata standards and IR systems for course selection should incorporate this type of subjective information.

Within the five factors, there are only two instances in which the criteria from a single questionnaire category load on two factors (see Table 51). In the first instance, only one of the five criteria from the "logistics " category loads on the "fundamentals" factor. However, in the second instance, five of the eight instructor evaluation criteria load on the "instructor expertise" factor, while the remaining three criteria load on the "accessibility" factor. The "accessibility" factor and the "Interaction" profile discussed earlier have two criteria in common: responsiveness to questions and availability to students. In this case, the factor analysis offers some support for the "Interaction" profile.

Table 51
Frequency of the Top 21 Criteria by Common Factors and Questionnaire Category

	Factors[a]				
Category	1	2	3	4	5
General Course Characteristics					2
Logistics of the Course			4		1
Technology Aspects				1	
Instructor Evaluation		5		3	
Course Evaluation	3				
Assignment Evaluation	2				

[a]1 = Instructional activities factor. 2 = Instructor expertise factor. 3 = Logistics factor. 4 = Accessibility factor. 5 = Fundamentals factor.

Additionally, the "instructional activities" factor included two questionnaire categories: previous students' course evaluation criteria and assignment evaluation criteria. Table 51 shows the frequencies of the top 21 criteria in the questionnaire categories and the common factors. It might be advisable to revise the survey instrument to reflect the organization of criteria suggested by the common factors.

More recently, studies of relevance criteria have identified a common core of relevance criteria categories that diverse users employ across varying use environments (Barry & Schamber, 1998; Wang & Soergel, 1998). It might be interesting to extend this line of research by mapping the criteria identified in this study to the categories previously identified. Doing so would further test the notion that there is a finite set of relevance criteria that applies to a wide range of IR environments.

User studies of relevance criteria generally involve actual relevance judgment situations including the retrieval of some or all of the resources, usually documents, and the examination of the retrieved documents as part of the relevance evaluation or resource selection process (Barry, 1994; Park, 1993; Schamber, 1991; Wang and Soergel, 1998). For example, Wang and Soergel's (1998) document selection model included selecting the citation, obtaining the full-text document, and deciding to cite the work. Course selection is different from document selection; courses are seldom available for examination during the selection process. In course selection, the equivalents to obtaining documents, examining them, and citing them are attending the course and subsequently enrolling in the course. In most cases, this would be an inefficient and cost-prohibitive course selection process. The important implication is that course selection prior to enrollment needs to provide a good measure of assurance that selected courses will match students' needs. The informational "clues" in the representation of the course need to provide students with enough information concerning the criteria of importance to them so that they are able to select a course. Metadata plays this vital role. Beyond metadata per se, there are other surrogates that represent courses, for example syllabi, reading lists, or sample lessons. It would enhance the online course selection process to include relational links from metadata records to this additional information.

Educational Metadata

The fifth research question asked if the IEEE LTSC LOM version 3.6 standard included the criteria students think are important for selection of higher education courses. The final analysis determined 15 of the 40 selection criteria were included in the IEEE LTSC LOM version 3.6 standard. It is interesting that only one of these 15 criteria was from a subjective questionnaire category: "degree of difficulty" in the course evaluation category (see Table 52). The remaining 14 criteria were from objective questionnaire categories.

Table 52
Questionnaire Categories Included in the IEEE LTSC LOM Standard

Category	Criteria
General course characteristics	Course description Tuition and fees Prerequisites Offering institution Admission to institution required Enrollment deadlines Admission to program required
Logistics of the course	Method of instructional delivery Location of course Attendance requirements
Technical aspects	Remote access to texts and course material Remote access to library resources Computer & Internet skills required Computer hardware & software requirements
Course evaluation	Degree of difficulty

Note. The categories are taken from the study questionnaire.

This study discovered that criteria pertaining to previous students' evaluations of the instructor, the course, and assignments are of importance to students in their course selection process. Additionally, the profiles of users that emerged suggest these criteria may be of more importance to younger students in their initial years of college education. This suggests that higher education institutions offering two-year degrees might want to consider allowing potential students access to previous students' course evaluations in order to meet the information needs of their younger students.

However, the combined findings that evaluation criteria are important to students and that they are not included in the IEEE standard is not enough to definitively recommend that the IEEE LTSC LOM standard formally include evaluation elements in its standard for two reasons. First, this study was exploratory and for many students in this study these elements were not important in their selection processes. Therefore, the findings need to be supported with additional research. Second, while the scope and purpose of the IEEE standard both include evaluation of learning objects, the scope of the standard also states that support of evaluation, security, privacy, and commerce is by means of metadata elements containing descriptive tokens related to these areas. It may be that the LOM implies two kinds of evaluation. The first being evaluation based on metadata elements in the LOM standard and the second being formal evaluation standards developed by other standards efforts, such as the World Wide Web Consortium. In the spirit of this latter interpretation of evaluation, the needs of students in their course selection processes require a standard for course evaluation, including instructor evaluation. Alternatively, the LOM allows for local extensions to the metadata set which could include evaluative elements of importance to students. An IEEE LOM element such as "relation" or "annotation" could point to course evaluation records developed either locally or in accord with a course evaluation standard.

This suggests a metadata model that involves multiple resource objects. For example, educational resources might include courses, instructors, or institutions. In fact, the IEEE LTSC LOM identifies learning objectives, persons, organizations, and events as learning objects in a broad sense of the definition (IEEE, 1999). Additionally, various resource objects might logically relate to one another.

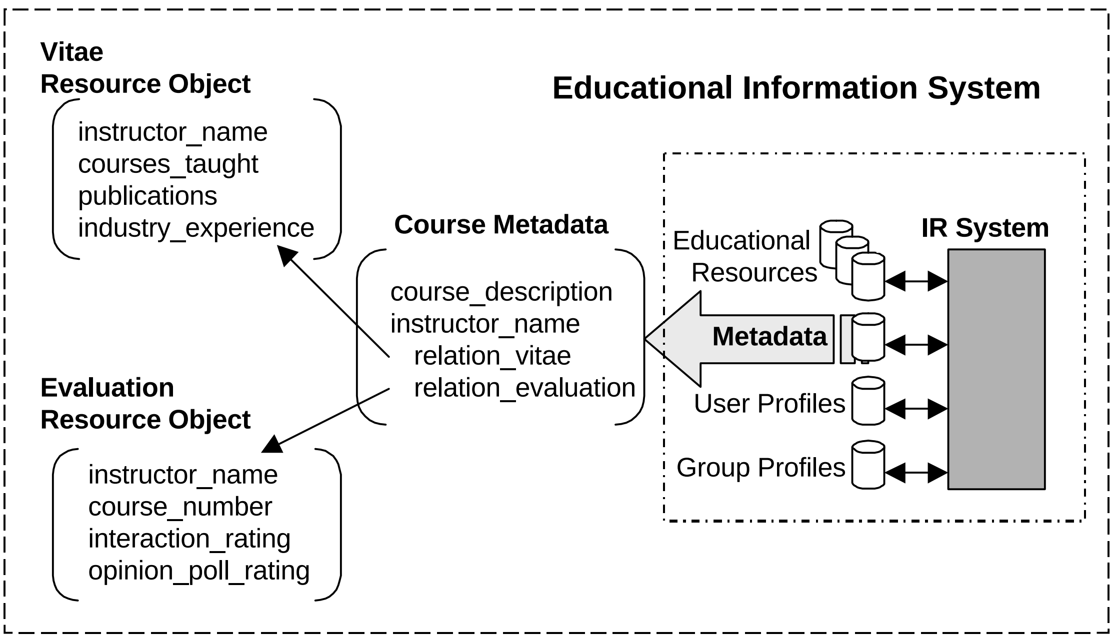

Figure 4. Metadata model for educational resource objects.

For example, an instructor's curriculum vitae and summaries of previous students' evaluations of the instructor might be resource objects that relate to a course or a particular section of a course. Metadata specific to any course might be linked via an element within the metadata standard, such as the "relation" element in the IEEE standard, to vitae and evaluation resource objects. Optionally, these resource objects might be represented by metadata in accord with some other standard. For example, student evaluation objects that include several evaluation items might be compiled into summary metadata elements such as an "instructor interaction" rating. Additionally, this model allows course metadata records to link directly to other resource objects via some relational metadata element. As previously discussed, these linked resources could be additional surrogates for courses, such as syllabi and reading lists, that provide students with important information to include in their selection process.

This modularization of metadata offers some benefits. An element set that includes course descriptions, logistic details, and technical aspects could represent courses somewhat minimally and yet provide many of the criteria of importance to students. Links from the minimal description to additional information could be provided, for example, a link to summaries of previous students' course evaluations or a link to institutional admissions and registration details. In this manner, students who employ these information criteria in their course selection process would have their information needs satisfied.

This view of metadata is in concert with the predictions of Dempsey & Heery (1997) who identified two future trends in the specification of metadata. Both trends relate to the increased importance of metadata specifications for general-purpose resource discovery of networked information resources. The first of these trends is that author and site metadata will become more important. In a higher education environment, an instructor might be analogous to an author and the university would be a site. Either author and site metadata might be gathered unselectively by a third party search site via web crawlers or there might be a deliberate selection process by a subject gateway interested in specific content. Collecting site-generated metadata enables search sites to offer element searching without incurring the expense of gathering and indexing the actual resources. The second trend pertains to communities or specialized domains that have created rich resource descriptions to satisfy the information needs of their users on their resource sites. These communities might publish selected portions of their metadata for general-purpose users (see Figure 5). General-purpose search sites might gather these "minimalist" descriptive records and provide links to the richer records at the resource site.

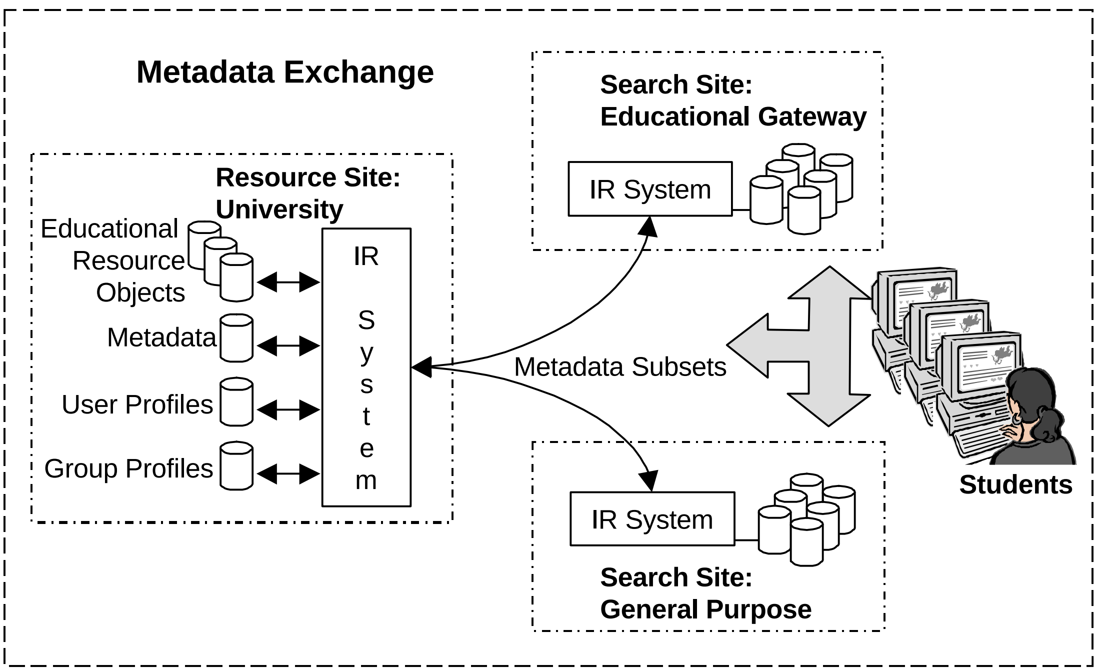

Figure 5. Metadata exchange in an NIDR environment.

In the higher education domain, university and entrepreneurial course developers might create course metadata for the explicit purpose of having it harvested by either a general-purpose search site or for a search site specializing in educational resources, which might be called an educational gateway. The author and the university might also generate richer metadata specific to the needs of users within their domain. For example, the minimalist descriptions might point to specialized databases at the university that are accessed according to functional groups or audiences, such as students and instructors. There could even be sub-classes within an audience, for example the student profiles suggested in this research study. The metadata would include subjective or evaluative criteria and objective or descriptive criteria of interest to each audience. Either a university resource site or an educational gateway search site would do this function; a general-purpose search site would probably not do it.

In this study, five selection criteria were insignificant for course selection: course title, course number, instructor name, class size, and competitive atmosphere. It seems reasonable that the first three of these criteria might well be significant for other processes in the overall information retrieval interaction, namely searching or course identification. Information seeking behavior often involves iterations in the search process. It may be that students would begin a search for courses by title or number or instructor name and subsequently employ other criteria in their final course selection process. While this study focused on metadata elements for course selection, it is important to understand that other types of metadata in support of other processes and functions are also important. For example, the IEEE LTSC LOM standard includes elements related to the person who created the metadata record and elements that allow for annotations about an educational resource, such as an independent review of an educational software resource object.

Ip et al. (1999) proposed a three-tier model for the maintenance and creation of metadata for web-based educational resource discovery and retrieval that is in concert with the modularized view of metadata creation suggested by this study and with the trends identified by Dempsey and Heery (1997). Within the model are three types of data: Type 1, Type 2, and Type 3. Type 1 data are courses or other educational resources. A resource site, such as a university, hosts these resources (see Figure 5).

Type 2 data includes "core" metadata that describes a resource and is derived from a resource. Type 2 data is produced either by a resource's author or creator or by a resource site, such as a university. Type 2 data might be contained within a resource or stored externally to a resource. A resource site might create additional metadata to meet the needs of its users or various stakeholders. Examples of this value-added metadata might be student course evaluations and instructor curriculum vitae.

Search sites create Type 3 data, which might include classification elements in compliance with a metadata standard or server-based evaluation elements. Examples of Type 3 data might be subject terms from a standardized vocabulary in compliance with an educational metadata standard or gateway-based retrieval frequency data for metadata records. Ip et al. (1999) liken the creation of Type 3 metadata to the work of a traditional library cataloger.

Standardized metadata supports interoperability between applications at resource sites and search sites. A search site, which could be either a general-purpose search site or an educational subject gateway, would gather the core metadata from resource sites. This core metadata would be sufficient to allow users to search the resources of multiple resource sites from a single search site. A resource site would control access to any value-added metadata created for its community of users.

This model allows for collaboration among resource sites, that is, participation in the server site, as well as for competition among the resource sites. The model begins to define the role of universities in metadata creation and maintenance and to articulate the role of metadata in a competitive educational environment. Additionally, the value of compliance with a widely adopted educational metadata standard becomes clearer.

Currently, universities seeking to adopt an educational metadata standard have two primary choices: the DC specification with extensions from the DC Education Working Group and the IEEE LTSC LOM standard. This study discovered only 38% of students' criteria for course selection were included in the IEEE LTSC LOM standard. Rather than interpret this as an indication that universities should not adopt the LOM standard, some insight might be gained by examining the context that influenced the IEEE LTSC LOM Working Group's standards development process. While this was not a primary focus in this study, a description of the IEEE LTSC LOM context at a high level might be helpful for university decision-makers.

The primary purposes of the LOM standard are to enable (1) management and interoperability of distributed learning objects in support of the creation of customized learning programs that accommodate individual differences and (2) documentation of learner completion of performance objectives. The IEEE standard is focused on the application of emerging technology in education. Its primary architects include international leading-edge research projects and collaborative efforts between industry, government, and higher education to meet future economic imperatives for education and training.

For universities, this is a time of profound and fundamental flux in their product and service mix. Most courses are still classroom based, yet video-based and web-based courses are becoming integral components in the overall mix. The IEEE standard is complex and targets a rapidly emerging distributed learning environment while still accommodating traditional classroom-based instruction. It should be given serious consideration as a candidate for educational metadata at the university level. However, it will need to be supplemented to meet the particular needs of students and possibly other stakeholders in a broader higher education context than the context in which the standard was conceived.

Internet Survey Research

A concern with survey research in general is the issue of self-selection of respondents and, more specifically, the differences between respondents and non-respondents that affect the generalizability of the results. Internet-based surveys share this concern (Zhang, 2000). Self-selection is involved in the wider issue of sampling bias, which limits the generalizability of research results. This study was interested in a broad spectrum of existing and potential students. The sampling method reflects this interest as well as the exploratory nature of the study. However, given the fairly recent emergence of Internet-based survey research in the social sciences, it may be more appropriate to take a conservative view of the generalizability of this study's results. In Coomber's (1997) words, this view suggests that the results are valuable as "indicative" information rather than as generalizable data. This view is also consistent with the nature of exploratory research.

Because Internet users tended to be young, male, affluent, and highly educated, researchers have been concerned that research results were not representative of the population at large (Coomber, 1997). However, as Internet access becomes more pervasive, this concern appears to be mitigating somewhat. Demographic results from the 10th GVU Survey indicate that gender is roughly equal in new Internet users and that this group has a higher average age than general Internet users (GVU, 1999b). The respondents in this study were mostly female (66%). Also, over one half (53.2%) of the respondents were 33 years of age or older and 18% were 48 years of age or older. Consistent with previous Internet research, the sample in this study was fairly educated, with 80% having completed some college, and most respondents were formally enrolled in higher education institutions (70%). While their educational status might limit the sample's representativeness in terms of the general population, the sample is quite representative of the inferred population of existing or potential students of higher education.

Additionally, concerns regarding the representativeness of a sample comprised of Internet users are of less concern in this study because users of Internet technology were in fact the individuals of interest in the study. That is, any biases that distinguish users of Internet technology from non-users, which might be important in other studies, are of less importance in this study, which was interested per se in the views and characteristics of these users.

Recommendations

While this study was concerned with students, several results from this study can inform and aid different stakeholders in higher education. The five recommendations included in this section flow directly from the results previously discussed.

1. This study provides a clear indication that previous students' evaluations provide important information to students in the process of selecting higher education courses. This may be particularly important for younger students at lower levels within the university. To meet their evaluation needs, an independent standard for student evaluation of higher education courses, including instructor evaluation, would be helpful. Both educational metadata standards and IR systems for course selection should accommodate the inclusion of previous students' evaluations.

2. This study indicates that groups of students who place importance on different course selection criteria may exist. Educational metadata standards should accommodate these group differences. Additionally, educational IR systems should consider these differences both in the design of their user interfaces, in the design of their user databases, and in the selective presentation of metadata subsets in their search results.

3. While the IEEE LTSC LOM standard is a strong candidate for a higher education metadata standard, other educational metadata specifications may better meet the information needs of students selecting higher education courses. Prior to adopting any metadata specification, universities should comparatively evaluate one or more educational metadata specifications vis-à-vis the criteria identified in this study.

4. Universities should identify the metadata requirements of (a) various stakeholder groups within the university, such as administrative personnel and instructors and (b) stakeholder groups external to the university, such as accreditation organizations, state licensing organizations, and alumni, and subsequently include these requirements as local extensions in their institutional metadata standards.

5. Groups responsible for the development of educational metadata standards for higher education need to ensure that the requirements of critical stakeholders, such as students, and critical processes, such as course selection, inform the design process. At a minimum, development of a metadata standard for course and instructor evaluation is recommended. Educational metadata standards in support of course selection should include this evaluation metadata or provide a means to reference it. Additionally, metadata standards in support of course selection should provide links to additional surrogate representations of courses.

Future Research Ideas

1. Providing evaluative information about courses and instructors to potential students elicits policy concerns for institutions, especially in regard to privacy. What are the implications for privacy? What policies need to be in place?

2. What are the costs of implementing metadata for course selection within a higher education institution? What are the metadata boundaries between collaboration and competition among providers of higher education? What data is in everyone's best interest to share and what data ought to be considered confidential in the interest of competitive edge?

3. As distributed learning becomes more available and more students experience this type of higher education, it will be important to measure respondents' experience with distributed learning and identify any relationships between that experience and the importance of course selection criteria.

4. What is the relationship between non-completion of courses and the provision of metadata in IR systems for course selection? Can developing student-based metadata reduce the costs associated with non-completion of courses?

5. It remains to be investigated if students would employ the criteria identified in this study in a "real world" course selection process involving a networked IR system. More qualitative course-seeking research should be conducted in which the criteria students actually employ in a course selection process are identified.

6. The four user profiles identified in this study provide a base upon which to group selection criteria and metadata elements for higher education courses. Further study of these four groups is necessary to determine the validity of the profiles. Such explorations should include a qualitative component that elicits criteria from students.

Closing

It was recommended that more research be undertaken regarding end user environments in the larger Internet community (Lynch, 1995). Such research might address the "problem of the unknown user" that confounds the task of subject analysis and classification of Internet-based resources (Ellis et al., 1998). This research suggested four student profiles that might help fill the gap between those creating metadata to represent courses on the Internet and students selecting courses via the Internet. The development of metadata schemes for particular domains enables user-centered resource description. However, within any domain it is important to describe resources richly enough to satisfy the information needs of important stakeholders within the domain.

In the education domain, there are a number of stakeholders. The description of higher education courses should attempt to embrace the criteria that key stakeholders in the domain employ in their evaluation processes. This research identified the criteria of importance to the student stakeholder group. Educators, government policy makers, and software developers were involved in the development of the IEEE LTSC LOM standard. This research found that the IEEE standard partially meets students' information needs. Future research should identify the criteria of importance to other stakeholders in the higher education domain and evaluate the IEEE LTSC LOM standard and other educational metadata specifications for the inclusion of selection criteria of importance to key stakeholders.

The future of higher education holds a good deal of uncertainty. Some predict the demise of universities while others offer warnings for universities to change radically or fall into oblivion (Noam, 1995; Pelton, 1996). More moderate predictions suggest the traditional college experience will remain viable at the same time that universities will face more competition on a global basis (Gubernick & Ebeling, 1997; Schure, 1994). It seems certain that distributed learning will play an increasingly important role in the viability of universities (Lewis et al, 1999).

The technological and economic forces driving distributed learning are causing a reevaluation of many aspects of the traditional university. In a highly competitive higher education market, meeting students' information needs vis-à-vis course selection will be a critical ingredient to the successful marketing of courses. Patrick Wilson (1978) discussed two types of information need in an IR system context: strong need and weak need. A strong need for information means that without the information a user's goal will not be achieved. A weak need for information means that without the information, achieving the goal will be more difficult, perhaps more costly and inefficient, and the result may be of lesser quality. Educational metadata can address both strong and weak needs. To be all-inclusive is probably too costly in terms of metadata creation and maintenance. Selective inclusion must pay attention to the elements contained in the metadata specification and, maybe more importantly, to the elements excluded. Metadata can improve the efficiency of IR systems. However, to improve their effectiveness it is imperative to include the critical elements that assist key stakeholders in satisfying their strongest information needs.

In the absence of standardized metadata that includes the selection criteria of importance to students, course selection will be costly and inefficient and students' satisfaction with the results of their selection will be of variable quality. Universities are in a position to identify the needs of their key stakeholders, evaluate educational metadata specifications, and establish an institutional standard that both meets the needs of their stakeholders and positions the university strategically in the growing distributed education environment.

APPENDIX A

EDUCATIONAL METADATA PROJECTS

UNIFORM RESOURCE LOCATORS

Table 53
Educational Metadata Projects: Uniform Resource Locations (URLs)

Acronym	Project	URL
ARIADNE	Alliance of Remote Instructional Authoring and Distribution Networks for Europe	http://www.ariadne.ac.uk
DBS	Deutscher Bildung-Server/German Educational Resources	http://dbs.schule.de/indexe.html
EdNA	Education Network Australia	http://www.edna.edu.au
	European Schoolnet	http://www.en.eun.org/menu/about/about.html
GEM	Gateway to Educational Materials	http://geminfo.org http://www.thegateway.org
GESTALT	Getting Educational Systems Talking Across Leading-Edge Technologies	http://www.fdgroup.co.uk/gestalt
IEEE LTSC LOM	IEEE Learning Technology Standards Committee Learning Object Metadata	http://ltsc.ieee.org
IMS	Instructional Management System	http://www.imsproject.org
VEC	Victorian Educational Channel	http://www.sofweb.vic.edu.au/help/aboutsof.htm
VES	Virtual European School	http://www.ves.eu.org/

APPENDIX B

VIRTUAL EUROPEAN SCHOOL

ELEMENT DESCRIPTIONS

Table 54
Virtual European School Element Descriptions

#	Categories & Elements	Description
1	Bibliographic data	
	identifier	Unique identifier for the content unit.
	title	Meaningful title of content unit.
	author	“Author or creator of the content unit.”
	last update	“Date of creation or last update of content unit (this is not the date when the content unit is put or updated on the VES system).”
	language	In which language is the content unit available–the mother tongue of the publisher.
	publisher	Publisher under whose responsibility the content unit was released.
	sources	Source document on which content unit is based.
2	General description	
	keywords	Significant words to find content unit.”
	abstract	“Short description of the content unit (maximum 1000 characters).”
3	Didactic data	
	discipline / subject	Scholastic or scientific discipline.
	kind of material	“Material type from a didactic viewpoint.”
	pupils age range minimum	“Age level at which education is to be provided. The publisher enters the minimum and maximum age estimated for the proposed materials (Standard range is 0-99).”
	pupils age range maximum	“Age level at which education is to be provided. The publisher enters the minimum and maximum age estimated for the proposed materials (Standard range is 0-99).”
	kind of use	“Type of use in the scholastic milieu.”
	level	“Difficulty level of content unit.”
	school type	“Description of the school type, starting from a national classification.”
	curriculum references	“Free text description of references to the national and/or international curricula.”

Note. Category and elements were identified in Rohatschek, H. (1999, September 10). VES metadata summary. DC-Education Listserv [Online]. Available: http://www.mailbase.ac.uk/lists/dc-education/1999-09/0006.html [1999, September 16]. Element descriptions were identified in Edna (1999).

Table 54 continued
Virtual European School Element Descriptions

#	Categories & Elements	Description
	applied use	"Classification of main usage of material in school."
	target group	"Target group the material is aimed for."
4	Technical information	
	content type	Decides between the different kinds of content.
	document handle	Depending on the content type, the document handle can either be a reference to file (online, downloadable), an ordering number (external) or a URL (Web-reference).
	file format	Ordered list of file extensions and their descriptions, used by the content unit."
	size	Size of content unit in kiloBytes.
	date update on system	"Date when the content unit was last updated on the VES system."
	time of download 28.8k / ISDN	"Estimated time of download in minutes for 28.8k models and ISDN."
	other requirements	"What is required to run the downloadable software, or which plug-ins are necessary to view the content unit on-line."
5	Economic data	
	reserved rights	Which rights are reserved, and in which extent.
	price	Information concerning the price of a not free content unit (in Euro).
6	Meta-metadata	
	meta - author name	Name of creator of metadata."
	meta - creation date	"Date of creation of metadata."
	meta - last modified date	"Date of last [metadata] modification."
	meta - language	"Language in which metadata is created."
	meta - validator name	"Name of supervisor that authorised metadata."
	validation date	Date of release by supervisor.
	automatic expiring data	"Specific content units may be taken from database."
	check date	"Date when next check of indexed content unit is due."

Note. Category and elements were identified in Rohatschek, H. (1999, September 10). VES metadata summary. DC-Education Listserv [Online]. Available: http://www.mailbase.ac.uk/lists/dc-education/1999-09/0006.html [1999, September 16]. Element descriptions were identified in Edna (1999).

APPENDIX C

IEEE LTSC LOM VERSION 3.6

METADATA ELEMENTS

Table 55
IEEE LTSC LOM Version 3.6 Metadata Elements

#	Name	Explanation
1	General	Context-independent features of the resource.
1.1	Identifier	A unique label for the resource.
1.2	Title	Name given to the resource.
1.3	CatalogEntry	Designation given to the resource.
1.3.1	Catalogue	Indication of the source of the following string value.
1.3.2	Entry	Actual string value.
1.4	Language	The human language of the resource.
1.5	Description	A textual description of the content of the resource.
1.6	Keywords	Keywords describing the resource.
1.7	Coverage	The spatial or temporal characteristics of the intellectual content of the resource.
1.8	Structure	Underlying organizational structure of the resource.
1.9	Aggregation Level	The functional size of the resource.
2	LifeCycle	Features related to the life cycle of the resource.
2.1	Version	The edition of the resource.
2.2	Status	The condition the resource is in.
2.3	Contribute	Persons or organizations contributing to the resource (includes creation, edits and publication).
2.3.1	Role	Kind of contribution.
2.3.2	Entity	Entity or entities involved, most relevant first.
2.3.3	Date	The date of the contribution.
3	MetaMetaData	Features of the description rather than the resource.
3.1	Identifier	A unique label for the metadata.
3.2	Catalog Entry	Designation given to the metadata instance.
3.2.1	Catalogue	Indication of the source of the following string value.
3.2.2	Entry	Actual string value.
3.3	Contribute	Persons or organizations contributing to the metadata.
3.3.1	Role	Kind of contribution.
3.3.2	Entity	Entity or entities involved, most relevant first.
3.3.3	Date	The date of the contribution.
3.4	Metadata Scheme	Names the structure of the metadata (this includes version).
3.5	Language	Language of the metadata instance. This is the default language for all "LangString" values.

Table 55 continued
IEEE LTSC LOM Version 3.6 Metadata Elements

#	Name	Explanation
4	Technical	Technical features of the resource.
4.1	Format	Technical data type of the resource.
4.2	Size	The size of the digital resource in bytes. Only the digits '0'..'9' should be used; the unit is bytes, not Mbytes, GB, etc.
4.3	Location	A location or a method that resolves to a location of the resource. Preferable location first.
4.4	Requirements	Needs in order to access the resource. If there are multiple requirements, then the logical connector is "AND".
4.4.1	Type	Type of requirement.
4.4.2	Name	Name of the required item.
4.4.3	Minimum Version	Lowest version of the required item.
4.4.4	Maximum Version	Highest version of the required item.
4.5	Installation Remarks	Description on how to install the resource.
4.6	Other Platform Requirements	Information about other software and hardware requirements.
4.7	Duration	Time a continuous resource takes when played at intended speed, in seconds.
5	Educational	Educational or pedagogic features of the resource.
5.1	Interactivity Type	The type of interactivity supported by the resource.
5.2	Learning Resource Type	Specific kind of resource, most dominant kind first.
5.3	Interactivity Level	Level of interactivity between an end user and the resource.
5.4	Semantic Density	Subjective measure of the resource's usefulness as compared to its size or duration.
5.5	Intended end user role	Normal user of the resource, most dominant first.
5.6	Learning Context	The typical kind of learners.
5.7	Typical Age Range	Age of the typical intended user.
5.8	Difficulty	How hard it is to work through the resource for the typical target audience.

Table 55 continued
IEEE LTSC LOM Version 3.6 Metadata Elements

#	Name	Explanation
5.9	Typical Learning Time	Approximate or typical time it takes to work with the resource.
5.10	Description	Comments on how the resource is to be used.
5.11	Language	The human language used by the typical intended user of the resource.
6	Rights	Conditions of use of the resource.
6.1	Cost	Whether use of the resource requires payment.
6.2	Copyright and Other Restrictions	Whether copyright or other restrictions apply to the use of the resource.
6.3	Description	Comments on the conditions of use of the resource.
7	Relation	Features of the resource in relationship to other resources.
7.1	Kind	Nature of the relationship between the resource being described and the one identified by "Resource" (7.2).
7.2	Resource	Resource the relationship holds for.
7.2.1	Identifier	Unique identifier of the other resource.
7.2.2	Description	Description of the other resource.
8	Annotation	Comments on the educational use of the resource.
8.1	Person	Annotator.
8.2	Date	Date that the annotation was created.
8.3	Description	The content of the annotation.
9	Classification	Description of a characteristic of the resource by entries in classifications.
9.1	Purpose	Characteristics of the resource described by this classification entry.
9.2	TaxonPath	A taxonomic path in a specific classification. There may be different paths, in the same or different classifications that describe the same characteristic.
9.2.1	Source	A specific classification.
9.2.2	Taxon	An entry in a classification. An ordered list of taxons creates a taxonomic path, i.e. "taxonomic stairway": this is a path from a more general to more specific entry in a classification.
9.2.2.1	Id	The identifier of the taxon in the "Source" classification.
9.2.2.2	Entry	The textual label of the taxon.
9.3	Description	A textual description of the characteristic being described.
9.4	Keywords	Keywords describing the characteristic, most relevant first.

APPENDIX D

CONTENT ANALYSIS

Table 56
Initial and Final Evaluation Criteria

Initial criteria	Criteria changes in final survey
General course characteristics	
Course description	
Course title	
Course number	
Corequisites	Deleted
Prerequisites	
Instructor name	
Number of credits	
Level	Level (freshman, sophomore, etc.)
Cost	Tuition and fees
Offering institution	
Enrollment deadlines	
Number of students	Class size
Admission to program required	
Admission to institution required	
Logistics of course	
Location	
Meeting days of the week	
Meeting dates	
Meeting time of day	
Method of instructional delivery (e.g., video broadcast, CDROM, Internet, classroom)	Method of instructional delivery (video broadcast, Internet, classroom, etc.)
Attendance requirements	
Technology aspects	
Hardware & software requirements	Computer hardware & software requirements
Technical skills required	Computer & Internet skills
Remote access to library resources	
Remote access to texts and course material	
Admission to program available on Internet	Admission to program via Internet
Registration available on Internet	Course registration via Internet

Table 56 continued
Initial and Final Evaluation Criteria

Initial criteria	Criteria changes in final survey
Instructor evaluation ratings	
Instructor contribution	Deleted
Instructor effectiveness	
Instructor interest	
Grading techniques	
Instructor enthusiasm	
Ability to stimulate interest	
Attitude toward class participation	
Responsiveness to questions	
Availability to students	
Students' overall rating	Past students' overall course rating
	Addition: Easy to approach
	Addition: Instructor experience in field
Course evaluation ratings	
Student rating of course content	Course content
Student rating of overall course	Overall course rating
Amount students learned	
Quality of readings	Quality of assigned readings
Workload	
Difficulty	Degree of difficulty
Competitive atmosphere	
Assignment evaluation ratings	
Appropriateness of assignments	
Instructor feedback	
Prompt return	

Table 57
University Websites Included in Content Analysis

Course information sites	Course evaluation sites
Swarthmore College	University of Washington
Amherst College	University System of Georgia
Williams College	Eastern Oregon University
Wellesley College	Lewis-Clark State College
Haverford College	University of Southern Australia
California Institute of Technology	University of Colorado at Boulder
Harvard University	Bismarck State College
Massachusetts Institute of Technology	
Princeton University	

APPENDIX E

SURVEY INSTRUMENT

Decision Criteria for Course Selection: A Survey of Students
University of North Texas Kathleen Murray November 15, 1999
<u>*Completion of this survey is on a voluntary basis.*</u>

[1-4]
***Purpose*:** **The purpose of this study is to identify the information students need in order to evaluate and select courses via the Internet**

Section A.	In order to understand your needs better, your current circumstances are important. Please describe your circumstances.

How did you find out about this survey? *(circle one)*

1 About.com Distance Education website
2 Southern Regional Electronic College (SREC) website
3 University of North Texas website
4 Was told URL by a friend
5 Other sources
6 Regents College

6. Indicate the highest level of education you completed. *(circle one)*

1	Grammar School	6	College Graduate (4 year)
2	High School or equivalent	7	Master's Degree (MS, MA)
3	Vocational/Technical School (2 year)	8	Doctoral Degree (PhD, EdD)
4	Some College	9	Professional Degree (MD, JD, etc.)
5	Community College Graduate (2 year)	10	Other

7. What is your university classification? (*circle one*)

Freshman
2 Sophomore
3 Junior
4 Senior
5 Masters Level
6 Doctoral Level
7 Not Classified

8. What is your enrollment status? (*circle one*)

1 Full-time Student
2 Part-time Student
3 Not Enrolled at an Institution

9. What is your primary reason for enrolling in higher education courses at this time? *(circle one)*

1	Major/minor, Master's, or Doctoral requirement	5	Personal interest
2	Major/minor, Master's, or Doctoral elective	6	Certification requirement
3	University requirement	7	Career development
	General elective	8	Not enrolling in courses
		9	Other

Please go to next page →

Section B.	Assume that you have identified several courses that satisfy your requirements or possibly one course with several sections. What are the factors you use to select a specific course or section? Indicate the importance to you of each factor below by circling the number between 1 and 5 that best represents how important each factor is to you.

	General Course Characteristics	Not Important	A Little Important	Somewhat Important	Very Important	Extremely Important
10.	Course description		2	3	4	5
	Course title		2	3	4	5
12.	Course number		2	3	4	5
13.	Prerequisites	1	2	3	4	5
14.	Instructor name	1	2	3	4	5
15.	Number of credits	1	2	3	4	5
16.	Level (freshman, sophomore, etc.)		2	3	4	5
17.	Tuition and fees	1	2	3	4	5
18.	Offering institution	1	2	3	4	
19.	Enrollment deadlines	1	2	3	4	5
20.	Class size		2	3	4	5
21.	Admission to program required	1	2	3	4	
22.	Admission to institution required	1	2	3	4	5

	Logistics of Course	Not Important	A Little Important	Somewhat Important	Very Important	Extremely Important
23.	Location	1	2	3	4	5
24.	Meeting days of the week	1	2	3	4	5
25.	Meeting dates	1	2	3	4	5
26.	Meeting time of day		2	3	4	5
27.	Method of instructional delivery (e.g., video broadcast, Internet, classroom, etc.)		2	3	4	5
28.	Attendance requirements	1	2	3	4	5

	Technology Aspects	Not Important	A Little Important	Somewhat Important	Very Important	Extremely Important
29.	Computer hardware & software requirements		2	3	4	5
30.	Computer & Internet skills	1	2	3	4	5
31.	Remote access to library resources	1	2	3	4	5
32.	Remote access to texts and course material		2	3	4	5
33.	Admission to program via Internet	1	2	3	4	5
34.	Course registration via Internet	1	2	3	4	5

Please go to next page →

Section C.	Again, assume that you have identified several courses that satisfy your requirements or possibly one course with several sections. What factors from past students' evaluations do you use to select a specific course or section? Indicate the importance to you of each factor below by circling the number between 1 and 5 that best represents how important each factor is to you.

Instructor Evaluation Ratings		**Not Important**	**A Little Important**	**Somewhat Important**	**Very Important**	**Extremely Important**
35.	Instructor effectiveness		2	3	4	5
36.	Instructor interest		2	3	4	5
37.	Grading techniques	1	2	3	4	5
38.	Instructor enthusiasm	1	2	3	4	
39.	Ability to stimulate interest	1	2	3	4	
40.	Attitude toward class participation		2	3	4	5
41.	Availability to students	1	2	3	4	5
42.	Responsiveness to questions		2	3	4	5
43.	Easy to approach		2	3	4	5
44.	Instructor experience in field		2	3	4	5
45.	Past students' overall rating		2	3	4	5

Course Evaluation Ratings		**Not Important**	**A Little Important**	**Somewhat Important**	**Very Important**	**Extremely Important**
46.	Course content		2	3	4	5
47.	Amount students learned	1	2	3	4	5
48.	Quality of assigned readings	1	2	3	4	5
49.	Workload	1	2	3	4	5
50.	Degree of difficulty		2	3	4	5
51.	Competitive atmosphere		2	3	4	5
52.	Past students' overall course rating	1	2	3	4	5

Assignment Evaluation Ratings		**Not Important**	**A Little Important**	**Somewhat Important**	**Very Important**	**Extremely Important**
53.	Appropriateness of assignments		2	3	4	5
54.	Instructor feedback	1	2	3	4	5
55.	Prompt return	1	2	3	4	5

Please go to next page →

56. Think of either an elective course you have taken or of a required course that had several sections and instructors. What influenced your choice? Circle the number between 1 & 5 that best represents how much each category influenced your choice.

	Category	Not Influential	A Little Influential	Somewhat Influential	Very Influential	Extremely Influential
57.	General Course Characteristics (description, prerequisites, etc.)		2	3	4	5
58.	Logistics of Course (location, dates, etc.)	1	2	3	4	5
59.	Technology Aspects (computer requirements, skills, etc.)		2	3	4	5
60.	Past Students' Evaluation of Instructor (interest, availability, etc.)	1	2	3	4	5
61.	Past Students' Evaluation of Course (content, workload, etc.)		2	3	4	5
62.	Past Students' Evaluation of Assignments (appropriateness, feedback, etc.)	1	2	3	4	5

Section D.	Please describe your experience with the Internet.

63. How long have you been using the Internet (including using email, gopher, ftp, etc.)? *(circle one)*

Less than 6 months
2 6 to 12 months
3 1 to 3 years
4 4 to 6 years
5 7 years or more

64. How often do you access the Internet from each of the places listed below? *(circle one)*

	Access Place	Never	Less than Once per Month	Monthly	Weekly	Daily
65.	From Home	1	2	3	4	5
66.	From Work	1	2	3	4	5
67.	From School	1	2	3	4	5
68.	From Public Terminal	1	2	3	4	5
69.	From Other Places	1	2	3	4	5

70. Which of the following have you done? *(Please circle all that apply.)*

1 ordered a product/service from a business, government or educational entity by filling out a form on the web
2 made a purchase online for more than $100
3 created a web page
4 customized a web page for yourself (e.g. MyYahoo, CNN Custom News)
changed your browser's "startup" or "home" page
6 changed your "cookie" preferences
participated in an online chat or discussion (not including email)
8 listened to a radio broadcast online
9 made a telephone call online
10 used a nationwide online directory to find an address or telephone number
11 taken a seminar or class about the Web or Internet
12 bought a book to learn more about the Web or Internet

Please go to next page →

Section E.	Please describe yourself.

71. What is your current employment status? (*circle one*)

1 Full time
2 Part time
3 Retired
4 Not employed

72. What is your sex? (*circle one*)

1 Female
2 Male

73. What is your age group? (*circle one*)

	18 - 22	7	48 - 52
2	23 - 27	8	53 - 57
3	28 - 32	9	58 - 62
4	33 - 37	10	63 - 67
5	38 - 42	11	68+
6	43 - 47	12	Rather not say

74. Where are you located? (*circle one*)

1	Africa	7	Canada
2	Antarctica	8	Mexico
3	Asia	9	Central America
4	Oceania (Australia, New Zealand, etc.)	10	South America
5	Europe	11	Middle East
6	USA	12	West Indies

Thank you very much for your participation!

Some questions on this survey were modified from the GVU's 10th WWW User Survey produced by the Graphic, Visualization, and Usability Center at the Georgia Tech Research Corporation.

APPENDIX F

SUMMARY OF SELECTION CRITERIA RESPONSES

Table 58
Summary of Selection Criteria Responses

Criteria		N	1[a]	2[b]	3[c]	4[d]	5[e]
General Course Characteristics							
1. Course description		208					
	f		2	6	24	87	89
	%		1.0	2.9	11.5	41.8	42.8
2. Course title		208					
	f		14	28	80	63	23
	%		6.7	13.5	38.5	30.3	11.1
3. Course number		207					
	f		76	30	55	32	14
	%		36.7	14.5	26.6	15.5	6.8
4. Prerequisites		208					
	f		5	18	61	78	46
	%		2.4	8.7	29.3	37.5	22.1
5. Instructor name		209					
	f		50	37	62	40	20
	%		23.9	17.7	29.7	19.1	9.6
6. Number of credits		208					
	f		10	19	60	67	52
	%		4.8	9.1	28.8	32.2	25.0
7. Level (freshman, sophomore, etc.)[f]							
	f						
	%						
8. Tuition and fees		209					
	f		17	16	36	59	81
	%		8.1	7.7	17.2	28.2	38.8
9. Offering institution		206					
	f		11	16	57	82	40
	%		5.3	7.8	27.7	39.8	19.4
10. Enrollment deadlines		205					
	f		15	20	54	65	51
	%		7.3	9.8	26.3	31.7	24.9
11. Class size		206					
	f		33	36	67	44	26
	%		16.0	17.5	32.5	21.4	12.6

[a]1=Not important. [b]2=A little important. [c]3=Somewhat important. [d]4=Very important. [e]5=Extremely important. [f]Data not collected due to a mistake in the HTML code of the web-based form.

Table 58 continued

Summary of Selection Criteria Responses

Criteria		N	1[a]	2[b]	3[c]	4[d]	5[e]
12. Admission to program required		204					
	f		16	18	55	65	50
	%		7.8	8.8	27.0	31.9	24.5
13. Admission to institution required		203					
	f		18	15	53	61	56
	%		8.9	7.4	26.1	30.0	27.6
Logistics of Course							
14. Location		209					
	f		19	17	33	61	79
	%		9.1	8.1	15.8	29.2	37.8
15. Meeting days of the week		209					
	f		9	10	30	64	96
	%		4.3	4.8	14.4	30.6	45.9
16. Meeting dates		209					
	f		12	9	38	66	84
	%		5.7	4.3	18.2	31.6	40.2
17. Meeting time of day		207					
	f		9	10	20	66	102
	%		4.3	4.8	9.7	31.9	49.3
18. Method of instructional delivery (e.g., video broadcast, Internet, classroom, etc.)		209					
	f		4	7	34	73	91
	%		1.9	3.3	16.3	34.9	43.5
19. Attendance requirements		206					
	f		16	18	54	52	66
	%		7.8	8.7	26.2	25.2	32.0

[a]1=Not important. [b]2=A little important. [c]3=Somewhat important. [d]4=Very important. [e]5=Extremely important.

Table 58 continued
Summary of Selection Criteria Responses

Criteria	N	1[a]	2[b]	3[c]	4[d]	5[e]
Technology Aspects						
20. Computer hardware & software requirements	209					
f		17	23	62	61	46
%		8.1	11.0	29.7	29.2	22.0
21. Computer & Internet skills	208					
f		19	25	57	68	39
%		9.1	12.0	27.4	32.7	18.8
22. Remote access to library resources	208					
f		16	22	42	70	58
%		7.7	10.6	20.2	33.7	27.9
23. Remote access to texts and course material	206					
f		14	9	44	70	69
%		6.8	4.4	21.4	34.0	33.5
24. Admission to program via Internet	208					
f		22	15	57	52	62
%		10.6	7.2	27.4	25.0	29.8
25. Course registration via Internet	207					
f		21	16	49	61	60
%		10.1	7.7	23.7	29.5	29.0
Instructor Evaluation Ratings						
26. Instructor effectiveness	207					
f		7	9	30	94	67
%		3.4	4.3	14.5	45.4	32.4
27. Instructor interest	207					
f		7	13	33	95	59
%		3.4	6.3	15.9	45.9	28.5
28. Grading techniques	206					
f		5	18	62	80	41
%		2.4	8.7	30.1	38.8	19.9
29. Instructor enthusiasm	207					
f		5	7	31	89	75
%		2.4	3.4	15.0	43.0	36.2

[a]1=Not important. [b]2=A little important. [c]3=Somewhat important. [d]4=Very important. [e]5=Extremely important.

Table 58 continued
Summary of Selection Criteria Responses

Criteria		N	1[a]	2[b]	3[c]	4[d]	5[e]
30. Ability to stimulate interest		207					
	f		3	13	34	82	75
	%		1.4	6.3	16.4	39.6	36.2
31. Attitude toward class participation		207					
	f		7	14	59	79	48
	%		3.4	6.8	28.5	38.2	23.2
32. Availability to students		206					
	f		5	12	38	80	71
	%		2.4	5.8	18.4	38.8	34.5
33. Responsiveness to questions		207					
	f		3	3	21	93	87
	%		1.4	1.4	10.1	44.9	42.0
34. Easy to approach		206					
	f		4	9	35	79	79
	%		1.9	4.4	17.0	38.3	38.3
35. Instructor experience in field		205					
	f		4	5	34	84	78
	%		2.0	2.4	16.6	41.0	38.0
36. Past students' overall rating		205					
	f		15	21	56	78	35
	%		7.3	10.2	27.3	38.0	17.1
Course Evaluation Ratings							
37. Course content		206					
	f		7	17	41	96	45
	%		3.4	8.3	19.9	46.6	21.8
38. Amount students learned		205					
	f		9	14	42	89	51
	%		4.4	6.8	20.5	43.4	24.9
39. Quality of assigned readings		206					
	f		7	14	50	89	46
	%		3.4	6.8	24.3	43.2	22.3
40. Workload		206					
	f		6	8	49	82	61
	%		2.9	3.9	23.8	39.8	29.6

[a]1=Not important. [b]2=A little important. [c]3=Somewhat important. [d]4=Very important. [e]5=Extremely important.

Table 58 continued
Summary of Selection Criteria Responses

Criteria		N	1[a]	2[b]	3[c]	4[d]	5[e]
41. Degree of difficulty		207					
	f		6	11	55	74	61
	%		2.9	5.3	26.6	35.7	29.5
42. Competitive atmosphere		208					
	f		29	33	65	54	27
	%		13.9	15.9	31.3	26.0	13.0
43. Past students' overall course rating		206					
	f		12	20	65	68	41
	%		5.8	9.7	31.6	33.0	19.9
Assignment Evaluation Ratings							
44. Appropriateness of assignments		207					
	f		8	11	45	94	49
	%		3.9	5.3	21.7	45.4	23.7
45. Instructor feedback		207					
	f		7	12	37	77	74
	%		3.4	5.8	17.9	37.2	35.7
46. Prompt return		205					
	f		8	14	50	78	55
	%		3.9	6.8	24.4	38.0	26.8

[a]1=Not important. [b]2=A little important. [c]3=Somewhat important. [d]4=Very important. [e]5=Extremely important.

REFERENCES

Allen, B. L. (1996). Information tasks: Toward a user-centered approach to information systems. San Diego, CA: Academic Press.

Barry, C. L. (1994). User-defined relevance criteria: An exploratory study. Journal of the American Society for Information Science, 45, 149-159.

Barry, C. L. (1998). Document representations and clues to document relevance. Journal of the American Society for Information Science, 49, 1293-1303.

Barry, C. L. & Schamber, L. (1995). User-defined relevance criteria: A comparison of two studies. In Tom Kinney (Ed.), Proceedings of the 58th ASIS Annual Meeting (pp. 103-111). Medford, NJ: Information Today.

Barry, C. L. & Schamber, L. (1998). Users' criteria for relevance evaluation: A cross-situational comparison. Information Processing and Management, 34, 219-236.

Bearman, S. (1981). LC to seniors: Sorry, folks. In The Joy of Cataloging: Essays, Letters, Reviews, and Other Explosions. Phoenix, AZ: Oryx Press.

Belkin, N. J., Oddy, R. N., & Brooks, H. M. (1982). ASK for information retrieval: Part1. Background and theory. Journal of Documentation, 38, 61-71.

Berners-Lee, T. & Swick, R.R. (1999, September 8). Frequently asked questions about RDF [Online]. Available: http://www.w3c.org/RDF/FAQ [2000, April 19].

Blumenstyk, G. (1999, April 9). The marketing intensifies in distance learning. The Chronicle of Higher Education [Online]. Available: http://chronicle.com/free/v45/i31/31a00101.htm [1999, June 17].

Borgman, C. L. (1986). Human-computer interaction with information retrieval systems: Understanding complex communication behavior. In B. Dervin. & M. J. Voigt, (Eds.), Progress in Communication Sciences (pp. 91-122). Norwood, NJ: Ablex Publishing Corporation.

Borgman, C. L. (1991). The science library catalog project: Comparison of children's searching behavior in hypertext and a keyword search system. Proceedings of the ASIS Annual Meeting, 28, 162-169.

Borgman, C. L. (1996). Why are online catalogs still hard to use? Journal of the American Society for Information Science, 47, 493-503.

Buckland, M., Chen, A., Chen, H., Kim, Y., Lam, B., Larson, R., Norgard, B., Purat, J., & Gey, F. (1999). Mapping entry vocabulary to unfamiliar metadata vocabularies. D-Lib Magazine [Online], 5(1). Available: http://www.dlib.org/dlib/january99/buckland/01buckland.html [1999, January 20].

Chowdhury, G. G. (1999). The Internet and information retrieval research: A brief review. Journal of Documentation, 55, 209-225.

Coomber, R. (1997). Using the Internet for survey research. Sociological Research Online [Online serial], 2(2). Available: http://www.socresonline.org.uk/socresonline/2/2/2.html [2000, February 8].

Cooper, W. S. (1971). A definition of relevance for information retrieval. Information Storage and Retrieval, 7, 19-37.

Cooper, W. S. (1973). On selecting a measure of retrieval effectiveness. Journal of the American Society for Information Science, 24, 87-100.

Course Evaluation Systems. (1998, December 12). Course evaluation systems [Online]. Available: http://www.exmsft.com/~aarons/CES [1999, July 19].

Cuadra, C. A. & Katter, R. V. (1967). Opening the black box of 'relevance'. Journal of Documentation, 23, 291-303.

Dempsey, L. & Heery, R. (1997, March). A review of metadata: A survey of current resource description formats. Deliverable No. D3.2(1) of Telematics for Research project DESIRE (RE 1004). [Online]. Available: http://www.ukoln.ac.uk/metadata/desire/overview/ [2000, April 28].

Dervin, B. N. (1983). An overview of sense-making research: concepts, methods and results to date. Paper presented at the International Communication Association Annual Meeting, Dallas, TX.

Dervin, B. N. & Nilan, M. (1986). Information needs and uses. In M. E. Williams (Ed.), Annual Review of Information Science and Technology, 21, 3-33.

Dublin Core Metadata Initiative. (1999a). Dublin Core metadata element set, version 1.1: Reference description [Online]. Available: http://purl.org/DC/documents/rec-dces-19990702.htm [2000, April 11].

Dublin Core Metadata Initiative. (1999b). Projects using Dublin Core metadata organized by geographical region [Online]. Available: http://purl.org/DC/projects/index.htm [1999, September 23].

Education Network Australia. (1999, October 20). Analysis of 10 metadata projects with particular reference to educational/pedagogical elements [Online]. Available: http://www.edna.edu.au/EdNA/genericpage.html?file=/edna/aboutedna/metadata/index.html [2000, April 21].

Ellis, D., Ford, N., & Turner, J. (1998). In search of the unknown user: Indexing, hypertext and the World Wide Web. Journal of Documentation, 54, 28-47.

Fidel, R. (1994). User-centered indexing. Journal of the American Society for Information Science, 45, 572-576.

Fretwell Downing Education. (1999, June 28). About the Gestalt project [Online]. Available: http://www.fdgroup.co.uk/gestalt/about.html [1999, September 22].

Gall, M. D., Borg, W. R., & Gall, J. P. (1996). Educational research: An introduction (6th ed.). White Plains, NY: Longman Publishers.

Graphic, Visualization, & Usability Center. (1999a, September 15). GVU's 10th WWW User Survey [Online]. Available: http://www.cc.gatech.edu/gur/user_surverys/survey-1998-10/ [1999, September 15].

Graphic, Visualization, & Usability Center. (1999b, September 15). Tenth Survey Reports [Online]. Available: http://www.cc.gatech.edu/gur/user_surverys/survey-1998-10/reports/ [2000, May 8].

Graves, W. H. (1994). Towards a distributed learning infrastructure. In The Canadian Multimedia Conference Procedings [Online]. Available: http://www.iat.unc.edu/publications/graves/graves3.txt [1999, April 17].

Graves, W. H. (1997). Adapting to the emergence of educational micro markets. Educom Review [Online], 32(5). Available: http://www.educause.edu/pub/er/review/reviewArticles/32526.html [2000, April 26].

Gubernick, L. & Ebeling, A. (1997, June 16). I got my degree through e-mail. Forbes, 84-92.

Gudivada, V. N., Raghavan, V. V., Grosky, W. I., & Kasanagottu, R. (1997, September-October). Information retrieval on the World Wide Web: Feature. IEEE Internet Computer, 1(5).

Hagler, R. (1991). Documents and bibliographic control. In The Bibliographic Record and Information Technology, (2nd ed.) (pp. 3-25). Chicago: American Library Association.

Harter, S. P. (1992). Psychological relevance and information science. Journal of the American Society for Information Science, 43, 602-615.

Harter, S. P. (1996). Variations in relevance assessments and the measurement of retrieval effectiveness. Journal of the American Society for Information Science, 47, 37-49.

Harter, S. P. &. Hert, C. A. (1997). Evaluation of IR Systems. In M. E. Williams (Ed.), Annual Review of Information Science and Technology, 32, 3-94.

Haynes, D. Streatfield, D., Cookman, N., & Wood, H. (1998). Comparative Evaluation of the Subject Based Gateways Approach to Providing Access to Network Resources: A Report to JISC under the eLib Supporting Studies Programme. London: David Haynes Associates & Information Management Associates.

Heery, R. (1996). Review of metadata formats. Program, 30(4), 345-373.

Hert, C. A. (1997). Understanding information retrieval interactions: Theoretical and practical implications. Greenwich, CT: Ablex Publishing Corporation.

Hill, L. L., Carver, L., Larsgaard, M., Dolin, R., Smith, T. R., Frew, J., & Rae, M. (2000). Alexandria Digital Library: User evaluation studies and system design. Journal of the American Society for Information Science, 51, 246-259.

Hinkle, D. E., Wiersma, W., Jurs, S. G. (1998). Applied statistics for the behavioral sciences. Boston, MA: Houghton Mifflin Company.

Huck, S. W. & Cormier, W. H. (1996). Reading statistics and research (2nd Ed.). New York: HarperCollins College Publishers.

Ianella, R. & Waugh, A. (2000, March 14). Metadata: Enabling the Internet [Online]. Available: http://www.dstc.edu.au/RDU/reports/CAUSE97/ [2000, March 14].

IMS Global Learning Consortium, Inc. (2000, March 2). About IMS [Online]. Available: http://www.imsproject.org/aboutims.html [2000, April 26].

Ingwersen, P. (1994). Information and information science. Encyclopedia of Library and Information Science, 54, 137-174.

Institute of Electrical and Electronics Engineers. (1999, September 5). IEEE Learning Technology Standards Committee (LTSC): Learning object metadata, draft document v3.6 [Online]. Available: http://ltsc.ieee.org/wg12/index.html [2000, April 24].

Institute of Electrical and Electronics Engineers. (2000). IEEE LTSC learning objects metadata WG home [Online]. Available: http://ltsc.ieee.org/ [2000, January 11].

International Federation of Library Associations and Institutions. (1999, August 24). Digital libraries: Metadata resources [Online]. Available: http://ww.ifla.org/ll/metadata.htm [1999, September 19].

Ip, A., Currie, M., Morrison, I., & Mason, J. (1999, October 4-6). Metasearching or megasearching: Toward a data model for distributed resource discovery [Online]. Available: http://www.dls.au.com/metadata/DataModel.html [2000, February 20].

Isaac, S. & Michael, W. B. (1995). Handbook in research and evaluation: A collection of principles, methods, and strategies useful in the planning, design, and evaluation of studies in education and the behavioral sciences (3rd ed.). San Diego, CA: Educational and Industrial Testing Services.

Kascus, M. (1997). Converging vision of library service for off-campus/distance education. Journal of Library Services for Distance Education, [Online], 1(1). Available: http://www.westga.edu/library/jlske/jlsde1.1.html [1999, April 13].

Koch, T. & Day, M. (1997). Specification for resource description methods part 3: The role of classification schemes in Internet resource description and discovery [Online]. Available: http://www.ub.lu.se/desire/radar/reports/D3.2.3/class_v10.html [1999, April 30].

Krippendorff, K. (1980). Content analysis: An introduction to its methodology. Beverly Hills, CA: Sage

Krochmal, M. (1998, July 1). Online courses lead for-profit learning trend. TechWeb [Online]. Available: http://www.techwe.com/wire/story/TWB19980701S0008 [2 July 1998].

Kuhlthau, C. C. (1991). Inside the search process: Information seeking from the user's perspective. Journal of the American Society for Information Science, 42, 361-371.

Lagoze, C. (1996, July/August). The Warwick framework: A container architecture for diverse sets of metadata. D-Lib Magazine [Online]. Available: http://www.dlib.org/dlib/july96/lagoze/07lagoze.html [1998, April 5].

Lancaster, F. W. (1986). Why vocabulary control? In Vocabulary Control for Information Retrieval, (2nd ed.) (pp. 1-4). Arlington, VA: Information Resources Press.

Laws, R. & Hynd, N. (1999, February 25). Alt.education.distance FAQ [Online]. Available: http://www.faqs.org/faqs/education/distance-ed-faq/part1/ [2000, February 8].

Levy, D. M. (1995). Cataloging in the digital order. In Digital Libraries '95: The Second Annual Conference on the Theory and Practice of Digital Libraires [Online]. Available: http://www.csdl.tamu.edu/csdl/DL95/papers/levy/levy.html [2000, April 28].

Lewis, L, Snow, K, Farris, E., Levin, D., & Greene, B. (1999). Distance education at postsecondary education institutions: 1997-98. Washington, D.C.: U.S. Department of Education, National Center for Education Statistics. (NCES 2000-013)

Lynch, C. A. (1995). Networked information resource discovery: An overview of current issues. IEEE Journal of Selected Areas of Communications, 13, 1505-1522.

Lynch, C. A. (1997, March). Searching the Internet. Scientific American [Online]. Available: http://www.sciam.com/0397/issue/0397/lynch.html [1998, May 4].

Marchiori, M. (1998). The limits of Web metadata and beyond. Computer Networks and ISDN Systems, 30, 1-9.

Maron, M. E. (1977). On indexing, retrieval and the meaning of about. Journal of the American Society for Information Science, 28, 38-43.

Mason, J. & Sutton, S. (2000). Dublin Core Metadata Initiative: Working groups: Education working group. [Online]. Available: http://purl.org/DC/groups/education.htm [2000, April 4].

Maurer, H. & Dietinger, T. (2000). How modern WWW systems support teaching and learning [Online]. Available: http://www.iicm.edu/gentle.htm [2000, April 24].

McCue, J. (1996). Why should a cataloging department hire a metadata specialist? Library Hi Tech, 14(4), 96-97.

McClure, C. R., Moen, W. E., & Bertot, J.C. (1999). Descriptive assessment of information policy initiatives: The Government Information Locator Service (GILS) as an example. Journal of the American Society of Information Science, 50, 314-330.

Milstead, J. & Feldman, S. (1999a, January/February). Metadata: Cataloging by any other name. Online, 23, 24-31.

Milstead, J. & Feldman, S. (1999b, January/February). Metadata: Projects and standards. Online, 23, 32-40.

Moen, W. E., Stewart, E. L., & McClure, C. R. (1998). Assessing metadata quality: Findings and methodological considerations from an evaluation of the U.S. Government Information Locator Service (GILS). In Proceedings of the IEEE International Forum on Research and Technology Advances in Digital Libraries - ADL'98 (pp. 246-255). Los Alamitos, CA: IEEE Computer Society.

Moores, C. N. (1951). Zatacoding applied to mechanical organization of knowledge. American Documentation, 2, 20-32.

Neeley, L., Niemi, J. A., Ehrhard, B. J. (1998, November). Classes going the distance so people don't have to: Instructional opportunities for adult learners [Online]. Available: http://www.thejournal.com/journal/magazine/98/nov/feat04.html [1999, April 11].

Nicholson, S. (1998). A proposal for categorization and nomenclature for web search tools. Jounal of Internet Cataloging [Online], 2. Available: http://www.haworthpressinc.com/jic/jic2nr3-4.html (2000, April 20).

Noam, E. M. (1995, October 13). Electronics and the dim future of the university. Science, 270, 247-249.

O'Connor, B. C. (1996). Explorations in Indexing and Abstracting: Pointing, Virtue and Power. Englewood, CO: Libraries Unlimited.

O,Connor, B. C. (1999). Representation context web. Unpublished conceptual framework.

O'Connor, B. C. & O'Connor, M. K. (1998). Book jacket as access mechanism: An attribute rich resource for functional access to academic books. First Monday [Online], 3(9). Available: http://www.firstmonday.dk/issues/issue3_9/oconnor/index.html (2000, July 1).

Park, T. K. (1993). The nature of relevance in information retrieval: An empirical study. Library Quarterly, 63, 318-351.

Pelton, J. N. (1996, November-December). Cyberlearning vs. the university: An irresistible force meets an immovable object. The Futurist, 17-20.

Rees, A. M. & Schultz, D. G. (1967). A field experimental approach to the study of relevance assessments in relation to document searching: Vol. 1. Final report. Cleveland, OH: Case Western Reserve University.

Ritter, S. & Suthers, D. (1999, May 3). Technical standards for education. Educational Object Economy [Online]. Available: http://www.eoe.org/FMPro?-db=Objects.fp3&-token=libraryPapers&-format=/library/paperdetail.htm&-recid=35179&-lay=all&-Find [1999, May 3].

Roschelle, J. (1999). Standards for educational objects. Educational Object Economy [Online]. Available: http://www.eoe.org/FMPro?-db=Objects.fp3&-token=libraryPapers&-format=/library/paperdetail.htm&-recid=35183&-lay=all&-Find [1999, May 3].

Rowley, J. E. (1996). Organizing knowledge: An introduction to information retrieval (2nd ed.). Brookfield, VT: Gower Publishing.

Saracevic, T. (1975). Relevance: A review of and a framework for the thinking of the notion in information science. Journal of the American Society for Information Science, 26, 321-343.

Saracevic, T. (1991). Individual differences in organizing, searching and retrieving information. In Proceedings of the 54th Annual Meeting of the American Society for Information Science (pp. 82-86). Medford, NJ: Learned Information, Inc..

Saracevic, T. (1996). Modeling interaction in information retrieval (IR): A review and proposal. In Proceedings of the 59th Annual Meeting of the American Society for Information Science (pp. 3-9). Medford, NJ: Learned Information.

Saracevic, T., Kantor, P., Chamis, A. Y., & Trivison, D. (1988). A study of information seeking and retrieval: 1. Background and methodology. Journal of the American Society for Information Science, 39, 161-176.

Schamber, L. (1991). Users' criteria for evaluation in a multimedia environment. In J. Griffiths (Ed.), Proceedings of the 54th ASIS Annual Meeting. Medford, NJ: Learned Information.

Schamber, L. (1994). Relevance and information behavior. In M. E. Williams (Ed.), Annual Review of Information Science and Technology, 29, 3-48.

Schamber, L., Eisenberg, M. B., & Nilan, M. S. (1990). A re-examination of relevance: Toward a dynamic, situational definition. Information Processing and Management, 26, 755-776.

Schure, A. (1994, March). Towards a new "distance learning" university. T.H.E. Journal [Online]. Available: http:www.thejournal.com/journal/magazine/94/mar/prodp2.html (1999, April 11).

Sharma, S. (1996). Applied multivariate techniques. New York: John Wiley & Sons.

Smith, P. L. & Ragan, T. J. (1993). Instructional Design. Upper Saddle River, NJ: Prentice-Hall.

Small, R. V., Sutton, S., Eisenberg, M., Miwa, M., & Urfels, C. (1998). An investigation of preK-12 educators' information needs and search behaviors on the Internet. In Proceedings of Selected Research and Development Presentations at the National Convention of the Association for Educational Communications and Technology. (ERIC Document Reproduction Service No. ED 423 862)

Solomon, P. (1991). User-based methods for classification development. In B. B. Kwasnik & R. Fidel (Eds.), Advances in Classification Research, Vol 2: Proceedings of the 2nd ASIS SIG/CR Classification Research Workshop (pp. 163-170). Medford, NJ: Learned Information.

Sutton, S. A. (1999). Conceptual design and deployment of a metadata framework for educational resources on the Internet. Journal of the American Society for Information Science, 50, 1182-1192.

Sutton, S. A. (2000, March 1). DC-Education face-to-face meeting report [Online]. Available: http://www.ischool.washington.edu/sasutton/dc-ed-f2f/ [2000, April 4].

Sutton, S. A., Lankes, R. D., Small, R. V., & Eisenberg, M. B. (1998). Networked information discovery and retrieval for educational materials on the Internet: Metadata development, deployment, and evolution. ASIS '98: Information Access in the Global Information Economy. Pittsburgh, PA: Information Today.

Tague-Sutcliffe, J. (1996). Information retrieval experimentation. Encyclopedia of Library and Information Science, 57(20), 195-208.

Taylor, A. G. (1992). Cataloging in context. In Introduction to Cataloging and Classification (8th ed.) (pp. 3-28). Englewood, CO: Libraries Unlimited.

Taylor, A. G. (1994). The information universe: Will we have chaos or control? American Libraries, 25(7), 629-632.

Taylor, R. S. (1982). Value-added processes in the information life cycle. Journal of the American Society for Information Science, 33, 341-346.

Taylor, R. S. (1991). Information use environments. In B. Dervin & M. J. Voight (Eds.), Progress in Communication Science: Vol. 10. Norwood, NJ: Ablex Publishing.

Turner, P. M. (1996). Good-bye to ivory towers. Planning for Higher Education, 25(1), 20-26.

U.K. Office for Library and Information Networking. (1999, April 23). UK Ofice for Library and Information Networking [Online]. Available: http://www.ukoln.ac.uk/ [1999, April 30].

U. S. News. (1999). 2000 college rankings [Online]. Available: http://www.usnews.com/usnews/edu/college/corank.htm [1999, November 15].

Vellucci, S. L. (1998). Metadata. In M. E. Williams (Ed.), Annual Review of Information Science and Technology. Medford, NJ: Information Today.

Wang, P. & Soergel, D. (1998). A cognitive model of document use during a research project. Study 1. Document selection. Journal of the American Society for Information Science, 49, 115-133.

Ward, N., Wood, A., Finnigan, S., & Iannella, R. (1996). Discussion paper: Networked information retrieval standards [Online]. Available: http://www.dstc.edu.au/RDU/reports/webir.html [1999, June 4].

Wason, T. (1999, August 23). IMS/IEEE vs DC [Online]. Available: http://www.mailbase.ac.uk/lists/dc-education/1999-08/0014.html [1999, September 16].

Weibel, S. (1999). The state of the Dublin Core metadata initiative: April 1999. D-Lib Magazine [Online], 5(4). Available: http://www.dlib.org/dlib/april99/04weibel.html [1999, April 15].

Weibel, S., Kunze, J., Lagoze, C., & Wolf, M. (1998, September). Dublin Core metadata for resource discovery [Online]. Available ftp://ftp.ietf.org/rfc/rfc2413.txt [1999, September 23].

Wilson, P. (1973). Situational relevance. Information Storage and Retrieval, 9, 457-471.

Wilson, P. (1979). Some fundamental concepts of information retrieval. Drexel Library Quarterly, 14(2), 10-24.

Withrow, F. B. (1997). Technology in education and the next twenty-five years. T.H.E. Journal Online [Online]. Available: http://www.thejournal.com/special/25thani/0697/feat01.html [1998, March 27].

Woodward, J. (1996). Cataloging and classifying information resources on the Internet. In M. E. Williams (Ed.), Annual Review of Information Science and Technology. Medford, NJ: Information Today.

World Wide Web Consortium. (1998). XML specification [Online]. Available: http://www.w3c.org/metadata [1999, September 23].

Zhang, Y. (2000). Using the Internet for survey research: A case study. Journal of the American Society for Information Science, 51, 57-68.