Key Issues for Educational/Learning Resource Sharing Networks: Standardization, Globalization and Localization in the ICT Environments

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Abstracts:

The Internet has provided us with an expanded access to a variety of ever increasing information resources all over the world. Due to the unstructured nature of Internet resources and limited functionalities of existing search engines, however, we often experience difficulty in locating high quality targeted information required for specific purposes. Digital educational materials are no exception. Several national and international consortia were established to facilitate a better access to high quality educational materials. They are developing and integrating standard cataloging and indexing schemes such as LOM (Learning Materials Metadata) and Dublin Core Metadata Profile, while incorporating XML (eXtensible Markup Language) and Unicode to overcome language problems.

The goals and objectives of higher education reflect cultural values and social contexts. Advances in information and communication technology (ICTs) bring about a fundamental paradigm shift in the perspectives of higher education from provider-based to learner-based. The new paradigm seems to emphasize the values and perspectives of learners rather than those of educators. The resource sharing of educational materials in higher education in the new ICT environment should respond to the paradigm shift.

The key features or two existing global resource-sharing endeavors in the educational domain, the GEM Consortium and the ARIADNE Foundation, are described and compared. The important issues in establishing and maintaining global resource-sharing networks in the educational domain will be discussed. They are: (1) goals and objectives, (2) standardization in format, language representation, metadata scheme, and semantics, (3) level of granularity, (4) copyright management, (5) quality control of metadata and educational materials, (6) vocabulary control, and (7) attitude toward cultural, gender, and racial biases.

Significance of Sharing Learning Resources in Higher Education

The goals and objectives of higher education reflect cultural values and social contexts. Advances in information and communication technology (ICTs) bring about a fundamental paradigm shift in the perspectives of higher education from provider-

based to learner-based. The new paradigm seems to emphasize the values and perspectives of learners rather than those of educators, which, in turn, may change the meaning of higher education. The resource sharing of educational materials in higher education in the new ICT environment should reflect such paradigm shift.

Goals of Education/Learning in the New Paradigm

The ultimate goals of education/learning may differ depending upon the cultural and social contexts of people. The goal of education is to cultivate a variety of knowledge and skills of people who support the future prosperity of society. Educators may exert themselves to impart knowledge and skills to their students to educate them to become good thinkers who can solve a variety of problems to be encountered in their life. Learners may engage in learning to obtain knowledge and skills that afford them an intellectually rich life and a survival advantage in the life long competition. The administrators may seek to contribute to society while maintaining the economic prosperity of their institutions.

Different Values of Higher Education Shared Among Teachers and Learners

The fundamental values of higher education may differ depending upon the cultural and social contexts of people. Those who teach may have different connotations in education than those who learn. The connotation of higher education may also reflect a variety of social values shared within a nation and it's culture.

Faculty members of universities may emphasize research rather than teaching and exert themselves in conducting research, publishing its outcomes, and training graduate students to be their successors, while paying little attention to actual teaching of undergraduate students. This is because they are socially evaluated based on their research outcomes and publications rather than on their conduct of teaching. Some college faculty members may have been emphasizing their role of teaching liberal arts and common sense. However, this emphasis may have changed due to the recent shift of focus in undergraduate education from cultivating citizens with common sense to developing skilled workers. Faculty members of professional education may be prone to offer students knowledge and skills required in occupational life of a society.

The meaning of higher education for learners may also differ depending upon their social contexts. Graduate students who seek to become researchers tend to emphasize research experiences under the apprenticeship of skilled faculty while students in professional schools are eager to earn occupational knowledge and skills readily usable in their perspective occupations. Students in liberal art colleges may enjoy their free time by developing friendship with their cohorts, expecting faculty members to entertain them in classes, while anxious about the security of future job opportunities.

Administrators of higher education institutions seek to fulfill the social and economical goals of their institutions. They may emphasize contribution to the society by encouraging high quality research outcomes from their faculty and by presenting well-trained graduates to the industry, while keeping a severe watch over the profitability of their institutes.

Paradigm Shifts in Education

A set of contrasting perspectives co-exist in the education: (1) the teacher-centered perspective which emphasizes the role of teachers and faculty members that focuses on developing students to be better citizens and researchers through formal education; and (2) the learner-centered perspective which emphasizes the needs of learners. Nevertheless, both perspectives ultimately seek to develop optimal educational/learning environments that respond to cultural and social needs. Each of these perspectives may have different assumptions for central connotations of education and learning, including students/learners, motivation of learning, learning behavior, and educational/learning materials as shown in Table 1.

Table 1: Implicit Assumptions of Teacher-Centered and Learner-Centered Perspectives

Concepts	Teacher-Centered Perspective	Learner-Centered Perspective
Students/learners	A person who attends courses held by an educational institution to seek credits and/or a degree	A person who is motivated in learning and seeks to obtain knowledge and skills
Motivation of learning	When a person attends a course or a class, that behavior is interpreted as s/he has a motivation to learn	That which induces learning behavior. It may reflect a person's physical, cognitive, social and/or affective needs
Learning behavior	Focuses on externally observable behavior of students' interaction with teachers and teaching materials	Focused on internal and/or social interaction beyond interaction with teachers or teaching materials to include the point where acquisition of knowledge and skills occur
Educational/learning materials	Objective entity such as lectures, textbooks, quizzes, etc. with which the student interacts to fulfill given assignments of classes or courses	Subjective construct that may change the structure of the learner's knowledge. It is the actual meaning constructed by the learner through interacting with learning resources

The advancement of ICTs has brought about a paradigm shift in education. The concept of "e-learning" is not merely the use of technology in delivering formal courses and lectures to the students who are registered to formal educational institutions, but the structure of learning environments themselves in which learners have more freedom in time and place of learning as well as in choosing educational/learning opportunities. In short, the teacher-centered perspective posits students as passive receivers of knowledge delivered within the framework of formal education. The learner-centered perspective, on the other hand, assumes learners as active processors of knowledge who choose what they learn, where they learn, and

when they learn by constructing meaning through their social and/or personal interaction beyond the framework of the formal education.

Goals of Sharing of Educational/Learning Materials in the ICT Environment

The significance of sharing educational/learning materials should be seen based on the learners' perspectives reflecting the paradigm shift of education/learning in the e-learning environments. The availability of and the accessibility to digital educational/learning materials in the current ICT environments may have different impacts on goals of education and learning for those who teach and those who learn. Teachers may expect to reduce their time and efforts in preparing for teaching by reusing educational materials developed by others. If the quality of these materials is guaranteed by frequent updates, teaching may also be improved by reusing them.

Availability of and accessibility to high-quality educational/learning materials for teachers may indirectly benefit learners when they are taught courses using these high-quality materials. Benefit for learners may be further expanded when they have free and easy access to high-quality materials from the home and the workplace. Hence a wide variety of learners, beyond the students of formal education, will have opportunity to choose and interact with high-quality learning materials. For example, the availability of course lists with elaborated syllabi will enable prospective students a better chance to choose from among a variety of degrees and certificates offered by real and virtual schools. The accessibility to educational materials used for these courses may not only help learners to pre-examine contents of courses to attend but also may enhance their self-learning by directly interacting with these materials.

A better indexing and organization of these materials may provide an easy access to high-quality learning materials for both teachers and learners. At the same, it may facilitate globalization and standardization of education and learning, when educational/learning materials produced by a particular culture attracts learners from other cultures.

Examples of Resource Sharing Networks in Education

A variety of resource sharing networks on regional, national, and international levels have been established in the domain of education. A few examples of international resource sharing networks in educational domain will be reviewed to facilitate our discussions on important issues to be considered in terms of their contributions to and implications for e-learning.

Gateway to Educational Materials (GEM)

The Gateway to Educational Materials (GEM) is a gateway site that provides easy access to high-quality digital teaching/learning materials on the Internet. The

ERIC Clearinghouse of Information Technology based at Syracuse University runs this site under the sponsorship of the U.S. Department of Education. It recently received a new five-year contract to continue expanding its links nationally and internationally. The GEM was established as a consortium of U.S. based collection holders of K-12 lesson plans in digital form in 1997 in response to ever-increasing requests for lesson plans of K-12 teachers to its sister site of AskERIC, a free digital reference service in the educational domain. The GEM gateway site accepted free teaching materials in 1998 when it was opened to the public in April 1998 with links to 2,000 items held by a handful of members. The GEM metadata collection grew rapidly to include metadata and links to more than 20,000 items held by more than 300 members all over the globe in three years. The scope of the collection was expanded to include fee-based materials published by commercial vendors, and non-English materials held by foreign educational institutions. The targeted audience has also been expanded to include the higher education and the vocational education communities.

The core of the GEM gateway consists of metadata and links to selected educational/learning materials held by consortium members. Metadata is a set of data that describes forms and contents of the materials. A library catalog, for example, is a form of metadata for the books in a library. Similarly, GEM metadata describes forms and contents of educational materials in digital form to which the gateway provides links. The GEM metadata set is based on the Dublin Core metadata profile, *a de facto* metadata standard that enables a unified grasp of all kinds of digital objects that facilitates the retrieval of a variety of information resources scattered across the Internet. The GEM metadata set added a few items to Dublin Core metadata profile to reflect the unique requirements of describing educational materials. They are "topic," "audience," "purpose," "curriculum standard" and "quality."

As shown in Figure 1, the contents of educational/learning materials in digital form are stored in the members' facility while metadata sets are kept in the gateway site. Each of the member organizations of the GEM consortium (collection holders) has local metadata sets as well as the educational/learning materials described by the metadata. The GEM gateway site, at which people can conduct traversal searches, has a shared metadata database in which the local metadata of collection holders are integrated. Thus, people searching the GEM gateway database can arrive at the contents of desired educational/learning materials by following the links in the metadata database. To use the contents, however, people must negotiate with the author or the organization regarding the copyrights or the purchase of the materials.

The establishment of GEM consortium and the development of GEM gateway site facilitated the standardization of the U.S. K-12 curricula. In the United States, each state or district has developed its own curriculum standard, and different contents are taught at different grades. As a consequence, a student faces difficulty

in choosing a grade and a class when they transfer to other school in a different state or region. The mapping of each state's curriculum standard to the national one, built in the GEM metadata profile, facilitates the coordination of curriculum among different states and regions.

The GEM consortium developed the GEM Cat, a metadata authoring tool to facilitate easy indexing of educational materials and provided it free of charge to its members in order to expand the membership while facilitating the adoption of GEM metadata profile in a wider educational community. As the number of institutions employing GEM Cat grew, the number of educational/learning materials linked to GEM increased. As a result, the GEM metadata profile is getting the status of *de facto* standard for describing educational materials.
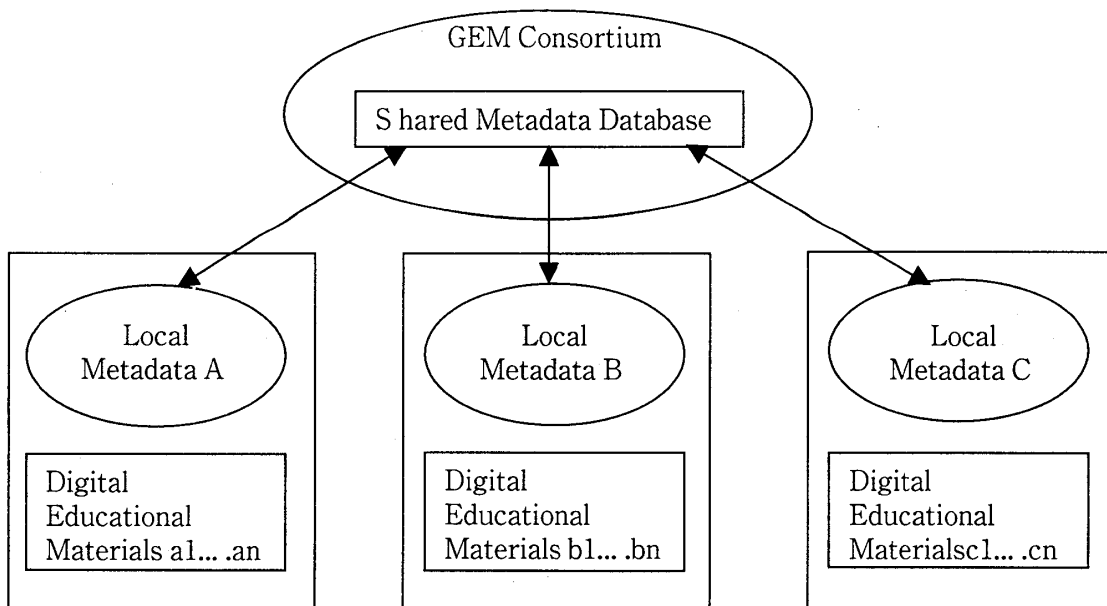

Figure 1: Relationship between GEM Metadata and Digital Educational Materials

ARIADNE

The ARIADNE Foundation, a non-profit international association based in Europe, was established in July 2000 to maintain and develop tools and the Knowledge Pool System produced during the European ARIADNE (Alliance of Remote Instructional Authoring & Distribution Networks for Europe) project in 1996-2000. Critical of the industrialization and the globalization of education and learning, the ARIADNE Foundation intends to facilitate a freer access to education and knowledge in the higher education community of multiple countries, emphasizing that (1) general knowledge and training systems cannot be reduced to and considered as a mere marketable good, (2) free access to knowledge must be recognized as a fundamental social right, closely bound to the right to education, (3) education and training must be provided in one's own language, and (4) knowledge can be usefully interchanged over many linguistic and cultural barriers. The European Commission and the Swiss

Government within the framework of the European Union IST Program support the Foundation, and the membership includes public service institutions, individual civil servants, as well as private companies.

CKP: Central Knowledge Pool
RKP: Regional Knowledge Pool
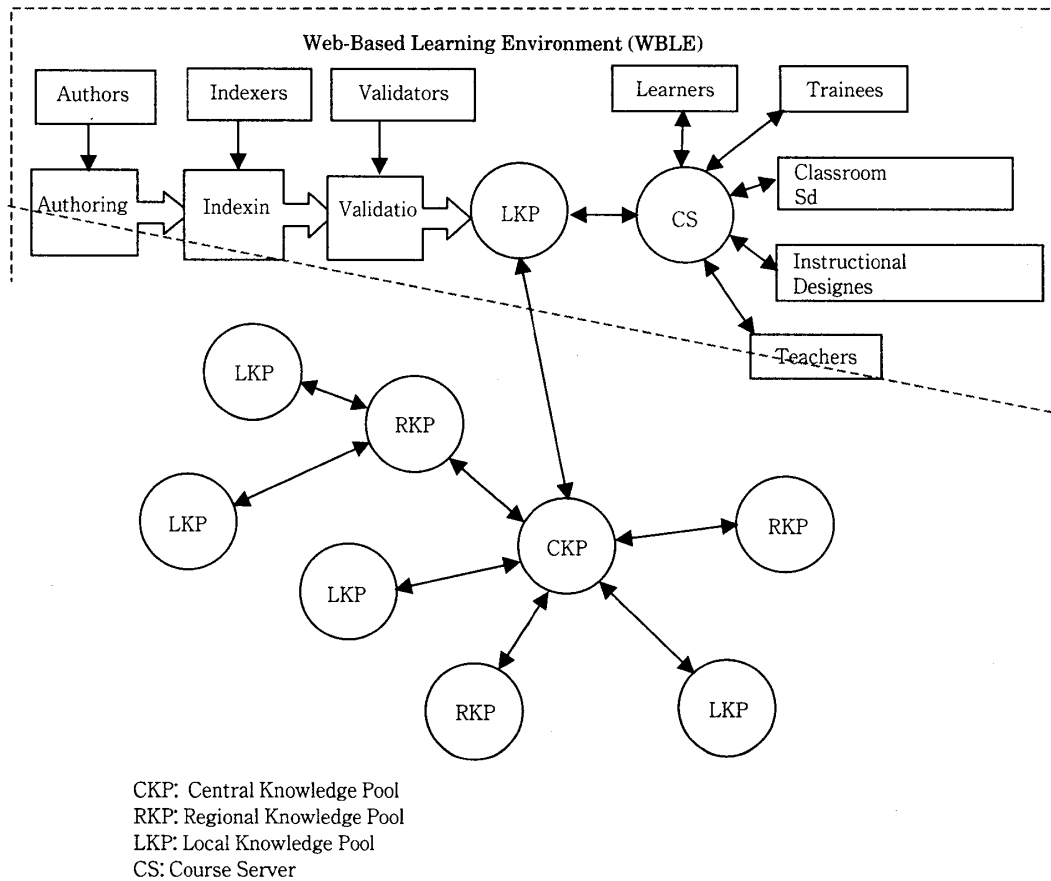LKP: Local Knowledge Pool
CS: Course Server

Figure 2: ARIADNE Knowledge Pool Network

The ARIADNE Knowledge Pool System consists of the authoring, indexing, validation and storage of digital educational materials created by member organizations (Figure 2). It rests on a distributed databases, comprising some 20 local nodes in nine countries. The local sites exchange their contents through a central node located in Leuven (Belgium) and authors can interact with a near by site through the Internet to create new materials or edit existing ones. Indexing is done with the ARIADNE indexing system (metadata scheme), compatible with the emerging IEEE/LOM standard, and consists of entering a number of descriptors in a general, semantic, pedagogical or technical point of view. These descriptors are also used to find appropriate materials in the Knowledge Pool.

As shown in Figure 2, the Knowledge Pool System consists of a distributed network of central, regional, and local knowledge pools with course servers, all interconnected in a star topology network. A typical ARIADNE site includes a Local Knowledge Pool and a Course Server, comprising the ARIADNE Web-Based Learning Environment (WBLE). Authors create new educational materials (pedagogical

documents: PD) or modify existing ones from the Pool. Indexers catalog these materials and add it to the Pool. Validators check descriptions and validate them. Annotators distribute their comments on the actual contents of the materials. Teachers create courses on the Course Server or reuse existing ones, incorporating educational materials readily available in the Pool. Learners access the WBLE and interact with the courses. The contents of Local and Regional Pools are updated every night through a replication process.

Comparing Key Features of GEM and ARIADNE

Table 2 compares key features of GEM and ARIADNE to depict the important issues in developing and operating resource sharing networks in educational domain.

Table 2: Comparison of Key Features between GEM and ARIADNE

Feature	GEM	ARIADNE
Membership	Free	Fee-based
Scope of Shared Materials	Free and Fee-based	Free
Target Audience	Teachers and Learners of All Levels of Education	Instructors and Students of Higher Education
Accessibility	Open to Public	Limited to Members
Metadata Standard	Dublin Core	IEEE/LOM
Shared Components	Metadata	Metadata & Contents
Shared Tools	Metadata Authoring Tool Query Tool	Content Authoring Tool Metadata Authoring Tool Query Tool Simulation Tool Questionnaire Tool Auto-Evaluation Tool Curriculum Editor
Language	English; French	English; French; German; Italian; Spanish; Dutch; Rumanian
Culture	American	Multi-cultural (European)
Granularity	Activity, Lesson Plan, Lesson, Course, Curriculum	Raw Media, Fragment, Document, Chapter, Session, Lesson, Course, Curriculum
Copyright Issue	Negotiation required	Do not declare copyright
Quality Control	Peer review	Peer review
Controlled Vocabulary	Three levels of vocabulary + Topic	Three levels of vocabulary + User-defined main concept

Key Issues in Global Sharing of Educational Materials

By comparing features of two global resource-sharing networks, we can identify key issues in global resource sharing in the domain of education. They are (1) goals of resource sharing, (2) standardization of metadata, (3) level of granularity in representing materials, (4) attitude toward copyright management, (5) quality control

measures and procedures, (6) semantics and vocabulary control in multilingual environments, and (7) attitude toward multiple languages and multiple cultures. Each of these issues is elaborated in the following.

Goals of Resource Sharing

The GEM Consortium emphasizes the better access to digital educational/learning materials scattered on the Internet, while the ARIADNE Foundation intends to improve the quality and efficiency of open and distance learning systems through the sharing and reuse of educational materials and claims the free access to knowledge and education. Thus, the former developed a metadata repository of high-quality educational materials readily available on the Internet in order to enhance the accessibility to existing digital educational materials. The latter, on the other hand, aims to develop a pool of educational materials for sharing and reuse. It established the Knowledge Pool to encourage member organizations' development and reuse of educational materials in order to increase the availability of reusable educational materials.

Standardization

Standardization is the core issue in every resource sharing activity in which seamless exchanges of all kinds of data are essential. Four elements are a particular focus of standardization in the global resource sharing within an educational domain.
- Format: XML (extensible Markup Language)
- Language: Unicode with the use of ISO language code
- Metadata Scheme: Dublin Core, IEEE/LOM
- Semantics: Subject classification and controlled vocabulary

Both employ XML and Unicode to overcome multiple language problems. The GEM Consortium based it's metadata scheme on the Dublin Core metadata, a *de facto* standard for describing digital objects on the Internet. The ARIADNE Project initiated the IEEE/LOM metadata scheme, the emerging standard for developing and managing educational contents in digital form. Both use their own hierarchical subject classification scheme with controlled vocabulary.

Level of Granularity

An important issue in indexing educational materials is the level of granularity or unit of indexing. Indexing can be done on various levels from a picture or stream, a paragraph, to a session, a lesson, a course or a curriculum. A lower level of granularity may result in higher reuse but requires higher cost in terms of indexing time and efforts. An appropriate level of granularity should be applied in order to get the best tradeoff between reuse and cost.

Copyright Management

The GEM consortium does not claim copyrights for educational materials described in the gateway's metadata. All the rights and responsibilities for the copyright management for educational materials are reserved to the GEM consortium members who develop and/or hold the materials. However, the ARIADNE Foundation emphasizes free access to knowledge and education as a fundamental social right.

The issue of copyright management may require a shared consensus of consortia members and a lower level of granularity in indexing even though it may increase the cost of indexing.

Quality Control

Both GEM and ARIADNE seems to have tried to incorporate quality assessment of educational/learning materials in the beginning. However, they seem to have gone astray in the process. The GEM consortium initially introduced five levels of quality indicators for accuracy, appropriateness, clarity, completeness, and organization. Current operation of the GEM consortium, however, only asks its members to avoid materials that include statements of bias and stereotyping concerning gender and ethnic groups. Similarly, ARIADNE gave up its initial plan of including the extensive peer review process before accepting materials in its knowledge pool, while validation is done only on the indexing of metadata. These experiences of GEM and ARIADNE imply that the elaborated quality assessment procedures before accepting materials may become a bottleneck in the growth and timeliness of shared collections.

Semantics and Vocabulary Control in Multilingual Environment

Both GEM and ARIADNE use their own hierarchical classification systems in categorizing their educational materials. GEM tries to map local curriculum standards to a national standard for the U. S. K-12 education and uses them to describe semantics of educational materials. ARIADNE developed its own classification scheme consists of a broader categorization of domains in the higher education. However, the introduction of user-defined main concepts and synonyms by ARIADNE seems to have contaminated it's structure particularly when synonyms in different languages are sought.

A well-defined controlled vocabulary in multiple languages, however desirable, should require an enormous amount of manpower resource.

Language and Culture

Different languages bring different cultural connotations and different culture represents different values -- no language and/or culture is free from bias when viewed from other languages and/or cultures. Therefore, we should be careful when dealing with educational materials of social and cultural domain. For example, the

GEM consortium requires its members to include only those educational/learning materials without gender and racial biases. However, a material seen as free from gender/racial bias in one culture may be considered as biased in another culture. This may be the very reason for requirements of localization when reusing materials developed in a different language with a different value system.

Conclusion

The goals and objectives of sharing educational/learning resources might reflect cultural values and social contexts. The paradigm of education/learning seems to have shifted from providers' perspectives to learners' perspectives due to the advancement of ICT. Based on these recognitions, the author identified key issues in the success of global resource sharing in education/learning by comparing two existing examples.

The key issues to be sought in establishing and maintaining a global resource-sharing network in the educational domain seem to include the following:

- A well-defined and agreed-upon goals and objectives of resource sharing activities among member organizations,
- Standardization of format, language representation, metadata scheme, and semantics to enhance a seamless exchange of a variety of data over different languages and different cultures,
- An appropriate level of granularity that provides the optimal tradeoff between the level of reuse and the indexing cost,
- A shared consensus on the copyright management and it's intentions,
- A simple and easy procedure of quality control on metadata and educational materials themselves,
- A well-organized and cost-effective vocabulary control procedure dealing with multiple languages, and
- An agreed-upon attitude to cultural, gender, and racial biases for educational materials that deal with social and cultural issues.

Acknowledgment

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