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Temoa: An Open Educational Resources Portal to seek, investigate and inquire

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Abstract

Temoa is a distributor of knowledge that provides a multilingual public catalog of collections of Open Educational Resources (OER). Temoa seeks to support the educational community to find the resources and materials that meet their needs for teaching and learning, through a specialized search system and collaborative social tools. Temoa was established after the need to expand educational coverage in the world, and specifically in developing countries. This paper aims to analyze the system of classification and metadata schemes of Temoa. Interviews were carried out to obtain information. Results shows Temoa's cataloging process: reviewing OER design, form, and content; the actors participating in the process. We conclude that Temoa is a useful tool that helps to integrate OER into teaching practices, encouraging Knowledge Transfer and Dissemination of innovative educational strategies.

Keywords: OER; digital libraries; cataloging process; teaching practices

Introduction

The development of digital libraries and their study are not isolated events; they are prompted by a series of causes and conditions of social, educational and technological nature. On the educational level, the pedagogical paradigm has been changing the way to transfer knowledge. The old role of the teacher as the central figure of authority has yielded to current models influenced by the constructivist school. According to this theory, students construct their knowledge more actively within and outside the classroom, and the teacher becomes a facilitator of tools for the students to exploit to the fullest (Díaz, 2003).

This idea is reflected in the comprehensive reform of basic education Mexico carried out in 2008, which specifies that the student must be at the center of the educational intervention in a model of competence development, complemented, amongst other factors, by the use of pedagogical materials and technology in the classroom. While education in Mexico has improved in aspects of literacy and coverage, the Secretariat of Public Education (SEP) assumes major shortfalls in the quality and scope of its educational system.

One of these shortfalls is that much of the population lacks access to quality education, technology and information access (SEP, 2007). In an environment where traditional classroom learning is increasingly more complemented with self-construction of knowledge in digital information centers, the lack of connectivity and technological infrastructure that supports this educational model is highlighted. In Mexico, during the 2008–2009 school year, less than a third of primary schools had computers with an Internet connection (SEP, 2009). While there are obvious delays in educational quality and access to technology and information, it is also true that a transition towards more democratic educational spaces and more infrastructure is currently undergoing; in this contexts, digital libraries can provide extra resources for more active, independent students who wish to attain lifelong skills.

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In a booming period for information technology in the world, Mexico has tried to capitalize on this trend with public and private efforts aimed at reducing the technology and knowledge gap (Gómez-Zermeño, 2012). In this context, Temoa arose from the need to expand educational coverage in the world, and specifically in developing countries. First proposed in Davos in 2007 under the name of the Knowledge Hub project, this portal is a project of Mexican University Tecnológico de Monterrey.

The word "temoa" comes from the Nahuatl language; it means to seek, investigate, and inquire. Currently, Temoa (http://www.temoa.info) is a knowledge hub that provides a multilingual public catalog of collections of Open Educational Resources (OER); it seeks to aid the educational community to find the resources and materials that meet their needs for teaching and learning, through a specialized search system and collaborative social tools.

This educational tool works in the context of the knowledge society to contribute to reducing the worldwide education gap, particularly regarding access to information. In order to enrich the necessary learning for life, Temoa provides reliable open educational resources that answer to the educational needs of students, teachers, and institutions. This knowledge hub supports the educational community from a public and multilingual catalog of collections of OER. Temoa catalogues selected OER, which are described and evaluated by an academic community, categorized by area of knowledge, education and language, among others (Temoa, 2011). It also provides a user-friendly search engine, through intuitive filters, and it allows the creation of communities around educational resources (Temoa, 2011).

This paper analyzes Temoa's system from its suppliers to their cataloging process, including the classification and metadata schemes. In this study, interviews were carried out with four key informants in order to answer the following research question: What is the process done for the organization of information in the OER portal Temoa?

While it is useful to review the academic literature on the subject of information organization, experiences of organizations specializing in digital libraries and their organization are relevant to improve current OER initiatives: the process Temoa uses to gather, select, evaluate and index OER, can become a model of good practices. Thus, this study contributes to a deeper knowledge of the practices related to the cataloging process, classification and metadata of OER portal Temoa.

Open educational resources

Within the knowledge society, gaps such as inequality in access to sources of information, technological infrastructure, and technological illiteracy can hinder its development. An interesting element to consider is related to the person's ability to properly absorb and process information with the intention of creating new knowledge. A central element of knowledge societies is the "ability to identify, produce, process, transform, disseminate and use information in order to create and apply knowledge necessary for human development" (UNESCO, 2005, p. 29).

The use of ICT is a central hub for the development of society with a knowledge-based economy. However, it is necessary to educate people to recognize when information is needed and have the ability to find it, evaluate it and use it effectively (Plotnick, 1999, cited in Burgos, 2010).

The steady progress in the development of information technology and global communication foster in different spheres of human activity an uninterrupted creative construction of new products and services in organizations to meet the demands of society on their needs (Burgos, 2010). Globally, more often people make use of websites to access information, perform operations, and maintain communication with third parties, among other service activities.

Education, in this context, cannot stand by and should reach its two main purposes: to ensure the transfer of knowledge from one generation to another and encourage creativity to change what

is already known (Haddad & Draxler, 2002). That is why all information channels should be an integrated and complementary system, so that they reinforce each other, in order to allow acquisition of knowledge and contribute to creating and developing possibilities for lifelong learning (UNESCO, 2000).

Thus the UNESCO in 2002 coined the term open courseware that aims for free access to educational materials, open education resources (OER) provided by ICT, for consultation, use and adaptation to a nonprofit social practice.

The William and Flora Hewlett Foundation defined OER as:

> Teaching, learning, and research resources that reside in the public domain or have been released under an intellectual property license that permits their free use or re-purposing by others. Open educational resources include full courses, course materials, modules, textbooks, streaming videos, tests, software, and any other tools, materials, or techniques used to support access to knowledge (Atkins, Seely & Hammond, 2007, p. 4).

OER represent a digital information object that can generate knowledge, skills and attitudes in correspondence to a training need of the subject (Ramirez, 2007). Open Educational Resources can be found in formats such as JPEG, PNG, MP3, PDF, HTML, WAP, FLASH, among others. Today, OER integrate various types of digital objects among which are full courses, modules, lessons, books, videos, tests, software and any other educational tool or teaching technique to provide free access to knowledge (Atkins et al., 2007).

Temoa considers the following to be the types of materials included in this concept (Temoa, 2011):

- Text documents such as books, essays, textbooks, book chapters and research papers.
- Images, illustrations, graphics, and photos.
- Audiovisual materials, such as interactive multimedia, conferences, class extracts.
- Software, such as desktop applications

The concept behind OER is not entirely new in the context of education. Often, teachers share materials with peers and peer reviews are based on similar underpinnings of open collaboration. Most likely, the novelty of this initiative lies in the ease with which the use of ICT allows the OER to be generated, distributed to mass audiences via the Internet and the legal security that free and open content licenses afford authors and users.

Organization of information

People, in all aspects of life "need to organize because they need to retrieve" (Taylor, 2004, p. 1). Information must have an order since not having it would cause great difficulty to find it; thus, throughout history, tools such as directories, dictionaries, catalogs, and many organizing methods have been invented. Taylor (2004) explains that the organization of the information relates to proprietary information packages, with formats ranging from textual to visual and multimedia. Two ways of organizing information sources are metadata organization and subject classification, which are described below.

Metadata

Metadata is a set of elements that are used to aid the identification, description and discovery of electronic resources via a representation of their bibliographic description (Martínez, 2007). Baures and Quade (2007) point out generalizations and discrepancies in metadata definitions. The authors argue that definitions vary by historical context and the disciplines that address them, plus it is too early to define a concept that has been volatile in its short history. Thus, they propose a flexible

and open definition of metadata, where objectives, resource formats or media access are not specified; the authors state that the metadata are often grouped in a set, and each of them individually are called “elements” that represent conceptual units to specify and describe information for a resource. Each element is constructed based on three dimensions:

1) Semantics: meaning assigned to each element.
2) Content Rules: Convention of values, format and ranges for specifying them, and links between different elements.
3) Syntax: structure and coding of compatible machine elements.

Metadata’s usefulness is undeniable: they are essential as they help preserve a digital library’s items, as well as to organize and create links between them, they also provide users access to them (Liu, 2007). Creating metadata helps facilitate the discovery of information through the identification of resources, since they distinguish dissimilar ones and join the ones that are similar (Eden, 2002); this allows the user to customize their search according to criteria that are relevant.

The main functions of metadata, according to the National Information Standards Organization (NISO, 2004) are organization of electronic resources, resource discovery, interoperability, archiving, preservation, and digital identification. With the exponential increase in resources, metadata allows to organize the hyperlinks to them. These lists of hyperlinks “can be built on static web pages with the names and locations of the encoded resources (hardcoded) in HTML”. However, “it is more efficient and increasingly common to construct these pages dynamically with metadata stored in databases” (NISO, 2004, p. 2). This clarification shows the difference in using metadata from other organizational forms such as lists, directories or taxonomies designated with text on the websites. The metadata, however, make portals dynamic by displaying different pages depending on the selection of metadata the user requires in their search for information.

Both Liu (2007) and Taylor (2004), and a large number of researchers classified the functions of metadata in three basic types:

1) Descriptive: Information about intellectual content that allows an item to be discovered and identified as unique, but also to relate it to other similar objects within the system. The author, title, and subject are examples of this type of metadata.
2) Structural: Information for maintaining and managing digital objects. They identify the different parts of the same item, allowing the user to navigate them functionally. Indexes, chapters, and individual pages are examples of structural metadata.
3) Administrative: Information about the internal structure of digital objects. Formats, creation dates, legal terms are some examples.

To be useful to the user community they serve, metadata must comply with the following features (Taylor, 2004):

1) Interoperability: the ability of different systems to interact harmoniously, regardless of their technical aspects.
2) Flexibility: the level of detail in bibliographic records and their adherence to cataloging rules.
3) Extensibility: ability to incorporate new elements for the community of users using the system.

Meanwhile, Martínez (2007) adds a fourth essential characteristic: multilingualism, understood as metadata architectures that respect the linguistic and cultural diversity. Existing systems do this by adopting international standards or locating the user and adapting language.

To maintain a flexible system, with a particular degree of extension but also interoperable, systems can be customized with elements of various metadata schemes conjoined by a group of guides that

explain the function of these elements in one or more schemes; it is also possible to create a metadata crosswalk, a tool that allows the conversion of a scheme to other through a mapping of elements or an intermediary (Olson, 2009). Such practices and tools are important because the same library may use different metadata standards to meet the needs of its resources and information retrieval needs of its users. In the category of general norms, Eden (2002) lists, among others, the Dublin Core Metadata Initiative (DCMI), Encoded Archival Description (EAD), Machine-Readable Cataloging (MARC) 21, Metadata Object Description Schema (MODS), The Open Archives Initiative (OAI) and Text-Encoding Initiative (TEI). In educational metadata standards specifically, Eden (2002) mentions the Instructional Management System (IMS) and the Learning Object Metadata (LOM), ascribed to the Sharable Content Object Reference Model (SCORM).

Puustjärvi (2007) addressed the issue of educational metadata standards to define as systems describing characteristics of a learning object and classified them as syntactic metadata and semantic metadata. While the former describes the structural features of an object such as its format, language, or author, semantic metadata describe the semantic content and the keywords that describe its topic, using taxonomies or ontologies.

As general and educational standards are mentioned, there are several other themes, formats, rights or industries to describe objects, to name a few of the many criteria by which standards are created, which are not always relevant to this study.

Classification

Classification is a multidimensional issue, defined according to the area of knowledge and technological approach. Gordon (1999) provides a definition of classification as a topic related to the investigation of the relationships within a group of objects, to establish whether the data can validly be summarized by a small number of classes of similar objects.

The origins of library classification can be traced to the philosophical classification of knowledge and a learning model (Wynar & Taylor, 1992); the difference is that while the latter organizes knowledge itself, the classification designed for libraries sorts the records that express and preserve knowledge, i.e., it is responsible for organizing forms that store contents for accessibility.

Library classification is a tool for the usability of an information center (Atkinson, 1990). By defining it as a useful way of organizing information, Atkinson (1990) emphasizes the term “useful” because it not only organizes the materials, but it does so by taking into account the relationship between them, i.e., gives meaning to their location and grouping in a manner that users can navigate through them and access other useful items. Classification is also a process of differentiation between objects and their properties: those with common features are grouped together under a category, which in turn may be related to others, all subject to semantically higher categories (Chan, 1994).

Wyman and Taylor (1992) pose a number of criteria for a successful classification system, like being inclusive and comprehensive, systematic, flexible and expandable and using clear and descriptive terminology, with meaning for the classifier and the user.

Additionally, from the field of information organization, Taylor (2004) defined classification as “the process of determining where a packet of information fits in a given hierarchy and often, then assigning an appropriate notation associated with a hierarchy level” (p. 359). The same author states that the library classification was created specifically for the purpose of organizing and retrieving not only information packages, but also representations of their characteristics in information systems. The above mentioned is important when it comes to digital libraries, where the physical location of the material is not important, but their logical order and accessibility in a more abstract environment such as the online interfaces and formats.

Finally, Taylor (2004) complements the classification issue from the perspective of the architecture of the internet sites. A website with extensive information can leverage the unique benefits that these systems provide, unlike other stricter systems. She mentions that a proper classification can help users navigate pages and enrich their textual searches. A clear example of this is that the same concept can belong to different categories, without creating conflicts in the rest of the system. Technology has brought changes in the way knowledge communities produce and categorize information. Cosh, Burns and Daniel (2008) discuss the problem of classification of content produced on the Internet, especially with the advent of Web 2.0, where users have a fundamental role in how to create and access information. Given this paradigm where information sources become dynamic, it is no longer possible to use the old systems of taxonomies, the authors propose as a solution a cloud content, which, unlike the tag cloud, is not created by the users but by an automated formula that takes into account the recurrence of the words in the sources to perform the classification.

Method

A descriptive exploratory study was carried out in relation to the open educational resources portal Temoa. Descriptive designs are procedures consisting of "placing one or several variables in a group of people and other living things, objects, contexts [. . .] and thus provide a description" (Hernández, Fernández & Baptista, 2010). According to Dankhe (1989), descriptive studies aim to familiarize the researcher with an unknown topic, little studied or novel; they seek to analyze further a phenomenon and its components. This descriptive approach was used since it is an emerging practice in education, and a descriptive exploratory approach, merely as diagnostic, and not assessment, was adopted (Gómez-Zermeño, 2012). Thus, Temoa's specific methods of organization were researched, as well as the characteristics that compose it, and the variables that led to the development team to be guided by these methods.

Temoa is a project born from the need to expand educational coverage in the world, and specifically in developing countries. This site is a project of the Tecnológico de Monterrey, a private university founded in 1943 in Monterrey, Nuevo Leon, Mexico. This private educational institution offers studies at high school, undergraduate and graduate levels. It is one of the largest private universities in Latin America, with nearly 100,000 students and 9,000 teachers distributed on 31 campuses across the country (ITESM, 2010).

One of the most important non-academic activities of this University is their social and community programs. In addition to these, the Technology department serves communities by installing thousands of centers for social development and business advice (ITESM, 2010). In education, the Temoa is one of these community efforts, developed at the Center for Innovation in Technology and Education (Innov@TE), a department that addresses critical aspects of inequality in Mexico and Latin America such as the educational gap and the digital divide; undertaking this mission with technology-based innovation, in synergy with public and private organizations worldwide.

For the selection of the participants, a sampling trial was performed, in which the researcher determined the study subjects relevant to the reality to observe and to provide substance for their immersion in their respective context (Giroux & Tremblay, 2004). For this study, this is relatively easy since the creation and maintenance of the project depend on a small team of people. The study explored the subject of research with the four key members involved in the creation, development and operation of Temoa, who work at Innov@TE.

Interviews were carried out with Temoa developers, to obtain information regarding the creation and development of Temoa. As a research instrument, interviews are used when the problem that is investigated cannot be observed in a natural situation, or if that assessment involves an ethical or logistical problem (Hernández *et al.*, 2010).

Interviews were semi-structured, consisting of a series of questions drawn from the literature review, previously established by the researcher but with room to incorporate new ideas that are useful to the purpose of the study.

Results

In this study, interviews with four key informants allowed to learn about Temoa's suppliers, cataloging process, as well as the metadata and classification schemes they apply. Lastly, information was obtained regarding the adoption of OER for the teaching-learning process.

Temoa's suppliers and quality criteria

Temoa, as an Open Educational Resources Portal, offers materials filtered from other servers and organized so that they are available to any user, while retaining services and systems of quality equal to that of a digital library with its server. Based on Sharon and Frank's typology (2000), Temoa offers a harvesting system, a mechanism that segregates and provides the best websites with digital resources of good quality and useful to be used in education. Therefore, Temoa has a catalog of suppliers of open source electronic resources; since this list of suppliers is ever growing and well over a 1000, it is best to consult it in Temoa's portal: http://www.temoa.info/providers?sid=26&tid=All&subject=All&tid_3=All

According to Temoa's website, these suppliers provide OER collections that have been suggested by users and have then been verified by Temoa staff according to their acceptance criteria (Temoa, 2011). Thus, OER must meet the following conditions:

- Access to resources is public and free; access to the content is not subject to payment.
- Access to educational resources is not subject to a subscription or registration of any kind, for example, user account creation.
- The website provider of the resource has a legal section with terms and conditions of use (except in the case of a website subsidized by a government entity) which clearly explains the license or use restrictions to which the contents are subject. The conditions of use of the contents should allow its use for educational purposes.
- The terms and conditions of use of the resource provider do not require the user to send a written request to make use of resources.
- Within the policies and conditions of use, the resource provider does not prohibit direct reference to its contents, that is, does not prohibit a hyperlink or shortcut to your content that avoids the need to navigate the site until the resource is reached (this action is also known as deep-linking).
- Publication of educational resource is indefinite; this means that there is no explicit date in which the resources expire.
- The educational resource provider has a reliable precedent; this means that it is an institution, organization or entity formally established.

Regarding the evaluation of the OER themselves, one of the participants pointed out that great care was put into developing several rubrics to evaluate the suggested OER. These evaluate several aspects such as

I. Content quality
II. Motivation
III. Presentation design
IV. Usability

V. Accessibility Rubric
VI. Educational value Rubric
VII. Overall rating

The following section further explains how and when this evaluation process is carried out within Temoa's OER cataloging process.

Temoa's cataloging process

Temoa is a portal where several actors with different characteristics and functions are involved. To describe the process in which OER are treated in this portal is explained with a metaphor chosen by the site's developers. The portal shows that OER are diamonds with varying degrees of sophistication: the more stages of the overall process the resource has experienced, the more refined it will become. Accordingly, one of the participants describes Temoa as a factory with different well-identified processes that must result in a final product quality.

As the participants interviewed explained, there are four stages of the review process to ensure the quality of the OER listed in Temoa (figure 1); each one has the participation of an actor:

- Contributors: the main profile of these actors is represented mostly as teachers. They can be called experts since they have experience in an area of knowledge that allows them to suggest electronic educational material. According to Temoa's developers these actors record basic metadata, they can also classify the OER, which will be evaluated and corrected later by the cataloger.
- Auditors: they are responsible for reviewing the contributors' submissions, their format, and content; they act as a first filter, checking spelling and writing, and whether the object meets the validity criteria of the resource, if it is indeed an educational resource and is also open access. At this stage of the resource classification process, the audit involves three conditioning actions: if the resource and its description contains slight errors, then it is classified; if the metadata has some mistakes, then the original contributor is asked to make the corrections; finally, if the application does not meet the criteria established by Temoa, then the object is not indexed.
- Catalogers: a team is formed by professional librarians, they refine the resource's description initially provided by the contributor and subsequently revised by the auditor. In this process, they ensure the resource's quality, by applying the Anglo-American rules (AACR2) standardization processes to classify a resource; a user's guide has also been developed where Temoa's characteristics and intentions are synthesized. Catalogers have the final word; they review each resource in detail to establish standardized vocabulary, metadata and subject classification that best describes the OER.
- Editorial review: they are specialists for this process related to the review of the OER. They cannot make changes to the metadata and content of the OER.

In short, contributors and auditors first allocate some metadata. Then, catalogers review and add more specialized and technical metadata, and finally, editorial reviewers review the spelling and only tune the details of writing. The following section further explains the metadata and classification schemes applied to OER.

Temoa's metadata and classification schemes

Regarding metadata, Temoa's developers decided to use standards like LOM/SCORM, which are used to discover learning objects; they also considered the Dublin Core standards, used mostly by

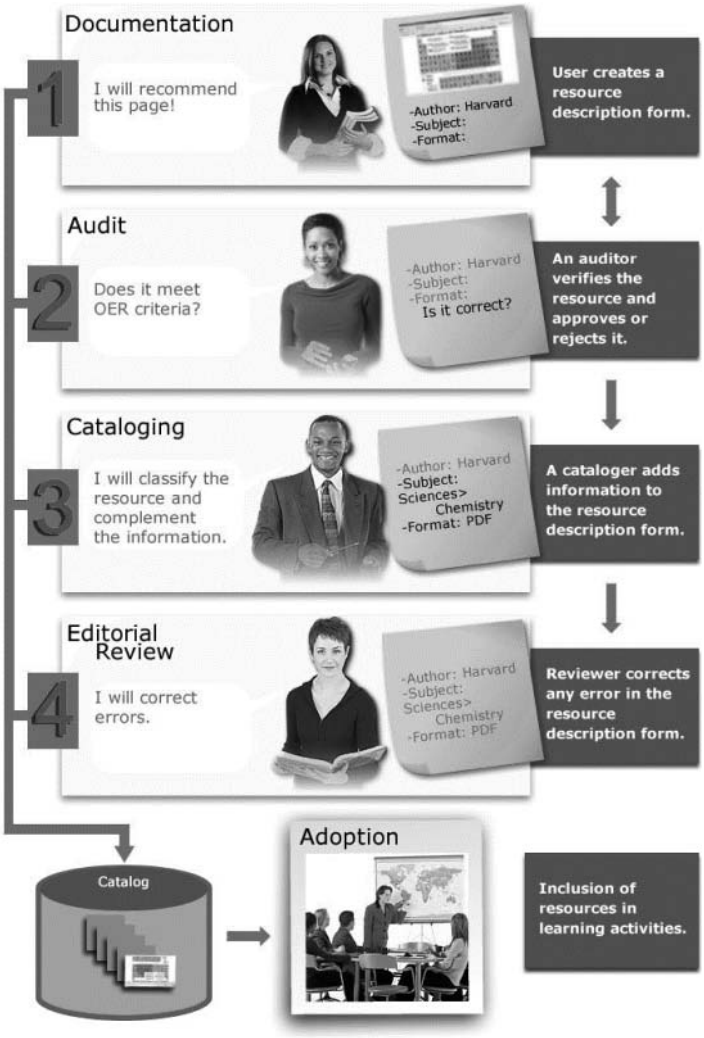

Figure 1: OER documentation cycle (Temoa, 2011)

digital libraries for cataloging web objects; and the Open Archives Initiative (OAI), does the same with open objects. Therefore, the team of developers defined a metadata standard based on the needs of Temoa. This definition of metadata is compatible with Dublin Core and SCORM, it is called metadata mapping or crosswalk metadata, and it is an interpreter table with existing metadata, user friendly and according to research carried out by the institution, they are constantly modified (see Table 1).

Concerning the classification of open educational resources, Temoa uses the classification standards of the Library of Congress of the United States, so the information is presented as an intelligible thematic division for interfaces with web content. This scheme, developed at Columbia University, has the characteristics of an electronic format collection, also with regards to the production and demand for various academic programs. According to the developers of the portal, the classification system adopted is sufficient in terms of specification levels of knowledge and breadth of it through its themes and subthemes (see Table 2).

The classification scheme is tree-like; the branches will be longer in knowledge areas that contain more than one resource, presented by topic and subtopic as appropriate. This represents how catalogers specified the resource to a particular subject. The subtopics can develop more knowledge

Table 1: List of applicable metadata for OER in Temoa

List of metadata in Temoa
Educational resource title
Language of the captured data
Resource Description
Address (URL) of the resource
Topic: General
Year of creation
Duration/Extension
Resource's Genre
Granularity
Content language
Presentation medium
Topic: Specific
Topic: Keywords
Key LCC
List of Sections
Author (s)
Audience educational level
Benefits for end users
Teaching recommendations

Table 2: Areas of classification of open educational resources

Area of Knowledge	Themes	Subthemes
Art and Architecture	5	
Business and Economy	2	12
Engineering and Applied Sciences	3	13
General	9	4
Health Sciences	6	10
History and Archaeology	5	20
Journalism and Communication	4	
Languages and Literature	17	27
Law, Politics & Government	7	32
Music, Dance, Drama & Film	4	5
Philosophy and Religion	2	23
Science	16	
Social Sciences	12	54

levels. This classification system helps users to refine their information search in the acquis. But navigation is even more efficient through the filters Temoa offers; in addition to the general topic or area of expertise, users can filter the resources considering: type of educational resource, presentation medium (text, video, images, software and audio), granularity, provider, creation date,

status (suggested, cataloged and audited), language, the end user (teacher, student and instructional designer), compatibility with cell phones and educated audience.

Temoa considers the selection of this classification system is related to the nature of open source, and recognizes the freedom that is given to implement and customize their content, under the constraint that it shall not be for profit, as the licensing is by Creative Commons Attribution-Noncommercial 3.0.

Because of the complexity and breadth of Temoa cataloging process, one of the participants highlights that while there is increasing improvement in the processes, certain errors continue to occur as:

- Gaps in the description of the resources
- Assigning numerical LC signatures that belong to physical libraries
- Source errors unidentified by catalogers and auditors

The same informant explained his belief that the errors come from causes such as:

- Difficulty in communicating well the good practice in cataloging and classification of resources, since the catalogers are not physically in the offices of Innovate, where Temoa department develops, but work in libraries of other campuses of the Tecnológico de Monterrey.
- Poor execution of the processes of cataloging: not reviewing the resources in time and correct way.
- Poor performance or misinterpretation of the classification processes: because of the catalogers' experience in physical libraries, they extrapolate their practices to a process of a digital library as Temoa.
- Poor filling of origin because of collaborators who are not paid a salary or automated filling data.

By identifying this information, it is possible to design better training for the participants, and it keeps Temoa developers mindful of the importance of keeping quality control practices throughout all of the processes.

Adoption of OER for the teaching-learning process

Temoa's mission is to improve educational practice and support closing the gap in global education. To achieve these purposes, it promotes in teachers at all educational levels the adoption of open educational resources, the exchange of learning experiences in the use of these and maintain a high quality in variety, utility, reliability and availability of its directory of OER (Temoa, 2011).

According to the OER documentation cycle, the ultimate purpose of OER is their integration into teaching. That is why Temoa developers define the status that is assigned to the resource when it is under revision (see Figure 2), so the user can see a symbol on the page that identifies the status of the OER; this helps users to make a decision whether to select or not any OER.

Educational research studies related to the use of ICT have agreed that OER represent an opportunity to put into practice many of the principles of the constructivist educational paradigm. One of these principles states that it is the students who build their learning from concrete actions; individually but also collaboratively. Therefore, it is necessary to design and/or implement dynamic learning environments proposed by the teacher.

Regarding environments, they derive from the interaction between individuals and the natural setting in which they operate, this situation attributes pedagogical actions that lead the learner to reflect on their and other people's actions (Ramírez, 2007). Thus, a learning environment is defined as an enclosed environment, which incorporates the characteristics of life, nature and work, with

Badge	Description
Suggested ER	The educational resource has just been suggested by a user; it has not been reviewed yet, and it may still be rejected if it does not meet the criteria for acceptance of an Open Educational Resource.
 Audited OER	The educational resource has been reviewed by the educational community (from the same area of knowledge), ensuring that the resource meets the criteria for acceptance of an Open Educational Resource, it operates correctly, and the basic description is provided in the bibliographic card.
 Cataloged OER	The open educational resource has been further reviewed concerning their functioning and has been enriched with additional descriptive metadata such as subject categories and keywords controlled only by a librarian.
 Adopted	The resource has been incorporated into learning activities; information is provided on how it is used.
	The resource has been rated by other users, based on the perceived value of its use in teaching and learning activities. The reviews appear in the description of the resource, indicating the author, evaluation and a comment made about the experience with the resource.

Figure 2: OER Specification status

the intention that the students study, reflect and intervene in it (Andrade, 2007). According to Waldegg (2002), interactive technology is a useful tool to motivate students to develop processes of what and how to learn.

OER play a significant role in learning environments to seek the realization of the educational objectives of a study program, even an entire curriculum proposal. In the particular case of Temoa, two actions that have been encouraged by educational practice stand out:

- *Knowledge Transfer.* The diversity of open access digital resources that exist on the web concentrate large volumes of data in several formats like HTML, PDF, FLASH, among others. ICT remains in constant production and exchange of knowledge and practices, hence the emergence of new formats and applications to reduce the information to deposit it on the web. In a recent study about Temoa's OER, Contreras (2008) findings seem to indicate that using OER favors changing learning environments, further encourages students to assume an active role and autonomy in selecting a range of topics that allow them to achieve the goals of a subject. Also, Contreras points out that it is possible to transfer content from other educational institutions when considering issues such as 1) identifying whether the university that shares content is recognized nationally or internationally; 2) considering the language in which the information is; 3) conduct a study of the contents and the relevance of the knowledge to transfer in a new context; 4) select the information that can be transferred; 5) design tools that enable the transmission of new information and adapt it to the framework of the target user, without losing the originality of the resource; finally, 6) assessing the transferred resource's usability, as well as the acquisition of new knowledge and questioning whether it was possible to add new elements.
- *Dissemination of innovative educational strategies*. It is clear that information and communication technologies facilitate the digital dissemination of knowledge (content), but they also support the design of innovative strategies that have improved teaching-learning experiences of teachers who have adopted OER (Burgos, 2010). This is possible in Temoa through

> "metadata, which is data that describes other data, and they are used together to describe and represent a digital object (. . .)" (p. 4). With this, Temoa developers have established monitoring mechanisms that allow them to recognize and support the educational practices that have been generated in the experience of OER use. A monitoring mechanism was to create a space in the portal called "Participate and share", this presents a directory of users that have shared experiences and innovative educational practices for topics or courses. Thus, the user shares, copies and reorganizes information from others to construct new knowledge to suit the needs of their learning environments, all this without losing the original sources (Temoa, 2011).

Both actions show that Temoa has proved an efficient and reliable tool for the selection of OER. In a study regarding values in artistic activities developed by Cedillo, Peralta, Reyes, Romero and Toledo (2010), authors confirm that "OER are complementary, innovative and motivating resources, to address the daily educational practice, as they encourage the teaching-learning process and contribute to the construction of meaningful learning that benefit the academic work and curriculum" (p. 119). Also, these teachers designed teaching strategies for insertion of these OER in class, each one applied it in their class contexts and in different institutions, which allowed to enrich the study subject.

Conclusion

Since its inception, Temoa's developers considered literature review and consultation with education experts to meet the educational aspects of the portal, as well as librarians and information technology developers for the technical and technological aspects that determine the methods of development, preservation, organization and presentation of information in Temoa.

As the participants in the study informed, Temoa's subject classification and metadata schemes use are based on recognized standards. For metadata, these have incorporated Dublin Core, as the most widely accepted standard for Web pages and LOM/SCORM to meet the particular needs of the description of educational resources. Meanwhile, the HILCC system, a hierarchical classification oriented to digital libraries based on the Library of Congress Classification is used. The portal is also ascribed to Open Access Initiative guidelines, which allows resource sharing metadata between open source sites. The assignment of metadata and subject classification is also performed following standardized cataloging rules such as the Anglo-American rules. This use of metadata standards, classification and cataloging of the materials follow the recommended guidelines and best practices for digital projects at the University of Maryland (Schreibman, 2007), NISO (2004), and Western States Digital Standards Group (2005).

The processes are well defined and executed by specialists in different areas. The resources are provided by teachers and peer reviewed by auditors. The organization of these is run by a team of experienced professional catalogers in libraries, coordinated and supervised by a chief librarian. This has been, in many occasions, with their respective training for different roles and following the rules of a manual, in the case of catalogers.

Temoa's developers, who also have technological and technical profile studies or on library systems, procure documentation supporting their strategies, indicators and user testing. Through these practices, the organization through which users can access materials is constantly questioned, considering their intelligibility, number and relevance for the purposes of the portal. The features offered by the portal are constantly evaluated and the interpretation and the use thereof by users

is reflected in constant changes in the implementation of the various metadata and allow not only interoperability but also the flexibility and extensibility of the same, as explained by Taylor (2004). This way, Temoa is conceived more as an entity in constant improvement that a finished product.

Some of the issues and challenges identified in the research are: problems throughout the chain of the presentation of resources, errors in filling metadata in different stages of the same; the dispersion of the cataloging staff, whose members work in different states of the country, which does not facilitate the integration and teamwork; the lack of a clear strategy in the development of the portal, making it difficult to identify the target users and, therefore, also the process of collection, development and organization of the information. However, several measurements are being proposed and studied within the developing team, to solve these issues.

Based on the process of documenting freely accessible objects in electronic format, it has been shown that Temoa maintains a comprehensive quality process that reviews from the OER design to the format and content of the information. Probably the one aspect that Temoa cannot guarantee is the preservation of the resource, this is due to having a harvested implementation, the resource provider may have changed or modified the URL, the server is in restructuring, and/or even the OER may have been "deleted" it from where it was hosted.

Temoa has been designed in order to contribute to educators, their educational practice and to the ongoing process of bridging the digital divide in access to information. This tool aims to be present in all technological devices, and under the idea of mobile learning, Temoa intends that the OER be compatible with smartphone technology for users to have them at all times. It continues to constantly innovate its metadata and continues to collect resources, but more importantly, it relies on the socialization of knowledge accumulated in the web.

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