

● Marcela Gómez-Zermeño
Monterrey (Mexico)

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Digital Libraries: Electronic Bibliographic Resources on Basic Education

Bibliotecas digitales: recursos bibliográficos electrónicos en educación básica

ABSTRACT

Studying electronic bibliographic resources for basic education involves thinking about search mechanisms that meet the needs of young users. Through the investigation carried out during the educational research project «Digital libraries», it became evident that the collections explored use a language better suited to higher education. Faced with this problem, the following question arose: What are the criteria for classifying electronic bibliographic resources for basic education? The proposed investigation was non-experimental, with a non-probabilistic sample of case studies; the sample comprised 250 resources from 10 bibliographic collections. The analysis assessed resources according to: accessibility, the curricular axis to which it is addressed, and format; pedagogical, functional, technological and aesthetic aspects. The results show a mean of 3.76, which indicates that the bibliographic collections provide quality resources, although it is necessary to improve educational and functional aspects. Classifying electronic resources for basic education requires the consideration of pedagogical needs, graphical and technological qualities and, especially, the dynamic way in which information is conceived nowadays. This confirms the need to establish a set of indicators that enable teachers to select electronic resources based on basic education curricular axes.

RESUMEN

Estudiar recursos bibliográficos en formato electrónico para la educación básica implica reflexionar sobre mecanismos de búsqueda que atiendan las necesidades de los pequeños usuarios. A través de los trabajos realizados en el proyecto de investigación educativa «Bibliotecas digitales», se puso en evidencia que los acervos explorados, manejan un lenguaje para un nivel de educación superior. Ante esta problemática, se planteó la siguiente pregunta de investigación: ¿Cuáles son los criterios de clasificación de los recursos bibliográficos electrónicos para la educación básica? Se propuso una investigación no experimental, con una muestra de estudio no probabilística de casos tipo, integrada por 250 recursos que ofrecen los diez acervos bibliográficos seleccionados en base a un estudio exploratorio previamente realizado. Para el análisis, se valoraron los siguientes recursos: accesibilidad, eje curricular al que está dirigido, formato y aspectos pedagógicos, funcionales, tecnológicos y estéticos. Los resultados muestran una media de 3.76, la cual indica que los acervos bibliográficos ofrecen recursos de calidad, aunque es necesario trabajar en los aspectos pedagógicos y funcionales. Clasificar recursos electrónicos para educación básica requiere considerar necesidades pedagógicas, entorno gráfico, tecnológico y sobre todo, la forma dinámica y cambiante de cómo se concibe la información. Esto corrobora la necesidad de establecer un conjunto de indicadores que permita a los docentes seleccionar recursos electrónicos en relación a los ejes curriculares de la educación básica.

KEYWORDS / PALABRAS CLAVE

Accessibility, interactive learning, digital libraries, digital information search, children education, teaching strategies, educational resources.

Accesibilidad, aprendizaje interactivo, bibliotecas digitales, búsqueda de información digital, educación infantil, estrategias educativas, recursos didácticos.

◆ Dr. Marcela Georgina Gómez-Zermeño is Director of the Centre for Research in Education of the Graduate School of Education at the Tecnológico de Monterrey Virtual University in Nuevo León (Mexico) (marcela.gomez@itesm.mx).

1. Introduction

By questioning classical conceptions and structures of digital libraries, Joint (2007) claims that they are metaphors derived from traditional definitions of libraries. He proposes a redefinition that takes into account the new technology and the way we conceive information in the postmodern era. He also warns about the complexity of building and classifying a digital library with existing standards since current information objects are ephemeral and lack permanence; hypertext collections are difficult to gather due to their mutable nature.

Indeed the Digital Library concept has been controversial because it could represent an organized collection of documents stored in digital format that also provides search services and information retrieval (Martínez, 2007). Another of the classic definitions of digital libraries is suggested by the Federation of Digital Libraries (DLB), which attributes to such organizations a wide range of functions like selection, structuring, preservation, interpretation and supply of digital resources for the user's convenience (Digital Library Federation, 2010).

The development of the new technologies of information and communication has brought interesting changes in the social and educational dynamic. A noticeable change lies on the information search mechanisms that allow the construction of knowledge (UNESCO, 2005). Although digital libraries possess a variety of digitized information, which can be accessed, it is interesting to recognize that the greater the number of electronic collections, the greater the need for efficient search strategies.

2. Framework

The recent curriculum reforms at all levels of basic education around the world bring with them the need to adapt educational materials. These reforms are a boost research and innovation associated with the technical and pedagogical work oriented to improving the achievement of students, teachers, head teachers and society's capabilities (CONACYT-SEP, 2008). As a result, the study of electronic bibliographic resources for basic education is vital.

Druin (2003) says that children's libraries developed from systems aimed at adult users provide access points whose interpretation requires higher cognitive skills, so the challenge of a digital library for children requires taking into consideration the need for access to and use of information, and the cognitive development of the students.

In this regard, Cooper (2002) confirmed that chil-

dren under seven have difficulties searching for information using alphabetic characters and socialized classifications, and they can use metadata but only if presented in a very direct way. He analyzed young children based on four developmental characteristics: cognitive, physical, social and emotional. In 2005 Cooper concluded that digital environments for children must consider balancing the familiar with new things built on prior knowledge, offer quick feedback, involve several senses and be participatory and user friendly. After inducting children aged 7 to 11 into a collaborative workgroup at the University of Maryland, Druin (2003) proposed a digital library model with emphasis on collection and cataloguing, metadata standards and the creation of new technologies to access and use the information. Once the contents were revised, Druin states that children want to get involved in the construction of libraries, have access to varied resources with different classification criteria (colors, shapes, feelings that the books awaken) and to find graphical and customizable interfaces to facilitate collaborative work.

The activities of the «Digital Libraries» educational research project revealed the prevalence of criteria derived from bibliographic collections developed for higher education. Most of these activities proposed interfaces aimed at adult users even though they offer bibliographic resources for basic education. An exploration on the basic education collections found that almost all the available electronic resources were in text format and used higher education language. Although e-collections routinely audit the cataloging processes, few examined the resources in detail during the quality control process. These findings confirm the need for continued help in the construction of electronic spaces for younger students (Gómez-Zermeño, 2010).

3. Research problem

Despite the significant volume of bibliographic resources in electronic format available for basic education that can be accessed through traditional search engines many are unreliable. Children might find it hard to perceive the relevance of such materials or receive incorrect information, which affects their learning. For Lugo and Hernández (2007), delimiting criteria for basic education electronic resources becomes a systematic tool that supports evaluation; they also point out that the current evaluation methods for digital resources are still under construction and are in constant evolution. In order to refine this process, they suggest creating standards and guidelines that can be used according to the needs and interests of users.

These authors also mention that existing work on the topic has mostly been developed in Europe and the United States. These studies focus on reviewing different types of evaluation, and report that the benchmarks and indicators used by each institution may vary. This has hindered the standardization of this activity because, in spite of the proliferation of digital libraries, there are few documented evaluation proposals for these information systems, most of which were made to solve practical problems; hence the need for the scientific community to explore the topic further (Ramírez, 2006).

Current literature related to libraries shows that progress has been made on the internationally accepted benchmarks and indicators required to assess the quality of bibliographic resources. Similarly, this research-project will generate more knowledge on this emerging study area by creating a model for the diagnosis of bibliographic resources in electronic format for basic education by identifying strategies that guide and assist teachers in optimizing the use of technological resources in their schools, and in developing digital materials to enhance the learning experience of their young students.

The «Digital Libraries» educational research project aimed to lay the foundations of a model for the diagnosis of bibliographic resources available in electronic format for basic education. The work undertaken in the first phase sought to generate relevant information about the collections of electronic bibliographical resources for basic education with the aim of identifying their main characteristics and defining a set of selection criteria. The second phase of the project underlined problems that led us to ask: What are the characteristics and classification criteria for electronic bibliographic resources for basic education?

4. Theoretical framework

Nowadays, educational technologies provide the opportunity to strengthen educational models through access to new ways of exploring, representing and acquiring meaningful knowledge. In an environment mediated by technology, a competent user needs a symbolic code or language in order to locate resour-

ces, and so technological advances and the abundance of information have forced users to establish quality criteria in the use of tools that facilitate the search for relevant resources. This, rather than a simple information search activity, represents a task that demands cognitive abilities from the user based on the culture from which he or she perceives, interprets and appropriates the knowledge that helps the student to understand a specific theme and the construction of his or her own learning (Barber, cited by Fainholc, 2005). For Bernhard (2002), search and selection processes of relevant information demand skills for handling tools that facilitate the inquiry as well as the proper use of unfamiliar search engines. Relevant information search

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ching requires more than the learning associated with «computer literacy».

4.1. Bibliographic resources in digital format

Today's technology is a tool that allows us to access information through processes that can break down barriers of space and time. For Torres (2000) the library of the future is designed as a space without walls in which all resources can be cited, gathered and consulted anywhere by the user. A digital library houses a collection of objects (also called items, resources or materials) such as books, periodicals and documents in HTML format web pages, as well as multimedia objects like images, recordings or video files (Sharon & Frank, 2000), therefore, fixing the bases of a model for evaluating bibliographic resources in electronic format requires taking into account the qualities of the information objects in electronic format, and because these resources are dynamic, establishing classification criteria has become much more difficult. For example,

hypertext collections are hard to gather due to their mutable nature. An analysis of the characteristics of digital resources also means reviewing their quality. Thus, a typological classification of bibliographic resources in digital format is a complex task because of the continuous changes that occur in such a dynamic environment.

4.2. Indicators for assessing bibliographic resources

New media and information items have new reference systems that are generally adaptations of standards used with bibliographic materials. Marquès (2003) suggests that electronic bibliographical resources are materials that integrate various textual (sequential and hypertext) and audiovisual (graphics, sound, video, animations, etc.) elements that can be useful in educational contexts. To assess their quality, the following parameters should be considered: a) pedagogical, b) functional and c) technical and aesthetic. According to Merlo (2003), the assessment process of electronic information resources requires specific planning that involves four key elements:

- Parameters: generic aspects to be evaluated, in order to establish blocks in terms of the scope of the analysis.
- Indicators: elements that give information about each of the parameters. They are the specific issues to be assessed.
- Procedures: methods used to make the application of parameters and indicators effective.
- Resources: objects that are necessary to the assessment process such as the instrumental, documentary and human resources required.

In the search and selection of resources that seek to strengthen the learning process, Ochoa (2007) suggests considering the following aspects:

- Quality, Depth and Usefulness of the Content: clear content, appropriate for the intended audience, useful links to other sites.
- References: broad perspective of a particular theme; availability of references to answer specific questions.
- Content Unity: the resource is presented as a whole.
- Updated Content: frequent renewal and maintenance.
- Copyright: information about the background and purpose of the organization, authorship and legality clearly indicated.
- Ease of use: friendly design, simple navigation, attractive graphic design in search engine, fast information retrieval.

- Customer service: contact information, correct e-mail addresses; prompt answers to questions.
- Efficiency: download of optimized pages, available plug-ins, fast and reliable server.
- Web Optimization: integrated components (audio, video, text, etc.), effective use of new technologies, useful information.

4.3. Bibliographic resources in electronic format for basic education

Educational research recognizes technology as a means for teaching and learning, and its important role in the education of children, but the opinion of these young users is rarely considered (Dressang & Gross, 2011). There is also a gap between the ideas of implementers and user's needs. As technology becomes an integral part of children's lives, Yohalem & Pittman (2003) declare that kids should participate in this work being done on their behalf. In a study conducted in the United States and Canada, it was found that only four out of 63 libraries were designed and created by children. This lack of involvement might have been related to a time shortage or the project's limited resources (Druin, 2003). The way children prefer to organize content is not often taken into account, even though all users—including children—require computer environments that meet their specific needs (Greenstein & Thorin, 2002).

With the aim of obtaining more related information, the International Children's Digital Library project at the University of Maryland put together a multidisciplinary, multigenerational team made up of researchers and children aged 7 to 11 (Druin, 2003). This experience yielded the following findings: 1) children want to get involved in this kind of project, 2) collections must consider offering books about boys and girls from different backgrounds, 3) collections should include a large amount of fiction books and books dealing with multicultural themes or different cultures and should contain, 4) old and new books, 5) the search mechanisms need to protect children from inappropriate information, 6) there should be a system for copyright payment, 7) metadata should consider the way in which children perceive the world, 8) the tools must be useable at home and enable collaboration, 9) interfaces should be graphically appealing, and 10) resource development must find a balance between innovation and users' needs (Druin, 2003).

This means that the role of the teacher in the selection of content for children's digital libraries is essential, and, according to Druin (2003), an especially relevant task in the field of children's libraries is to pro-

tect end-users from harmful information. So, the teacher's new role will be a combination of facilitator and protector of information.

In order to establish the basis for a model to diagnose bibliographic resources, Pirella and Ocando (2002) refer to the following objectives: a) to complement education, b) to elaborate the curriculum, c) to promote educational materials, d) to improve teaching practice, e) to expand creativity, f) to foster reading, and g) to ensure lifelong learning and research.

5. Methodology

In designing the research, the techniques selected must be completely independent of the researcher's epistemological approach and implemented from a set of additional factors in order to answer the investigation question (Schmelkes, 2001). For Keeves (1988), it is important to acknowledge that in educational research there are different paradigms and epistemological ways of knowing and constructing knowledge. Since it is impossible to manipulate the independent variables, the methodology of our study was exploratory-descriptive and non-experimental (Gómez-Zermeño, 2009). Borgman (quoted by Cabrera and Coutín, 2005) implies that any assessment encompasses aspects of evaluation and measurement that must be carried out in a systematic way. The initial proposal was to begin the research with an exploratory study that would provide the information for a descriptive study. To switch from the exploratory to the descriptive study, a new «observation guide» to assess electronic bibliographic resources was designed. The guide considered pedagogical, functional, technological, and aesthetic aspects (Marquès, 2003). Each aspect evaluated five variables; each variable consisted of five indicators. The indicators relating to curricular axes of the basic education curriculum (SEP, 2008) were also integrated. A pilot test was performed in order to verify reliability in two of the collections. It tested the measuring instrument, conditions for application and the procedures involved.

6. Analysis

To diagnose the electronic bibliographic resources, 56 collections were explored during the first phase of the project. Then, 23 collections focusing on basic education were chosen. Lastly, a non-probabilistic sample of 10 representative collections were selected for analysis (Hernández, 2008, quoted by Gómez,

2009): 1) International Children's Digital Library; 2) World Library; 3) National Library of Virtual Manipulatives; 4) Chile for Children; 5) New Library for the Mexican Child; 6) Latin American Institute for Educational Communication (ILCE); 7) Universal Virtual Library; 8) «Know your World» Library for Children; 9) Storyplace; 10) The National Science Digital Library

The research results show that the 10 selected collections were mostly developed by public or international institutions; five call themselves «digital» and the other five «virtual»; only two operate via distributed implementation, the rest are independent libraries that host their resources in a single server with direct access. According to Druin (2003) children's libraries offer the opportunity to display various types of resources in order to strengthen educational activities. To achieve this, the teacher must assume an active role in selecting the collections and resources.

The following categories analyzed 25 random resources per collection (250 in total) according to the indicators proposed.

- Curricular axis. A high percentage of objects meet the demands of the curricular axis 'exploration and understanding of the natural and social world' topics. This confirms that resources can contribute to the development of new ways in which students may explore, represent and acquire knowledge (Escudero, 1995). The resource must lead to young students acquiring transversal knowledge.

Curricular axis	Percentage
Language and Communication	18.7%
Mathematical Thinking	11.7%
Exploration and Understanding of the Natural and Social World	57.8%
Personal Development for Coexistence	11.7%

Table 1. Curricular axis frequency.

- Format. Sharon and Frank (2000) state that electronic collections house documents, HTML web pages, multimedia resources, images, sound and video. The resources evaluated in the study were mostly in text format.

Format Type	Percentage
Text	41.3%
Image	23.5%
Sound	3.6%
Video	3.4%
Multimedia	28.2%

Table 2. Format frequency.

- Evaluation indicators. The evaluation of electronic resources takes into account educational, functional and technical-aesthetic parameters (Marquès, 2003). It was found that the re-

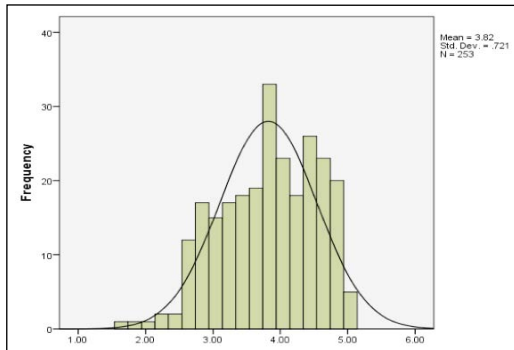


Figure 1. Resources results for quality parameters.

search collections offer quality resources (see Figure 1), with new technologies enriching educational models and making communication easier.

- The average by parameter analysis (see Table 3) clearly shows the area of opportunity in which to improve the quality of electronic resources for basic education.

Parameter	Result
Pedagogical	3.73
Functional	3.62
Technical-aesthetic	3.82

Table 3. Average by parameter.

sang & Gross (2011) explain that resources backed up by technological means can aid the educational development of young users. In this regard, Pirela and Ocanco (2002) suggest that electronic bibliographic resources should consider the curriculum, working for the development of creativity, learning and research, and offering the teacher permanent training in order to complement the educational process in basic education (see Figure 2).

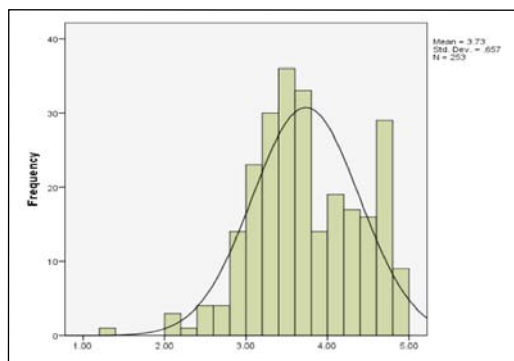


Figure 2. Resources results for pedagogical aspects.

See Table 4 in relation to pedagogical variables:

- Motivational capacity: the resources arouse curiosity and encourage inquiry.

- Adequacy and adaptation to users: the contents were appropriate for basic education users, but the activities and the resource background could be improved.

- Resources: greater synthesis, and more summaries and schemes are needed to facilitate the cognitive process of assimilation.

- Tutorial and assessment: The resources relate to the basic education curricular objectives, and they are useful for lesson planning. However, the feedback the student gets to correct or explain mistakes must improve.

- Pedagogical approach: Resources support meta-cognition but should promote more collaborative work.

- Functional aspects. Bernhard (2002) states that the process of search and selection of relevant information demands skills for handling technological tools.

Variable	Result
Motivational capacity	4.28
Adequacy and adaptation to users	4.15
Resources	3.78
Tutorial and assessment	3.13
Pedagogical approach	3.89

Table 4. Results for pedagogical variables.

Developing these skills requires the resources to be easy to use, ergonomically comfortable and design-friendly (Ochoa, 2007; Codina, 2000; Cooke, 1999) (see Figure 3).

See Table 5 for Functional variables:

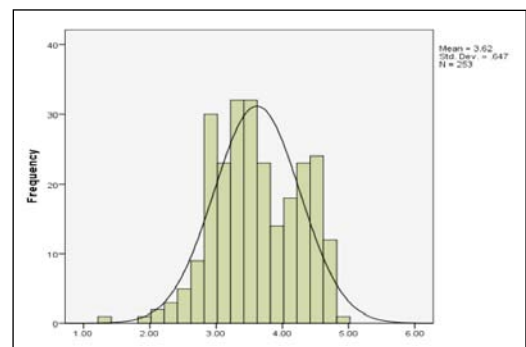


Figure 3. Resources results for functional aspects.

- Ease of use: The access and use of the resources was easy, but they do not have a Help section.

- Information Retrieval: It is easy to retrieve information, especially when the resource has an index, but they do not show how to get information from other resources.

- Versatility: The resources can easily adapt to dif-

ferent educational contexts. Nevertheless, there is a need for open content resources, multilingual objects and Administrator tools to make adjustments.

- **User Autonomy and Control:** resources offer clear and precise instructions that make them easy to operate.

- **Global Functionality:** the resources were found to be adequate for educational purposes; they are efficient, relevant and effective for young students. Electronic objects must be of sufficient quality to satisfy learning expectations (Marquès, 2003).

- **Technological and aesthetic aspects.** Although

Variable	Result
Ease of use	4.07
Information retrieval	3.50
Versatility	2.70
User autonomy and control	3.35
Global functionality	4.45

Table 5. Results for functional variables.

work has been done on dynamic interface design, the starting point must be to find out how children prefer to organize content and how to improve computer environments based on the specific needs of young users (Greenstein & Thorin, 2002) (see Figure 4).

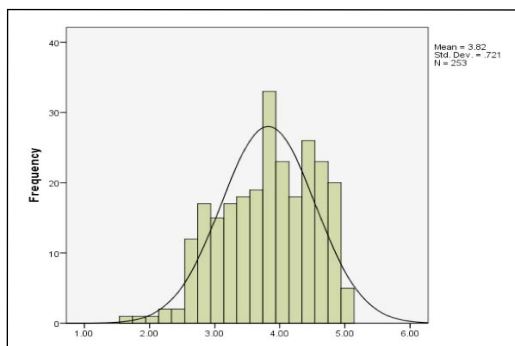


Figure 4. Resources results for technological - aesthetic aspects.

- Further information about Technological-Aesthetic Variables in Table 6:

- **Visual environment:** The visual aids and screen resolution were good, texts complied followed grammar and spelling conventions.

- **Data Bases:** Content is relevant, well-selected, developed with clarity and quality; it is important to be accurate and update information.

- **Navigation:** Clear, structured navigation maps make resources ergonomic, but hypertext with more information should be included.

- **Interactive Dialogues:** Young students should have the option to enable or disable functions according to their preferences.

- **Technology and Design:** In order to be reliable and original the resources need to be supported by advanced technology.

Variable	Result
Visual environment	4.17
Data bases	4.09
Navigation	3.92
Interactive dialogues	2.95
Technology and design	3.95

Table 6. Results for technological-aesthetic variables.

7. Conclusion

Ensuring quality of education means designing parameters, variables and indicators to standardize the evaluation of electronic resources for digital libraries. The development of electronic collections for basic education opens up the possibility of spaces that host reliable and relevant information for young students. In the Mexican context, an indicator guide was designed based on the needs and interests of teachers and students as well as the basic education curricular axis in order to evaluate the relevance of educational resources in three key aspects: educational, functional and technical-aesthetic.

Throughout the study, the characteristics and classification criteria of electronic bibliographic resources were identified via an evaluation guide. Regarding the pedagogical aspects, resources should motivate the student to be inquisitive and creative through a dynamic and appealing environment, so it is imperative that the content be based on educational purposes to enrich the cognitive experiences. The added value of resources must be the ability to feedback the learning of young students. In the case of functional aspects, an educational resource in electronic format should be easy to use and give the user autonomy and control to interact with it. The objects should allow the young students to make adjustments, modify content according to their cognitive ability, offer clear instructions and an assistance system. In the technical-aesthetic aspects, the resources were found to be adequate for basic education, with an attractive visual background and well-represented in terms of colors, text, sound, image and language. Even when the information is relevant, it is necessary to provide hypertext to guide the knowledge acquisition process.

To classify electronic resources for basic education is a complex process. It must consider pedagogical

needs, graphic appeal, technological aspects and, especially, the dynamic way in which information is now conceived. The research confirms the need to establish a set of indicators to guide teachers in the selection of electronic resources, and mix them with educational activities according to the curriculum axes of basic education in Mexico.

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