The Use of a Digital Library of Science (BDC) by High School Biology Teachers

Helika A. Chikuchi, Eduardo K. Kimura, Gabriel G. Hornink and Eduardo Galembeck

1 University of São Paulo (USP), Brazil, helika@usp.br
2 State University of Campinas (UNICAMP), Brazil, ekkimura83@gmail.com
3 Federal University of Alfenas (UNIFAL), Brazil, gabrielbio@gmail.com
4 State University of Campinas (UNICAMP), Brazil, eg@unicamp.br

Abstract: In this work, we will present an analytical view of how biology teachers have been using the BDC (Biblioteca Digital de Ciências) – a digital library held at the Institute of Biology inside the State University of Campinas. The BDC was created to publish educational resources for people interested in both teaching and learning about science related subjects. The study of how high school biology teachers have been using the BDC may help us understand what kind of educational resources they might be interested in, and encourage the development of resources to more efficiently meet their interests and needs. Besides educational resources, the BDC offers some interactive tools that aim to put users and authors in contact with other and to promote collaborative learning and authoring, in a web-based environment. Our preliminary data shows that high school biology teachers registered at the BDC are from public (66,2%) and private schools from all over Brazil and that software and animation are the resources they most download. A significant percentage of teachers have downloaded the same material more than once, suggesting its relevance and maybe an online use. Articles and other materials for self-learning are downloaded less often, suggesting that users are most in need of educational materials.

Keywords: Teacher, Internet, Teaching Materials, Content Management Systems

1. Introduction

Technological advances, especially those in the area of telecommunications - computer interfaces, are primarily responsible for the large and rapid transformations in our way of interacting socially, working, thinking, producing and circulating new and old knowledge (Furtado, 2004).
Pierre Lévy (1999) states that “the rate of emergence and renewal of knowledge shows that most of the skills acquired by a person at the beginning of his career path will be obsolete by the end of it.”

As information is increasingly codified in digital formats, it is necessary to develop special skills and abilities that allow people to operate the technology, seek information, organize and manage this information for problem-solving, and to use it in the production of new knowledge. Without a process of continuous and permanent education, there is no way to accompany the renewal of knowledge in the current world (Candy, 2002).

One of the responsibilities of schools is the development of the skills and competencies necessary for youngsters to enter the productive world. In Brazil, the Law of Basic Tenets and Guidelines for National Education (LDB) of 1996, contains several references to this concept. In Article 35 of this document, for example, it is mentioned that one of the goals of high school is the formation of youth “capable of continuing learning in order to be able to adapt flexibly to new working conditions or subsequent improvement, and the development of intellectual autonomy and critical thinking.” Article 36 of the same document states that these goals should be achieved through a curriculum that provides a "basic technological education, the understanding of the meaning of science, the arts and the letters, the historical process of transformation of society and culture, the Portuguese language as an instrument of communication, access to knowledge and the exercise of citizenship" (Brazil / MEC, 1996).

However, 13 years after the publication of the LDB, neither schools nor teachers are yet well prepared to implement its goals. There are issues at different levels, such as the lack of infrastructure, but one of the major problems is that the majority of in-service teachers had no training in the use of digital technologies during their pre-service education and thus they still do not feel very secure about using them in the classroom (Furtado, 2004). Besides this, we must also consider the fact that the availability of good quality digital educational freeware resources in Portuguese is very limited.

Biology teachers usually agree that digital technologies can support teaching. Simulation software, animation and movies allow the representation of natural phenomena in an attractive, interactive and dynamic way, as they are capable of combining many types of representation: images, sounds and texts (Giordan, 2008). Information and communication tools can also be used, for example, to promote interaction among students and teachers. Such tools include creating and maintaining a science blog with the students, where controversial and ethical questions, such as stem cells, abortion or cloning, can be discussed. These tools can also stimulate communication and cooperation among students from different schools and scientists through chats, e-mails and videoconferences for example, to solve problems designed to develop the scientific literacy skills and competencies required for citizenship (Lombard, 2008). Technologies may also be useful for the self-education of both students and teachers. These technologies allow them to
find up-to-date information on the internet about all the changes that affect biological knowledge.

Nowadays, many innovations and discoveries are being announced all the time. This presents a challenge to teachers, and particularly to biology teachers. We also have to consider that many of the skills acquired during these teachers’ pre-service education have become outdated, and they are in the firing-line of some controversial and complex issues brought about by new scientific discoveries.

In this paper, we will present the Digital Library of Science (Biblioteca Digital de Ciências da Unicamp - BDC), which was created by researchers from the Biology Institute of the State University of Campinas (UNICAMP). Their goal is to disseminate scientific information and educational resources, especially those related to biology, and promote teaching and collaborative learning in a web-based environment. Also, the library possesses resources and tools that allow it to conduct research about its users. The BDC database registers various types of information such as search practices, a visual heat map of click, the number of visitations to each page, materials downloaded and uploaded, and much more. One of the studies currently being conducted investigates what biology teachers are looking for when they navigate in the BDC.

2. The Structure and the Resources of the Digital Library of Sciences

Set up in April, 2006, the BDC (www.bdc.ib.unicamp.br) is a virtual environment of teaching and apprenticeship that provides free access to digital science content (Figure 1).

Figure 1: Home page of the BDC, obtained on January 12 of 2009.
The BDC is comprised of a main database and some thematic child databases, such as the Interactive Guide for Urban Bird Identification, the Virtual Microscope, the Odyssey, and the Brazilian Journal of Biochemistry and Molecular Biology Education. Anyone can register to use the library, download or submit their own materials.

On March 24, 2009, the BDC had more than 19,000 registered users. The average number of daily visits was approximately 2,955. Among the visitors who accessed the BDC from November 27, 2008 to January 13, 2009, the majority was from Brazil (90.8%), followed by Portugal (7%). The BDC is accessed from all over the world.

Among the tools the BDC offers users are:
1. Grading system: This is an interaction tool, that allows the user who is logged on to evaluate material through the assignment of a grade and/or a comment, thus giving authors feedback about their published content;
2. Submission system: Every logged user is considered a potential author, and is thus allowed to submit materials of his authorship online, which will be revised by the co-editors in charge and by the editorial board. If accepted, the material will be published;
3. Peer-to-Peer Content Revision: The materials sent by users are subject to a system of peer-to-peer revision, which is online and conducted through an Extranet;
4. Multiple Languages Support: The BDC supports multiple languages. Currently it is available in Portuguese and English, and other languages may be added once more people become interested in carrying out the translations. The BDC’s multi-languages system also has the capability of detecting the country from where the user is connected and delivering content in the appropriate language. It currently offers Portuguese to Portuguese speaking countries and English to the rest of the world;
5. Material Indication System: Any registered user can indicate material of interest to a friend, using this notification system which sends a brief description of the suggested material and its URL by e-mail;
6. User and Author Profiles: Information related to all the material sent by each author can be visualized, allowing the user to send private messages to the author;
7. Search System: This system allows a quick search for “material” or for “keywords”. The searches by keywords are stored in a database for statistical purposes.

Several pieces of information are stored in the BDC database for statistical purposes such as the materials most frequently downloaded, number of visitors, and number of user clicks on each page.

There are also several administrative resources in the BDC, which allow the management of the pages, materials, questionnaires and users, and the generation of filtered statistical data about users and the articles they access, for example.
3. High School Biology Teachers registered at BDC

On February 4, 2008, we implemented an online questionnaire. The main objective of this instrument was to discover the profile of teachers and other library users and to find out what kind of science information or resources teachers are seeking on the internet.

Among BDC registered users, only 26.3% are teachers at all levels (from basic to university education). Within this category, 36.4% are high school biology teachers who work mainly in public schools (66.2%). These results surprised us because of the School Census carried out by the Ministry of Education in 2006 which revealed that 62% of Brazilian private schools have a “computing laboratory”, compared to only 7% of public ones. The exception is Sao Paulo, the most developed and the richest state in the country, where about 80% of private and public schools have such a laboratory (BRASIL/MEC). It would have been expected that the difference between the number of teachers from private and public schools that use the BDC were not so relevant and that teachers from private school would have represented the majority. We will investigate the reasons for these results, but this data may be related to the fact that a large number of private schools, especially in the south and the southeast, have the support of educational portals. These portals are web-based learning environments, maintained by private corporations which provide different kinds of services, like contents for lesson plans and teacher self-learning, and digital resources for teachers and students of member schools (Furtado, 2004). In the case of Brazilian public schools, the access to these kinds of portals is not so widespread. Our hypothesis is that without this kind of support, teachers from public schools have to seek out materials by themselves. This could explain why more teachers from public schools look for materials in the BDC than teachers from private schools.

The results that will be presented below refer to the period from February 4, 2008 to March 24, 2009. We analyzed data from 773 high school biology teachers. According to the last school census carried out by the Ministry of Education in 2005, Brazil had 508,423 high school teachers. In the same year, another census of professional and basic education showed that there were 32,446 high school biology teachers. The number of high school biology teachers that have been using the BDC represents approximately 2.3% of the total, but this sample is representative of the purpose of this study and includes teachers from all over the country and from both public and private schools. Besides this, there is no census or study that provides information about the number of Brazilian high school biology teachers that use information and communication technologies for professional purposes. We should also consider that the BDC is a local digital library, ran by an IT research group. It is neither an official nor a government initiative.
Amongst 773 biology teachers, 16% registered on the BDC but have not downloaded any material yet, 46% of the teachers that have downloaded at least one material, downloaded more than three materials (Figure 2).

![Figure 2: Number of downloads made by high school biology teachers registered at the BDC.](image1)

![Figure 3: Number of times that the same material were downloaded by high school biology teachers registered at the BDC.](image2)

The biology teacher usually downloads each material only one time, but cases where a teacher downloads a given material more than once are not rare. This result indicates that the materials downloaded more than once by a teacher might be useful to him (Figure 3).

The most highly ranked downloads are presented in Table 1. We can see that teachers prefer to download animation and software. The most highly ranked static image is in 34th position and the most highly ranked print download is in 40th position. Nine of the most highly ranked materials were developed to be handled by students or presented using a multimedia projector. The material “Fermentation” listed in Table 1 refers to a lab class procedure.

Table 1. BDC most highly ranked material by download

<table>
<thead>
<tr>
<th>Title</th>
<th>Type</th>
<th>Downloads</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embriology</td>
<td>Software</td>
<td>387</td>
</tr>
<tr>
<td>Parasites (High School)</td>
<td>Software</td>
<td>238</td>
</tr>
<tr>
<td>Osmosis in Plant Cells</td>
<td>Animation</td>
<td>149</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>Slide Presentation</td>
<td>116</td>
</tr>
</tbody>
</table>
These results suggest that biology teachers are more often seeking our classroom materials than materials for their own education.

Amongst those who accessed materials, female teachers predominate (62.2%). This is no surprise because traditionally there are many more female teachers than male teachers in Brazilian schools.

In relation to the time that teachers have been using the internet, most of the users of the BDC (68%) can be considered veterans, having accessed it for more than 5 years (Figure 4).

Figure 4: Classification of biology teachers according to the time they have been internet users.

When asked about how they found the BDC website, 77.8% answered that they used a search engine, which is consistent with the fact that most of the users have been internet users for over 3 years (82%). Another result which is consistent with the fact that most of those who accessed the BDC are experienced internet users is that less than 1% has used the technical support.

In terms of the location of users, the majority (46%) live in the Southeast. Sao Paulo is the state with the biggest number of teacher users (22%), followed by Paraná (11.8%), Rio de Janeiro (11.5%) and Minas Gerais (11.2%). This information is also consistent with the fact that population density is greater in these states and they have more access to the internet (Figure 5).
When asked about their reasons for registering at the BDC, most teachers choose one or more alternatives. The majority (28%) were searching for support materials for their lesson plans; 26% were looking for materials to be shown to students. A smaller percentage of teachers (14%) answered they were interested in learning about issues that they did not know about; 20% had the objective of improving or updating their knowledge on topics that they already knew about (Figure 6). This data reveals that teachers are searching more for educational resources to plan lessons than for informative materials for their own self-education. This result is consistent with the data about the kind of material which is downloaded (Table 1).

Questions open for future investigation: what kind of resources are most required, that is, are users looking for software, sound files, pictures or laboratory guides, for example? Do they modify or adapt downloaded software? How and where are teachers conducting their self-education? Further investigations will be conducted by BDC researchers to answer all of these questions.

The responses about uploading materials to BDC were the lowest: only 5% had intended to upload material produced by themselves, and another 7%, material from other authors. Why, in a collaborative environment, are so many teachers just interested in downloading, but not uploading materials? Are they able to
prepare their own teaching materials or not? Why don’t they express an intention to share information, or to recommend other sites?

The low use of interaction tools - only 6% of the teachers have evaluated some material, and only 2% have written a comment in the material forums – reinforces this difficulty in interactive behavior.

A basic principle behind working in a network is to interact and share information. Students on the internet share music, games and video files, for example, but why don’t teachers seem to share information with others? Do they feel insecure or uncomfortable? How can teachers be encouraged to share their materials, opinions and knowledge?

4. Final comments

The Brazilian Government, at different levels, has made an ongoing investment in the implementation of the internet and computers in public schools all over the country, and more recently in digital content production. Universities have been called on to participate in digital inclusion projects as well. There is no further doubt that the use of technology in schools is essential to promoting the digital inclusion of students, in particular, of those living in difficult social conditions. In a globalized world, where production systems are interlinked and totally dependent on technologies, digital exclusion means social exclusion. In the same way, there is no further doubt that without teacher training and digital inclusion, there is a high risk that school projects will fail.

In developed countries, the discussion about technologies in schools is further ahead. The discussion in this case is focused, for example, on what is the best way to develop the skills and competences of students using technology. Biology teachers can count on labs and equipment to conduct "hands on" experiments in biotechnology, for example. This is a very different situation from that of developing countries, where a portion of practicing teachers has not yet graduated.

Not much research has been conducted on digital resource needs in international literature. This may be due to the differences in status already outlined. But this is an important issue, especially when we consider biology teachers in Brazil. Most of the resources available on the web is in English.

The fact that the majority of high school biology teachers registered at BDC found the contents that they were interested in after a Google search, and that this is how they discovered that the BDC existed, reinforces the paramount importance of the production of more resources in Portuguese.
References


