# The use of internet tools for teaching and learning by in-service biology teachers: A survey in Brazil

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## HIGHLIGHTS

- A survey on the use of the internet by Brazilian biology teachers.
- Brazilian biology teachers spontaneously use the internet to improve teaching.
- Brazilian biology teachers use the internet essentially in a distributive way.

## ARTICLE INFO

## ABSTRACT

The study investigated the profile of use of internet tools by in-service biology teachers in the State of Rio de Janeiro. We identified four purposes of use: Study, Didactic, Professional Management and Personal Socialization. The pedagogical use internet tools proved to be small. It was mostly focused to the search for information about biological contents for individual use and to the download of materials to distribute to the students. We discussed the importance of articulating policies and programs of teacher education through the development of activities to raise awareness about the pedagogical potential of collaborative internet tools among Brazilian teachers.

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## 1. Introduction

The understanding of society as a network is the result of the widespread use of computers and the new technological paradigm characterized by the high speed at which information is generated, processed and shared (Castells & Cardoso, 2005).

The internet tools allow the access, processing and production of information available in text format, image, sound, data, multimedia and hypermedia documents, constituting an essential language of communication in contemporary society (Lévy, 2001).

International institutions like the British Educational Communications and Technology Agency (BECTA, 2003), the United Nations Educational, Scientific and Cultural Organization (UNESCO, 2005, 2008) and the World Bank (World Bank, 2005) have advised and promoted the use of Information and Communication Technology (ICT) for teaching and learning. Asian and European countries have implemented public policies aimed at increasing and improving the use of ICT in their educational systems (Law, Lee, & Chan, 2010; Usun, 2009). Such policies involve providing high speed access to the internet, acquisition of hardware and other digital resources, as well as providing technical and pedagogical support to schools, including opportunities of the so called teachers' "professional development" (Plomp, Anderson, Law, & Quale, 2003, 2009).

In Brazil, official documents have reflected the importance of using ICT in education. Resolution CNE/CP No. 1/2002 of the National Council of Education suggests that qualifying for the teaching activity should include the use of information and communication technologies (Conselho Nacional de Educação, 2002). Recently, the

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National Conference on Education emphasized the importance of ICT in the educational context, as well as the effect of a policy of Teacher Education Program for the use of technology by in-services teachers (Conferência Nacional de Educação, 2010).

Brazilian science and technology policies for digital inclusion are being implemented by means of providing low cost access to high speed internet and the distribution of personal computers to both teachers and students (Brasil, 2012). Although such initiatives are not yet homogenous throughout the country, recent actions include substantial funding for providing internet access and computers to all Brazilian schools in a relatively short term (FNDE, 2010). Partnerships between higher education institutions and schools aimed at improving basic education have also been developed at smaller scales (Fidalgo-Neto et al., 2009).

### 1.1. Potential use of ICT in teaching and learning processes

The use of the internet and ICT in education has been the subject of research, both in relation to students' learning as well as to teachers' pedagogical practices. New technologies can be used to support and foster learning to create situations based on real-world problems brought to the classroom as well as to create opportunities for feedback and reflection, construction of learning communities and expansion of learning opportunities for teachers (Bransford, Brown, & Cocking, 2000). Literature review showed that the use of ICT in teaching has also a strong motivational effect on students (Balanskat, Blamire, & Kefala, 2006; Lee et al., 2011). According to Osborne and Hennessy (2003), the use of ICT in science classes benefit students in developing their critical thinking skills, handling and collection of data as well as by increasing their access to knowledge presented in a visual format, raising motivation and engagement.

The successful integration of ICT in schools' classrooms has been suggested to depend on the ability of teachers to structure learning environments which incorporate the ICT in their teaching of specific contents rather than as an additional isolated content to be taught (Mishra & Koehler, 2006; UNESCO, 2008; World Bank, 2005). Several studies have reported the impact of ICT use in teaching while other have focused on understanding how teachers are coping with these tools in their practice (Law, Pelgrum, & Plomp, 2008; Law et al., 2010; Martinovic & Zhang, 2012; Plomp, Pelgrum, & Law, 2007). The results of many of those studies show that despite the increase in ICT usage in education, the teachers seldom use the ICT in ways that positively impact their education contexts (Dawson, 2008; Hinostroza, Labbé, Brun, & Matamala, 2011; Plomp et al., 2007). Indeed, reports from several countries suggest that ICT use by teachers, if present, is frequently limited to the preparation of texts for classes and for personal communication by email, and not for teaching science, where research suggests more benefits for learning (Dawson, 2008; Gray, Thomas, & Lewis, 2010). In fact, the use of ICT in schools is influenced by many mutually intertwined factors such as teachers' knowledge and abilities in ICT usage, national curricula and infrastructure, among many others (Plomp et al., 2007).

### 1.2. Possibilities of internet use in the teaching learning processes

The evolution of the internet from a model known as the Web 1.0 (distributive) to the Web 2.0 (collaborative) has allowed to expand the use of its pedagogical possibilities. Web 1.0 is characterized by a division of roles between producers and final information users (consumers) by the centralized production of content, static websites and mainly by a one-way distribution of knowledge by downloading (Oreilly, 2007). Oreilly also states that, the concept of Web 2.0 was created to define a new kind of experience of internet use, which redefines the role of the Web as a platform, in which the use of tools with a greater interactivity potential creates

a network effect by participation and collaboration among users. In that way, its main features offer the possibility of authorship, information sharing and collective building of knowledge: users can continually remix data from multiple sources, whilst providing their own data and services, allowing these to be remixed and edited by others and so forth.

The popularization of the internet and advances in technology have enabled the emergence of new digital tools and actions related, which in turn, have the potential to be used for educational purposes (Martin et al., 2011). These tools available on the internet have received different names in the current available literature, Web 2.0 technologies (Franklin & Harmelen, 2007), social web (Boulos & Wheeler, 2007), internet tools (Chen, 2008), social media (Dabner, 2012) Web 2.0 tools (Laru, Näykki, & Järvelä, 2012), digital technologies (Brito, 2012) among others. Armstrong and Franklin (2008) describe the following as examples of important and common Web 2.0 technologies: blogs, wikis, social bookmarking, media sharing spaces, RSS feeds, collaborative editing tools, microblogging and social networking sites. However, traditional tools of the internet such as emails, chats and search websites remain widely used up to date (Pew Internet & American Life Project, 2008), providing a mix of possible actions on the web. Thus, users have at their disposal a number of tools to perform specific actions such as doing research using search websites (e.g. Google, Ask, Bing); communicate via synchronous and asynchronous tools (e.g. Gmail, MSN, Skype), file sharing (e.g. YouTube, Flickr), write and publish online diaries (Wordpress, Blogger, Twitter) and social networking (Facebook, MySpace, Second Life).

In Brazil, the pedagogical use of internet has grown exponentially over the last decade (INEP-MEC, 2010). That increase is largely consequent of the use of internet tools for distance education (DE) both in undergraduate and graduate courses. From 2007 to 2011, the Ministry of Education (MEC) has invested an amount of funds of R\$ 1.5 billion (about U\$ 750 millions) in the distance education system in Brazil (Clímaco, 2011). The percentage of students enrolled in DE undergraduate programs has increased from 0.2% in 2001 to 14.1% of total Brazilian undergraduate students in 2009 (about 800,000 students) (MEC, 2010). In addition, improving teachers' teaching abilities is considered a key factor for overcoming Brazil's serious educational problems (OECD, 2010). It is reasonable to consider that such a widespread stimulus for the use of internet tools for teacher training should preceded by studies on teachers' preparedness and interest for the use these tools in science classes. However, very little is known about the pedagogical use of internet by Brazilian teachers and reports on its pedagogical use for teaching in Brazil are scarce, along with studies that focus on computer use and search on the internet. Martinho and Pombo (2009) carried out a study in science teaching with students of the 7th grade of basic education, identifying an increase of 10% in test scores among students who were taught using projection pictures in power point, viewing educational videos and internet search. The findings also indicated that 92% of the students were positively influenced when they made use of such strategies for learning. The students reported that these strategies improved their concentration and increased their enthusiasm to learn.

On the other hand, in relation to teachers' training, an isolated report has pointed out that Chemistry teachers who attended a continuing education course presented serious limitations with the use of ICT, and that, even having access to computers at home and also to computer labs in their schools they still do not make use of ICT in their classrooms (Aires & Lambach, 2010).

The paucity of information on internet use by Brazilian teachers makes it necessary to further characterize such use in order to offer support to the several teacher training initiatives already in course in that country. The present study aimed to identify the profile of

internet tools use by biology and science teachers, characterizing the purpose of use of these tools in order to improve future in-service Teacher Education Programs (TEP). The general relevance of the results for science education is also discussed.

## 2. Methodology

### 2.1. Teacher Education Program (TEP)

Brazil is world's 5th country in terms of territorial size, with land borders with other 10 other South American countries. Due to its nearly continental extension, most of the Teachers Education Programs (TEP) is developed regionally, although many of them receive federal funding. In the last decade the Rio de Janeiro State has been developing one of the country's broader initiatives in Distance Education (DE), the Foundation Center of Science and Higher Distance Education of the State of Rio de Janeiro, Brazil (CECIERJ − http://www.cederj.edu.br). The CECIERJ foundation offer both DE undergraduate and TEP courses. The general model adopted for the TEP initiatives in the fields of Science and biology has been to offer courses on relevant scientific contents. Such TEP initiatives are due to incorporate activities that blend learning of specific contents with the use of internet tools in order to familiarize teachers with educational options available for the pedagogical incorporation of such tools in science teaching and teacher education.

The CECIERJ TEP courses are held in partnership with the central production and management office, with the support of the information and communication technologies (ICT). The courses are free of charge and are offered via the internet through the Moodle platform. Each course has an estimated workload of 30 h, distributed for a period of three months. Teachers are allowed to enroll in two courses per period. Registration is made on the internet by filling out a form with personal information.

### 2.2. Sample

A total of 1096 teachers took part in the nine courses offered, and 33% of them attended more than one course. The questionnaires (see below) were filled by 895 of the teachers, resulting in an initial response rate of 81.7%.

The courses offered addressed exclusively biology topics such as the Human Body and Microbiology among others. Teachers of other areas such as Geography, Chemistry and Physics, had also their applications accepted and could attend to the courses. The population of enlisted teachers was thus very heterogenous.

In order to obtain a more homogenous sample, we used the following inclusion criteria: i) teachers that were currently teaching biology and/or science in basic education in the State of Rio de Janeiro; ii) teachers that answered all applicable open questions and iii) For participants enrolled in two courses, we have picked only one of the questionnaires at random for analysis. The application of these criteria generated the sample of 454 teachers that was analyzed in the present work (this sample comprised 75.2% of the 612 biology or science teachers present in the initial population of responders).

### 2.3. Instrument of data collection

Earlier studies characterized the use of ITC by teachers based on surveys that investigated the use of the internet combined with other ITC. A survey carried out by Plomp et al. (2007) for instance, combined software and internet, while Martinovic and Zhang (2012) dealt with internet and hardware while Dawson (2008) investigated hardware, software and internet use by teachers. Moreover, the structure of some surveys included specific

sentences describing the use of each component for the teachers to choose from (Dawson, 2008). On the other hand, Chen's report focused on the use of internet by teachers for teaching thus not allowing the characterization the use they made of the internet for other purposes (Chen, 2008). In the present study we opted to elaborate a survey that allowed Brazilian teachers to freely describe their general use of the internet to put the didactic use in perspective regarding other purposes of use by teachers.

We used an online questionnaire consisting of 18 questions (Appendix A) made available to the participants throughout the first week of classes. The questionnaires heading briefly described the research goals and explicitly explained that answering to the questionnaire was not mandatory and that choosing not to answer would by no means influence teachers' participation from the courses.

This questionnaire was designed to characterize the frequency of internet use, the tools used and the purposes of such use. For the setting of the questionnaire we opted for 17 tools (Box 1). There is a wide variety of tools available on the web and it would not be feasible neither to identify nor to build a survey including all of them. Moreover, some tools, such as the email can be used from different sources or websites (e.g. webmail providers). Others share this feature but can also be seen as actions, rather than tools (upload and download). We are thus aware that the term tool should be regarded with caution, as it includes trademark websites (e.g. Facebook), actions (e.g. download) and tools (e.g. email). We decided to keep the term tools as it has been widely used in the literature to refer to several of the resources studied in the presents report (Armstrong & Franklin, 2008; Boulos & Wheeler, 2007; Brito, 2012; Chen, 2008; Dabner, 2012; Franklin & Harmelen, 2007; Laru et al., 2012). It must also be highlighted that our main goal was to identify the didactic use of the internet rather than specific resources used to achieve such use. To be included in the survey a given tool would have to fit one or more of the following criteria: i) be of common usage worldwide, ii) have been reported in the literature to be used for didactic purposes (in Brazil or elsewhere); iii) be of common use in Brazil (with or without didactic purposes) and iv) have the potential to be used for didactic purposes

**Box 1**
Main features of used tools.

| Tool | Key features |
| --- | --- |
| Search | To obtain information from websites. |
| Email | Asynchronous conversation. To send and receive information. |
| Chat | Synchronous conversation. |
| Forum | Asynchronous conversation. |
| Skype | Synchronous conversation. To send and receive information. |
| Download | To obtain information in the form of documents. |
| Upload | To make information available. |
| Photo | To obtain and/or make static images available. |
| Video | To obtain and/or make videos available. |
| Blog | To post and publicize information. Asynchronous conversation. |
| Twitter | To post and publicize information. Asynchronous conversation. |
| Wiki | Collective drafting of texts. |
| Orkut | Interpersonal relationships. To obtain, post and publicize information. |
| Facebook | Interpersonal relationships. To obtain, post and publicize information. |
| Myspace | Interpersonal relationships. To obtain, post and publicize information. |
| Ning | Interpersonal relationships. To obtain, post and publicize information. |
| Second Life | Interpersonal relationships through a three-dimensional 2simulation virtual world. |

(regardless of any research report on such use). The combination of those criteria allowed us to include both Web 1.0 and Web 2.0 tools in the survey as shown in Box 1. Detailed explanation for the inclusion criteria used for each tool is given bellow, with the criteria used in each case are shown in parenthesis.

Email, chat, blogs and forum are tools that fit all four criteria. Search, download, upload, photo and video sharing were included because are common actions that also fit all four criteria. Facebook and Orkut are the most used social networks in Brazil (Comscore, 2011) (iii). Myspace is widely worldwide used (i). Skype (Voip service) and Twitter (microblog) are used worldwide and also in

management interactions with institutions or colleagues, usually to deal with schedules, deadlines or institutional communications of several types were grouped in the category Professional Management. The answers that did not fit the inclusion criteria for any of the mentioned categories were grouped in the category Others. These answers included in this latter category were very heterogenous and did not allow the creation of additional useful categories. The answers were analyzed and classified in those five categories (Box 2). A single answer could contribute to two or more categories because teachers could report two or more purposes for any given tool.

**Box 2**
Categories used in the analysis of the answers to the open questions regarding.

| Category | Definition (use) | Examples |
|---|---|---|
| Study | Studying or learning subjects of the training area. | "*I seek for novelties and interactive material on the internet when preparing lessons for my students as well as clarifying some doubts of some concepts*".[a] <br> "*I download scientific articles, music and movies*". <br> "*I use the wiki to research education related subjects*". |
| Didactic | Related to their teaching practice, such as preparation of classes and teaching. | "*I seek for novelties and interactive material on the internet when preparing lessons for my students as well as clarifying some doubts of some concepts*"[a] <br> "*I keep a blog to provide information and material for students*". <br> "*I share videos related to the subject I teach with my students*". |
| Professional management | Related professional practice provided it is not referred to the purposes defined as Study and Didactic. | "*I use the email to send work reports and to keep in touch with friends and relatives*". <br> "*I use the chat to communicate with the school where I work*". |
| Personal socialization | Personal communication with friends and relatives. | "*I use the email to send work reports and to keep in touch with friends and relatives*". <br> "*I share photos with friends and family*". <br> "*I use Facebook to reconnect with friends and make new friends*". |
| Others | Purposes that could not be framed in the above categories. | "*I download scientific articles, music and movies*". <br> "*I use Twitter to get news and information about celebrities*". |

[a] Example of an answer that contributed to more than one category.

Brazil (i and iii). Ning is a social network widely used for educational purposes (Ning, 2011) (iv). Wiki and Second Life are well known tools that have also been reported to be used for didactic purposes (ii) (Salmon, 2009; Wheeler, Yeomans, & Wheeler, 2008), while Second Life has lost its appeal more recently.

The questionnaire consisted of closed questions with affirmative or negative answers on tools used. In case of affirmative answers, an open question about the purpose of its use was presented (Appendix A).

The closed answers obtained from the questionnaires were quantified by defining the frequency of internet use (question 1) and the percentage of use of each tool (questions 2–18). The open questions were formulated to obtain spontaneous responses of teachers in order to identify through analysis thereof, the purposes for which they used the internet and its tools. For categorization of the answers to open questions concerning the use of each tool, a set of 50 questionnaires were read. Five categories were defined based on the recurrence of its contents. The category Study included answers that clearly stated that teachers used a given tool to learn or acquire information on specific or general subjects, without making any reference of the use of those informations in their classrooms. The category Didactic was used to group the answer that explicitly mentioned the use of internet tools for teaching, usually by making references to classrooms, lessons and/or students. Answers that mentioned the use of tools to interact with another individual or groups, frequently mentioned family, friends and less frequently their colleagues were included in the category Personal Socialization. Finally, the answers that mentioned professional

## 3. Results

According to questionnaire responses, 94% of teachers access the internet from 3 to 7 days a week, indicating that the sample is composed of frequent internet users. The percentages of teachers that use each of the internet tools are shown in Fig. 1. Our instrument of data collection does not allow determining the frequency of use of each tool by the teachers. It does allow, however, identifying the purposes of usage of each of the tools. That, in turn, can be helpful in characterizing a general model of internet use by biology teachers.

Almost 100% of teachers use email (electronic mail) and search websites, and more than 90% make download files. These results show that they use tools to obtain information provided by third parties on the network. This pattern of the predominant use of basic tools such as search websites, text editors and email by teachers is common in literature, both in Brazil (Aires & Lambach, 2010; Costa & Medeiros, 2009) and other countries (Chen, 2008; Dawson, 2008; Gray et al., 2010). However, 79% of the teacher's access to at least one social network (mainly Orkut or Facebook), indicates that the web is also an important instrument to keep up or establish personal relationships.

Brazilian Orkut, the most used social network in Brazil (Comscore, 2011), is also used by a greater percentage by teachers (77.8%), suggesting that they also show interest in tools that provide increasing interactivity with groups of people through the internet is a fact that was previously unreported for Brazilian teachers (Fig. 1).
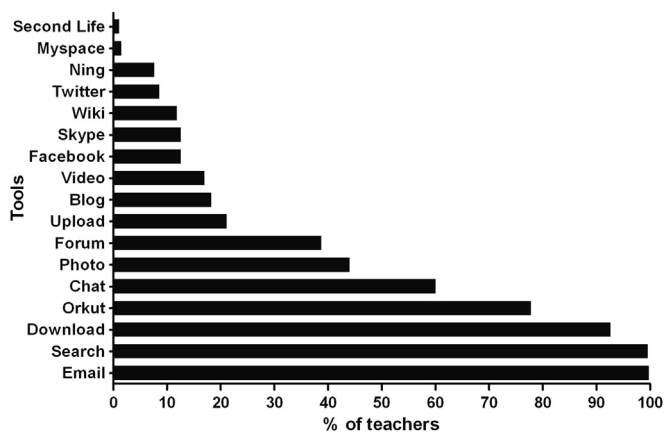
**Fig. 1.** Percentage of use of internet tools ($n = 454$).

To understand the purposes of use for each tool, we have categorized the open responses, analyzing each tool separately. Teachers often reported the use of a single tool for two or more purposes and as a result, the number of purposes sometimes exceeds the total number of teachers. The results of this categorization are shown in Table 1.

In many cases, the tools are used almost exclusively for the specific purpose for which they were initially created. For example, 95% and 93% of the use of Orkut and Facebook are directed to personal socialization, while Wiki (87%) and Ning (91%) are associated with study (Table 1). Email, search, forums, download, video and Blogs were used for a greater variety of purposes. Six of the internet tools were used mainly for studying, others six of them for personal socialization purposes, but none was used mainly for didactic or professional management purposes (Table 1).

The personal socialization use of the tools referred to keeping in touch with friends and relatives (frequently those living in distant locations) and to deal with personal or private issues (seldom related to their duties). This was especially true for both synchronous (Chat and Skype) or nonsynchronous (email and Twitter) communications tools. They also use the internet to share photos and videos of personal nature by downloading and uploading files.

Forums usage, on the other hand was mainly directed to study. Indeed, Forum, as well as Download, Search, Blog, Ning and Wiki

appear among the most frequently cited for study purposes (Table 1). Download and search were mostly associated with searching and obtaining of material for acquiring information and were used by many teachers. Ning and Wiki were used by very few teachers. Besides that, none of the teachers reported to have used Wiki for the collective drafting of texts. Based on the prefix used in the questionnaire (Wiki) and for the use of Wiki tools declared by teachers, it is possible to infer that the participants have checked this option on the questionnaire due to their regular use of Wikipedia. The declaration of a teacher supports this statement by saying that "*if wiki is Wikipedia, I do make use of it, but if it is not then I do not even guess what it could be*". Forum, on the other hand, featured 72% of its use for study purposes, usually in the context of online courses.

The social network most commonly used to study is Ning (Table 1) but, its use was seldom reported (Fig. 1). Ning Networking is an online platform that allows the creation of individualized social networks with independent management. Each user can create their own social network and join other networks of interest. Unlike generalist networks like Orkut or Facebook, where social interaction takes place through the users' personal pages, Ning focuses on sharing specific interests through the main page of each community. This is consistent with the responses of teachers who reported using Ning to learn and share information about biology or science topics.

The results concerning the Didactics usage show that 8 out of the 17 tools were never reported to be used for that goal. The tools reported to be used for didactic purposes were either among the least used by teachers (e.g. blogs and videos) or the didactic use was less common for that specific tool (e.g. download). Indeed, Search, videos, Download and Upload are among more cited to be used with didactic purposes. Teachers report their use to search educational resources when preparing lessons, as well as to get files to be incorporated into teaching materials. According to the teachers, these files are texts, handouts, tests, papers, books, lectures, animations and videos. This use has been declared by most teachers as demonstrated in the following example of a teacher who said "I do some research on some contents that can make life easier for my students and me also, and mainly for the proposed activities in the classroom." The understanding and visualization of natural phenomena could have benefitted from the use of such files, rather than otherwise, when they would be limited to still images and explanatory texts presented in textbooks.

The collection of material from the internet deserves consideration. If one considers the abundance of data and resources retrieved using a simple search engine, it becomes clear that the use of appropriate search criteria as well as the identification of reliable sources is crucial for the obtainment of reliable information. In that sense, the development of information literacy (American Library Association, 1989) should also be considered as a goal for the Teachers Education Program, similarly to what have been recommended for other professionals (Brettle, 2007).

The exchanging of ideas, teaching proposals or other didactic uses of interactive tools is likely to occur in Blogs but was underreported or unreported for other interactive tools such as Forum or chats and social networks, respectively. The same is probably true for versatile tools such as email as its didactic use corresponds to only 1% of the purposes reported. Only 4.6% of the teachers used Blogs for didactic purposes (not shown), a quite small percentage when compared to those obtained in Taiwan, where 32% of the teachers reported the use of Blogs for teaching (Lai & Chen, 2011). These conclusions are corroborated by a study conducted in Brazil, with medical psychology professionals which showed that only 12.82% of the 64 Blogs and 1.07% of the 187 Orkut Communities analyzed were aimed to develop educational activities (Maia & Struchiner, 2010).

**Table 1**
Purposes of use reported by the teachers for each tool.

| Tool | $n^a$ | Study | Didactic | Professional management | Personal socialization | Others |
|---|---|---|---|---|---|---|
| Search | 452 | **59%**[b] | 21% | 0% | 0% | 20% |
| Email | 643 | 10% | 1% | 28% | **46%** | 15% |
| Chat | 333 | 7% | 1% | 16% | **76%** | 0% |
| Forum | 192 | **66%** | 3% | 3% | 5% | 23% |
| Skype | 59 | 0% | 0% | 11% | **89%** | 0% |
| Download | 632 | **43%** | 13% | 1% | 0% | **43%** |
| Upload | 101 | 9% | 14% | 6% | 0% | **71%** |
| Photo | 212 | 0% | 2% | 7% | **91%** | 0% |
| Video | 81 | 5% | 22% | 5% | **38%** | 30% |
| Blog | 90 | **36%** | 23% | 10% | 10% | 21% |
| Twitter | 41 | 3% | 0% | 10% | 10% | **77%** |
| Wiki | 55 | **86%** | 7% | 0% | 0% | 7% |
| Orkut | 381 | 3% | 0% | 5% | **88%** | 4% |
| Facebook | 58 | 0% | 0% | 4% | **91%** | 5% |
| Myspace | 7 | 0% | 0% | 0% | 14% | **86%** |
| Ning | 35 | **91%** | 0% | 6% | 3% | 0% |
| Second Life | 5 | 0% | 0% | 0% | 20% | **80%** |

[a] Purposes ($n = 3382$) presented by teachers in their answers to open questions.
[b] Highest values are highlighted in bold.

In general, the results described here for Brazil are corroborated also by a study carried out in the United States indicating that very few teachers use blogs (9%), Wiki tools (9%) or social networks (7%) in education (Gray et al., 2010). Moreover, only 37.7% of the teachers reported the didactic use of one or more tools and the majority of these teachers used only one tool (Fig. 2). In addition, 70.8% of the teachers who reported the didactic utilization of tools used only download and/or search (not shown) thus characterizing a predominantly distributive use of the internet. The low usage of tools for teaching purposes may be related to the lack of basic knowledge about the functioning of the tool, as well as the ignorance of their potential educational use. In fact, some teachers acknowledged their limitations in the use of various internet tools. In relation to Twitter for example, while a teacher knew about it but did not use it ("I have not found the applicability for this tool in my day to day"), another teacher showed interest in knowing it ("I still do not use it, but I would like to learn"). A similar fact was observed concerning the tool Skype, that was still unknown to some teachers ("I do not know what it is!") but was deemed of little use to others ("I've tried to use, but have not found much use"). Other tools like Ning and Wiki were also unknown to some teachers who stated they did not know them. "To tell the truth I do not know what wiki means" or "I have no idea what Ning is". Moreover, issues of personal interest of tools can define their use. One teacher stated, "*I find Twitter really boring and useless. It's a fad that will soon pass*". Likewise another teacher said in relation to Second Life: "*I do not use it, is boring.*"

The Professional Management category reflects the use of tools for purposes other than studying and learning, but is still related to their professional practice. We found that teachers make little use of internet tools for this purpose. This limited use is mainly related to communication tools: email, chat and Skype as well as those that allow them to publicize their private services (Blog and Twitter).

The "Other" category presents very different characteristics. For each of the tools, there are several types of use related to it that do not fit in any of the above categories. Besides, some of the uses are related to a specific tool (e.g. downloading movies and music). The heterogeneity and low frequencies of uses have not enabled us to a more detailed analysis.

To identify the percentage of use for each purpose regardless of the tools, we have calculated the percentages for each category from the total of 3382 purposes declared by the teachers (Table 1) in open-ended responses to the questionnaire (Fig. 3).

As already indicated by data in Table 1, the personal socialization use of the internet tools in general predominates among biology teachers (Fig. 3). The tools are also frequently cited as being used for studying and for professional management activities. The relatively
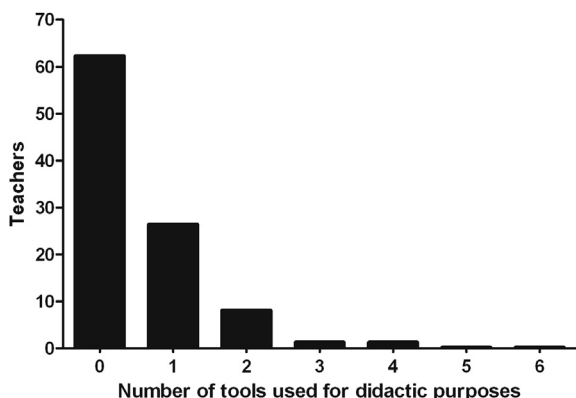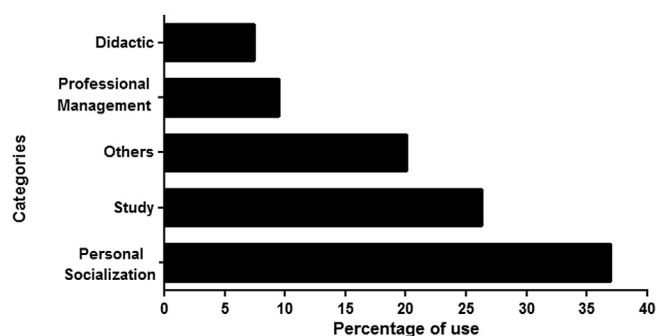


Fig. 3. Percentage of internet tools usage for each purpose. Usage was classified as described in Table 1 ($n = 3382$).

high percentage of use for other diverse purposes is a consequence of the versatility of some tools (Table 1).

Nevertheless, only 7.4% of the purposes of use reported are directed for teaching (Didactic, Fig. 3). In fact, didactic was the less frequently cited purpose of tool usage. Such low usage of the internet tools for didactic purposes also suggests that teachers make little use of them in the classroom, as there was no report on the use of internet tools in didactic activities with the participation of students. It is likely, however, that videos and images downloaded from the web are used in their classes.

The analysis of the teachers' answers to open questions provided valuable information regarding their views of the pedagogic value of the internet tools. In our analysis we will focus on the answers that were included in the category didactic, so as to shed some light on the pedagogic use of the internet tools.

Teachers' answers gave us some clues on their general motivations to use internet tool for didactic purposes adding new material to their classes. It was quite evident that teachers wanted to improve their teaching, since the verb "to enrich" commonly appeared in association with several types of resources and with lessons, such as in: "I search for specific contents that I will teach in order to enrich my classes", "I search for information on the subjects that I am currently teaching" and "I search for any subject that may enrich my classes". In which such enrichment was expected to occur. As shown below, other teachers gave more specific answers that clarified the many uses they made of the internet.

Teachers answers often revealed that their intention when searching the internet was to become up to date with relevant biological information in order to improve their teaching: "I search for updated information to use in my classes"), "I search for up to date information regarding subjects that I will teach in my lessons" and "I search for updated biological knowledge to complement my classes". There were also reports of teachers who searched in primary sources of biological knowledge (scientific journals) to improve teaching: "I also use tools to search the internet as ways to be up to date in my lessons by reading scientific journals". Some teachers expressed concerns on reassuring the quality of the sources of information to be used ("I search reliable sources of scientific information to share with my students".

In many cases, teachers do perceive the internet as a valuable source of didactic materials to be incorporated in their lessons. That perception was especially evident when they reported searching and downloading: "I obtain multimedia material and texts that enrich my classes" and " I search pictures to build presentations and videos on YouTube that can be used in my biology classes" and "I find and download multimedia material to include in my lesson plans". Sometimes, teachers were more specific on the description of the expected outcomes of their use of internet tools for teaching. Indeed, teachers expected that the use of audiovisual material



Fig. 2. Number of internet tools used for didactic purposes by teachers ($n = 454$).

obtained from the internet would either make their classes more interesting ("I search for animations that wake students' interest for the taught subject" to facilitate learning ("I search material that could make it easier for my students to learn") or both ("I download and use multimedia to facilitate learning and increase my students' interest for the lessons").

Other answers mentioned the possibility of enriching the classes by obtaining information specifically on teaching rather than on the contents to be taught: "I try to search ways to improve the quality of learning-teaching processes in public schools, both for teachers and students", "I obtain materials about science teaching to enrich my classes", "I search teaching activities that can be performed in my classrooms with my students" and " I search for different lesson plans", "I download short videos showing teaching experiences" and "I search for scripts/guides of practical lessons to be used in my classrooms". However, the exchange of their own successful didactic experiences was seldom mentioned by the teachers, although inspirational examples could be found when a teacher mentioned using Orkut to "interact with a community of biologists (…) that allows me to exchange of experiences with other teachers" while others used chats to "post the works of my students from two different schools in order to allow them to share and discuss their ideas".

Taken together, these data suggest that teachers perceive the internet as a valuable source of materials that can fill their need to stay updated on specific biological contents. They also seek the internet in order to improve their teaching and to help their students to learn. The fact that teachers are looking for ways to improve the teaching learning processes by using the internet is auspicious. These data reveal that Brazilian biology teachers perceive the web as a friendly and helpful environment. That, in turn, highlights the fertile ground available for educational initiatives to help teachers to fully develop their skills on the didactic use of the internet tools. Teachers' pedagogical knowledge is recognized as crucial for the improvement of the learning-teaching process thorough research (Treagust, Harrison, & Venville, 1998). It would be very important if the internet tools could contribute for the teachers to recognize the value of their own practical knowledge and as an environment for sharing such knowledge with their peers. It is well known that teachers are subjected to time constraints due to their overloaded working schedules. However, the internet allow the asynchronous exchange of information in several formats (text, images, videos and so forth). That could facilitate the interaction between teachers. It is tempting to suggest that strategies that could highlight to teachers the importance of their pedagogical knowledge increasing their self-esteem and that could also foster the exchanging of pedagogical knowledge and experiences among them could prove valuable for increasing the didactic use of the internet.

## 4. Discussion

Taken together, data allow us to speculate that the didactic use of internet occurs in a rather distributive way, in which teachers browse the web searching for videos and other materials to download, with little exchange of ideas and practices with their peers or other professionals (e.g. scientists). These data corroborate results found in literature, highlighting the limited use of the pedagogical potential of ICT and especially the internet in Brazil (Aires & Lambach, 2010, Costa & Medeiros, 2009; Maia & Struchiner, 2010), as well as in other countries (Andersson, 2006; Chen, 2008; Dawson, 2008; Dawson, Forster, & Reid, 2006; Gibson & Oberg, 2004; Gray et al., 2010; Hinostroza, Labbé, & Claro, 2005; Hinostroza et al., 2011; Inan, Lowther, Ross, & Strahl, 2010; Lee & Tsai, 2008; Martinovic & Zhang, 2012). That is not to say that

such exchange does not occur, but that it seems to be limited whilst the internet potential to provide means for these kinds of interactions remains unnoticed by teachers.

Previous studies included the internet as one of the many ICT available for teaching with little distinction between the several different tools available in the web. Although the instruments for data collection used in those studies are heterogenous, it is interesting to compare our results with those previously reported for other countries. Gray et al. (2010) investigation on the use of ICTs by U.S teachers showed that more than 90% of them have computers and internet access available in their classrooms and used ICTs for text preparation as well as more general purposes such as the practice of basic skills. In addition, although more than 90% of the teachers reported the use of internet for teaching, a much smaller percentage of them used collaborative tools for doing so. Data concerning the use internet for social purposes were not collected. More than 90% of teachers used remote access to the internet to manage students' grades, attendances and assessment. Together, those data suggest that U.S. teachers' internet use for non-didactic activities prevails over the didactic usage. Chilean teachers' access to computers and to the internet is considerably high, especially when compared to their Latin American counterparts (Hinostroza et al., 2005). Those teachers use the web to search for information to incorporate in their classes and use email and chat mostly to communicate with friends and relatives but use the ICT with their students for about 3 h per week only. A more recent study indicated that such use of the ICT in general and of the internet has remained roughly unchanged (Hinostroza et al., 2011). Although in some educational contexts teachers used the Web for teaching more frequently than their Brazilian counterparts, and such use is usually based mainly on distributive tools.

Western Australian science teachers stated that they felt more prepared to search internet and to use the email for personal communication than to join discussion groups online or to design web pages (Dawson, 2008). Not surprisingly, those teachers' use of the internet for teaching was based on searching information rather than on joining or creating online discussions groups with their students (Dawson, 2008). Moreover, teachers' answers to interviews also suggest that even in allegedly ideal conditions (where all students and teachers would have free access to individual computers), teaching by means of the internet could still be based on searching information on specific science contents (Dawson, 2008). It has been suggested that pre-service teachers with little experience on ICT usage respond better to its incorporation into teaching, possibly by enhancing attitudes and confidence to ICT use (Dawson et al., 2006) and that learning about teaching with ICT works better when adjusted to individual skills and rhythm (Dawson, 2008). In general, western Australian science teachers seem to use the internet for teaching but do so mainly by means of distributive tools, as reported here for Brazilian teachers. A survey on the use of the internet for teaching by recently graduated Swedish teachers also indicated that despite searching the web for information, the internet was seldom used for teaching (Andersson, 2006). It has been shown that 80% of a sample of 311 English teachers from Taiwan used the web for teaching and that searching engines and email were among the most used tools (Chen, 2008).

Despite their positive attitude toward the internet, its potential as an innovative tool for learning and teaching seems to be unknown to Canadian teachers who seldom report using collaborative web based tools (Gibson & Oberg, 2004). The recognition of the internet as an useful and beneficial tool was also reported for Canadian pre-service teachers, who nevertheless considered it useful mostly as a source of information (Martinovic & Zhang, 2012).

A previous study has shown that the incorporation of actions such as word processing and searching the internet into classrooms

were associated with student-centered activities (Inan et al., 2010). According to the authors, further studies are still needed to investigate whether such computer applications lead to the use of student-centered strategies or vice versa. If the former hypothesis holds true, it is possible that even the simple extension of Brazilian teachers' current use of the internet to their classrooms as well of the adoption of similar practices by their peers could improve teaching by increasing investigative and collaborative practices among their students. Chen (2008) suggested that prior training on ITC was a key factor for teachers to integrate the internet to their classrooms. Lee and Tsai (2008) believe that there seems to be a lack of knowledge on the broad potential of didactic tools available in the internet among teachers. That may help to explain why they seldom use collaborative tools for teaching their subjects. It is possible thus to hypothesize that teachers would better integrate the use of collaborative tools in their teaching if they could also learn by using such technologies both in pre-service and in-service teachers' education programs.

The reported use of internet tools by biology teachers raises interesting questions and open perspectives for future initiatives of in-service TEPs. It is our opinion that the didactic use of internet tools can be viewed from at least two different points of view. First, there is the internet potential in helping the teachers to improve their teaching strategies through the sharing of information (teaching proposals, didactic materials) and/or interactions (clarifying doubts, giving and receiving suggestions on the teaching of critical biological subjects) with their peers. Those approaches could ultimately permit the collective elaboration of didactic material by groups of teachers working in different and distant institutions, something that is hard to implement outside the web.

Social ties seem to be closely related with the intention of people to share knowledge on the internet (Chen, Chen, & Kinshuk, 2009; Yang, Chen, Kinshuk, & Chen, 2007). This have sometimes been regarded as a possibly limiting factor when using these tools for teaching and learning, taking into account the need to establish relations of mutual trust between teachers and students. We suggest that the scenario must be understood in the opposite way.

Teachers are aware of the existing communication, search and download tools, have already established social networks in the web, but do not use them for didactic purposes. In this situation, some of the basic grounds for one way to foster didactic use of the internet (that is, interaction among peers) are already settled. It would thus be important to develop activities to bring the teachers in contact with tools of similar nature as those they already know, but more directly connected to teaching and learning processes. The use of collaborative online learning environment can help teachers to reflect on and articulate their concerns in a practical way, moving forward in their learning through online discussions (Farren, 2006). Opportunities of this kind can offer teachers the opportunity to reflect critically on their learning through peer validation meetings (Farren, 2008).

In that sense, bringing teachers in contact with virtual learning communities (VLC) and tools for creating VLC (Moodle, Elgg and Group.ps, for example) would be desirable, because it would allow them to build their own networks aimed for didactic purposes. The use of these resources can lead teachers to perceive learning as a collaborative process, which involves not only the teacher's dialogue with his or her students, but in a broader dimension of dialogue among students themselves (Farren, 2005). Indeed, it has been shown that the use of learning environments based on the internet can promote the ability of scientific argumentation, interpretation and data processing among students (Lee et al, 2011). The online platforms where Blogs and social networks are built constitute virtual environments filled with great potential teaching tools in which the ability of scientific argumentation could

be exploited by teachers along with their students. According to Martin et al (2011) the social web and mobile devices are the most important technologies for the near future to be used in education.

Second, it would be important to raise teachers' awareness for the potential use of the internet tools in didactic activities with their pupils. As shown by our results, although some tools are ignored by teachers, in most cases they lack the ability to utilize them in teaching. The creative use of internet tools for teaching certainly has to cope with technical and material barriers (Plomp et al., 2007). In the case of Brazilian schools, as despite the massive investment, there is still a very limited infrastructure for the use of informatics resources in Brazilian schools (Fidalgo-Neto et al., 2009). Brazilian documents (Conferência Nacional de Educação, 2010) as well as some international official documents (UNESCO, 2005, 2008; World Bank, 2005) seem to agree with the need to update the teachers in face of the growing challenges of incorporating the internet and ICT in their practice (Balanskat et al., 2006). However, an early study on the results of a broad Brazilian national test (the SAEB) detected a slight but significant decrease in low-performing students from public schools that use computers in assignments, whilst the use of computers as a pedagogical tool had no effect on students' performance (Wainer et al., 2008). Due to limitations of the instrument used for data collection, that study dealt with the use of computers in school assignments without further information (that may range from text processors to complex educational software). The situation regarding the potential of computers as pedagogic tool was also quite different ten years ago when their data were collected. The authors themselves cautioned readers that their methods did not detect causal connections and that confounding variables were likely to exist. Those results highlight the importance of articulating the public investments in making the ICT and the internet available for teachers and students (Fidalgo-Neto et al., 2009) and the efforts to improve its pedagogical use by Brazilians teachers. Finally, Jones, Blackey, Fitzgibbon, and Chew (2010) found that the use of social networks for educational purposes can create conflict between students and teachers, as the former use of cyberspace to share their personal and social life with friends and relatives and can be resistant to its use for purposes related to school activities. The separation or combination of learning and social life in these spaces is therefore, an additional challenge for didactic activities involving teachers and students together in the internet.

## 5. Conclusions

In the present study it was found that biology teachers make limited use of the internet and information and communication technologies (ICT) for educational purposes. They report predominantly the use of tools such as Email, Search and Download to obtain information distributed on the network and of social networks solely for social interactions.

The use of internet tools for didactics purposes is reportedly rare. The use of social networks for this purpose was not mentioned by participants, although they do use such tools for social interactions. Teachers are thus likely to be unaware of the potential use of social networks for teaching.

Mastering the use of internet tools is not sufficient to raise teacher's awareness of their potential as pedagogic instruments and it is unlikely that it would suffice to foster their effective use (Martinovic & Zhang, 2012). Teacher Education Programs must embed the pedagogical use of internet tools within their discussion on teaching and on the teaching of scientific contents (Goodwin, 2010). Enough time should be available for teachers to practice what they learn in order to be prepared for the challenges of their

future classroom activities (Zhang & Martinovic, 2008). It is possible that such approach would offer positive experiences of learning with internet tools to the teachers stimulating their future pedagogic use.

Although having access to ITC is an obvious prerequisite for their pedagogical use (Martinovic & Zhang, 2012) we are aware that simply providing teachers with the access to technological resources is insufficient to change teaching practice. On the other hand, the fact that teachers do use internet tools for purposes others than teaching suggest that their self-efficacy regarding the use of internet may be high and that has been reported to positively influence teachers' web based learning (Kao, Wu, &Tsai, 2011). The incorporation of ITC in teacher's initial formation is essential, since teachers are key persons for the adoption of innovative educational practices (Pettenai, Giuli, & Khaled, 2001). The availability of computers and ICT in Brazilian schools has been shown to be of little practical educational effect (Villani, Pacca, & Freitas, 2009). It would be important for national and regional TEP to be articulated in a model that includes the effective use of ITC in order to avoid the investment of the funds available in initiatives that would render little if any positive educational impact in schools.

One way to improve the didactic use of the internet would be the development of initiatives of teachers' education based on the Technological Pedagogical Content Knowledge (TPACK) approach. The TPACK approach integrates the technological component to knowledge of didactic nature (Angeli & Valanides, 2009; Koehler, Mishra, & Yahya, 2007; Mishra & Koehler, 2006). This type of model goes beyond teachers training in those three isolated knowledge basis because the new skills needed by teachers are at the intersections between them (Mishra & Koehler, 2006). It seems to us that it would be crucial that few Brazilian teachers that are already fruitfully using the internet tools for didactic purposes should be brought in contact with those who do not yet have such skills or are unaware of the fact that such use is possible. Public policies in Brazil should consider the need to bridge this gap, creating opportunities to exchange knowledge of the teacher work experience with their peers and experts on how to integrate the use of internet tools to their ways of learning and teaching biology. The same asseveration could be true for other countries and educational contexts.

There is a need for the articulation between policies at different levels in order to promote effective teachers training. The massive investment on ITC and web based education in Brazil have not been matched by investigation on teachers abilities or interest in their usage for teaching and learning. The present study sheds some light on teachers' use of the internet tools, suggesting that their potential use for teaching remains largely unknown.

## Employment

## Acknowledgments

## Appendix A. Questionnaire

1. How frequently do you use the internet? Seldom − Once a week − twice a week − three day per week − four day per week − five day per week − six day per week − every day.
2. Do you search the internet? Yes or no. For what?
3. Do you use email? Yes or no. What for?
4. Do you use chat? Yes or no. What for?
5. Do you use Twitter? Yes or no. What for?
6. Do you use Skype? Yes or no. What for?
7. Do you use the internet to download? Yes or no. What for?
8. Do you use the internet to upload? Yes or no. What for?
9. Do you share photos on the internet? Yes or no. What for?
10. Do you share videos on the internet? Yes or no. What for?
11. Do you use de wiki tool? Yes or no. What for?
12. Do you participate of a blog? Yes or no. What for?
13. Do you participate of a forum? Yes or no. What for?
14. Do you participate of Orkut? Yes or no. What for?
15. Do you participate of Facebook? Yes or no. What for?
16. Do you participate of Myspace? Yes or no. What for?
17. Do you participate of Ning? Yes or no. What for?
18. Do you participate of Second Life? Yes or no. What for?

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