Internet navigation and information search strategies: how do children are influenced by their participation in an intensive ICT project

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Abstract The aim of this study was to describe and analyze the involvement showed by 190 students who participated in an introduction to Information and Communication Technologies (ICT) project, in public schools from Spain. By means of an Internet browsing test, access and information selection processes were afforded. The purpose of the study was to explore whether students who usually worked with ICT in their class-rooms, had better knowledge and management with computing tools, and if they are better prepared to research and select information. Results show that students of elementary and secondary education, who have a greater contact with ICT, but not specifically introduced to searching for information on the Internet, know how to use the technology. All these students show better knowledge and control of the computer as well as presenting better Web literacy skills. Although they found, organized, used and assessed the information better their literacy in Web information is missing key skills, especially in analyzing, assessing and summarizing information.

Keywords Internet search · ICT · ICT skills · Web literacy · Education

Introduction

There continues to be steady increase in using the Internet, because of the easy access to applications covering all aspects of people's lives. This, impacts considerably on school practices, as student use of the Internet changes both formal and informal educational opportunities, providing greater autonomy and protagonism in learning tasks (Knezek and Christensen 2002). Young people use technology quite naturally for gaming, instant

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messaging, downloading their favourite music and some may also become Web authors themselves by constructing websites (Kuiper et al. 2009).

The Internet can be a powerful pedagogic tool, when used with proper methodology, objectives, clear and realistic goals and harnessing its added-value for learning. This might help both the quality and diversity of classroom learning experiences to be more pertinent, significant, joyful, constructive and contextualized. The Web offers the greatest amount of multimedia documents of informative features, which is easily converted into an extraordinary communication instrument. There is plenty of everything, but not all is of high quality. So Where to search? How to select? To find the best and most appropriate material is a real issue.

Within this scope, the social impact generated by the Internet is gradually increased in such a way that it becomes indispensable to have the ability to locate and retrieve specific data from the Web which, for their immediateness or specificity, it would not be easy to be found somewhere else. Research performed in Spain indicate that in 2009 search for general information was the first activity of the cybernauts, with 14 h dedicated to this media in a week in users between 16 and 24 years old (Fundación Telefónica 2009). These amounts are also kept in school aged students, because in two-thirds of the youngsters between 10 and 17 that regularly use Internet, search for information is the main objective (ACPI and PROTEGELES 2002) and 74.7% of the students connected to the Internet in school time, do it for information search on school content (Sigalés et al. 2007). Although students are active users of Internet, several authors have observed that children often do not have sufficient Web skills at their disposal. Most children lack adequate web searching skills, as well as skills to process and critically evaluate web information (Bos 2000; Fidel et al. 1999; Lorenzen 2001; MaKinster et al. 2002; Pritchard and Cartwright 2004; Shenton and Dixon 2003). Also Badilla and Cortada (2010) and Walraven et al. (2008) summarized that children and teenagers had troubles with specifying search terms, judging search results, judging source and information as well as regulating the search process.

This reality evidences the presence of important educational challenges, such as the effective training in using the Internet and a proper use of the information searching systems for those who teach. On this complex scene ICT and digital literacy competences acquire special pedagogic relevance, because of the preparation of youngsters for their future world in which they must get skills for managing information as well as the capacity to assess the reliability and relevance of what is being requested on the Web (Albion 2007).

In this context our research explores the use that students' make of the WWW regarding a specific requirement and focus on the students' proceedings in searching and selecting the information. This is different among students who have been under continuous school training in ICT from those who have not had such a chance. Another important aspect will be to describe the strengths and weaknesses showed while exercising these ICT competences and what type of valuing or self-perceptions students have on their own performance.

Research background

Digital literacy and ICT skills

The necessity of being competent in the domain of the different codes, symbolic systems and ways of interacting with the information, is an unquestionable fact for all who are part of the information society (Area 2005). In order to become effective ICT information

users, students must have frequent opportunities to handle all kinds of information and thus, achieve both objectives and goals of a person literate in Web information (ALA 2000; Benito 2000; Doyle 1992):

- Recognizing and articulating informative needs
- Understanding how information is stored and organized
- Identifying and selecting the most accurate search or retrieval systems
- Developing and put into practice effective search strategies
- Identifying, locating and retrieving information
- Analyzing, evaluating and synthesizing information
- Using information efficiently in order to achieve a specific purpose, and
- Evaluating the search for information process as well as the product.

The search and selection process of information on the Internet requires the development of certain skills in order for the individual to know where to go, how to get there is the shortest way and how to interpret the several forms in which information is presented to achieve and construct knowledge. Thus, being competent in using information, supposes being able to both acquire and process information through the best available and the most efficient ways in order to organize, present and communicate it (Ortoll 2006; Wu and Tsai 2005).

The Higher Assessment Council of the Catalunya Educational System, along with 8 of Spain's regions, identified basic ICT skills—knowledge, abilities and attitudes- to be achieved by all students by the end of their obligatory school time. Through the consultation with experts and a sample of 4,000 people of different social sectors, 39 basic skills were identified grouped in 11-D (Consell Superior d'Avaluació del Sistema Educatiu 2004). These dimensions were:

- Knowledge on computer systems
- Use of operative system
- Search and selection of information through the Internet
- Interpersonal communication and work in collaborative network
- Text processing
- Image management
- Use of data sheet
- Use of data bases
- Amusement and learning with ICT
- General attitude before ICT.

Taking the 11-D, this study is focused on the first 3-D. Knowledge on computer systems and use of operative system are of an instrumental kind understood as general indispensable knowledge in order to manage ICT successfully. The third dimension, search and selection of information through the Internet, is focused on the usability of the network of networks and it is directly related with this research work.

Search process and information selection

Web literacy (i.e., search process and information selection) is a combination of various skills regarding the critical use of the Web for one's own purposes. Kuiper et al. (2009) established three subcategories of skills: Web searching skills, web reading skills and web evaluating skills. Several authors propose different categorizations needed to carry out a successful search and selection of information on the Internet (Brand-Gruwel et al. 2009;

Kuhlthau 2007; Monereo 2005; Ruiz 2004). However, there are 4 stages common to all models: formulation of the demand and preparation of the search, performance of the search and access to resources, information processing and assessment and finally, presentation of results or communication of the research.

During the process of search and selection of information more than one element is used, but the interaction established among the users, the requested task or demand and the environment have to be taken into account. There is a set of components that form the basis of the search, as well as a set of knowledge, skills and experiences required to achieve the desired results. Along with this technical-practical domain of the Information and Communications Technologies, there is the development of higher order thinking skills that include interpretation of the technological processes, comprehension of both explicit and implicit messages represented by the media and their analysis for decision making among others (Vilches 2002).

The literature advises on the fact there are many factors that determine successful search skills in youngsters, such as the amount of experience the child has had in the use of the Internet, guidance from both adults and parents and the ability to explore the virtual environment as well as the tools they have (Madden et al. 2006; Willoughby et al. 2009). Outcomes from the study of Revelle et al. (2002) with fifth grade North American students (age 9–10) indicate that, despite their young age, they are able to locate information independently, use search engines; while the youngest ones are even able to perform successful searches through different scaffolding platforms.

Despite the multiple factors that influence an Internet information search, there are only two variables that intervene in the same way: task and user. Task is related to the kind and nature of the formulated request, whereas user is the initiator of the searching process and, because it is not a homogeneous group of people, features such as age and knowledge level influence it.

Through analysis of several investigations, we defined three kinds of Internet users related to the student's experience towards the WWW: beginners, advanced and experts. Beginner users are those who have basic knowledge on ICT tools, but do not manage on information selection and search systems. As a consequence, they do not successfully solve the information needs presented to them. The Advanced users have knowledge for using tools, but they are not strategic in searching. This user is known to be a clever person, who easily uses the computer at a basic level, enough to move comfortably on the Internet, as well as other pieces of commonly used software, like MS Office tools. While navigating they behave low skilled and they do not know whether by not knowing or even by comfort and frequently operate in the same way. During navigation they show greater restlessness, performing a great amount of questions to their favourite search engines opening a great amount of Internet until finding what they were looking for. Most of the time, they can complete the searching tasks but, by being low in strategic terms they take more time and effort to achieve them (Luconi and Tabatabai 1999). Finally, Expert users are those who handle searching tools and moreover, they do it strategically (Fuentes 2001), performing such tasks with full domain and comfort on the Internet, performing consciously intended searches, in a complex and flexible way.

The study

This research was performed within the context of the assessment carried out for the Ponte dos Brozos Project (PdBP), by the Social Pedagogy, Information and Communication

Technologies Research Group (PSITIC). It was implemented an expost-facto design, because it has only been able to access the population studied several years after starting their involvement in the Project.

PdBP was developed by the Amancio Ortega Foundation on 2001 in three educational centers of Arteixo, Galicia. Currently there are five participating schools, covering all stages of the non-university education, from 3 to 18 years old children.

The PdBP is an educational project supported by ICT that aims to unite technology and pedagogy to respond to the need to renew the teaching–learning methods and adaptation of the education system to the demands of society information. This pioneer project has provided technological equipment to the participating centers consisting of <u>didactic resources, digital interactive whiteboards, audiovisual systems, scanners, computers, printer and a series of connectivity points to the Internet.</u> Also the high school students have be able to purchase laptops through the project, allowing them to use them regularly in school, as well as for personal activities at home, facilitating the relationship with their teachers and interpersonal connections with their environment. Interestingly, one of the participating centers, Pastoriza Secondary Education Institute, has become the first center in the country with one computer per student (Arteixo 2007). Among other activities the students spontaneously created computer clubs to share practices and provide simple solutions and technical support to both teachers and students. Moreover, <u>training activities are undertaken intended for teachers with the idea of introducing changes adjusted to the social and cultural context of each school, to encourage reflection and collaboration of teachers in the introduction of innovative teaching in the classroom with ICT. Teachers are involved in practical classes, lectures, seminars, conferences, workshops, visits to other educational institutions and national and foreign schools, exchanges between teachers, parents and students; advice on the development of platforms and websites, among other activities.</u> This experience allows them to develop their classroom experiences with systematic and continuous support of ICT.

Research questions

The purpose of this study was to describe, analyze and interpret the performance showed by students belonging to the PdBP before the formulation of strategies and access to information test, an instrument created by PSITIC called "challenging". Through this test it was possible to explore and analyze which search and selection of information were used and which processes the students used. Therefore, three research questions were examined in this study: <u>(Q1) What is the impact of the PdBP on the achievement of students' basic skills of ICT? (Q2) Is there any difference between children who participated in PdBP, gender and kind of Internet user in searching and selecting the information? and (Q3) Which are the students' self-perception related to their ICT skills, and development process while solving information problems on the Internet?</u>

From these questions emerge the four variables of the study: <u>ICT basic skills, Search and selection of information, Internet user experience and Self-perception on performance.</u>

For this research ICT basic skills consist in the knowledge level that a person have in 3-D: Use of operative system within a Windows environment, text processing and image processing. These dimensions are also considered *skills for the instrumental use of the ICT tools*.

The second variable is related to *search and selection of information* skills consisted in Web literacy—that includes two sub-variables named Accessing strategies and Information selection- and the Reporting of search results.

Unifying these two variables we constructed a supra-variable called *ICT skills*.

The *Internet user experience* variable is related to the knowledge on ICT tools and proceedings in searching and selecting the information. Based on the results, in the discussion and conclusions section we can recognize three kinds of users: beginners, advanced and experts.

Finally, *self-perception on performance* is the last variable and it was understood as the every subject's assessment on the difficulty degree of the test, as well as on their performance.

Methodology

Participants and setting

One hundred and ninety students from four centres of elementary and secondary education participated voluntarily in this study (107 boys and 83 girls). Students were in sixth grade of Elementary Education (EE) (Mean age 11.5), and from first to third degree of Obligatory Secondary Education (OSE) (Mean age 13.5). All schools are in Arteixo, Galicia in Spain.

For the purpose of this study, fieldwork was carried out at two different moments in times with different participant sample in order to improve the results' validity. Thus, phase 1 was developed in the academic period between 2005 and 2006, with two participating schools which were familiar in working with ICT because they had been participating for at least 5 years in the PdBP: Ponte dos Brozos Kindergarten and Elementary Centre and Pastoriza Secondary Education Institute. In those schools teacher have the freedom to choose their involvement, so there were no Project involvements in 1st and 4th grade of OSE. In this scenario the control group (CG) in phase 1 was constituted by students in 1st and 4th grade of OSE from Pastoriza Secondary Education Institute with limited access to ICT in classroom, and with only the common infrastructure existing at the information technology laboratory (the time students spent at the computer Mean = 17 h per week, SD = 4.5 h). The experimental group (EG) was formed by students from 6th grade of EE and 3rd grade of OSE with no differences between these classes related to the Internet connection at school, the time students spent at the computer (Mean = 32.4 h per week, SD = 2.8 h) and with respect to the training on ICT received by teachers to use the technology in classrooms.

Due to the unfeasible option to tests students outside those schools, in phase 1 the tests were applied during the first term for CG (1st grade and 4th of OSE) and during the last term for EG (6th grade of EE and 3rd grade of OSE) to be considered with equivalent age and could be compared (see Table 1).

Phase 2 was developed between 2006 and 2007 academic period. The sample consisted of students from 6th grade of elementary education and 3rd grade of secondary education. The experimental group in this phase was formed by students from Ponte dos Brozos Kindergarten and Elementary Centre and Pastoriza Secondary Education Institute who are involved in PdBP and used to using ICT regularly in classroom. The control group comprised of two schools not involved at the Project had limited access to ICT in all classes only in the common infrastructure existing at the information technology laboratory: San Xosé Obreiro Kindergarten and Elementary Centre and Manuel Murguía Secondary Education Institute (the time students spent at the computer Mean = 15 h per week, SD = 3.3 h).

Table 1 Sample groups in terms of Phases 1 and 2

Phase	Group	Level	School	Age	N Boys	N Girls	N
1	Control	1st OSE	IES Pastoriza	12.50	33	21	58
	Experimental	6th EE	CEIP Ponte dos Brozos	11.41	11	11	22
	Control	4th OSE	IES Pastoriza	15.56	27	16	43
	Experimental	3rd OSE	IES Pastoriza	14.64	24	21	45
2	Control	6th EE	CEIP San Xosé Obreiro	11.49	7	8	15
	Experimental	6th EE	CEIP Ponte dos Brozos	11.51	3	10	13*
	Control	3rd OSE	IES Manuel Murguía	14.52	3	4	7
	Experimental	3rd OSE	IES Pastoriza	14.64	11	4	15*

* Student groups not considered in the sum of the total sample for having participated in both phases

Due to the participation of schools from outside the Project in this second phase, the number of students involved in the investigation was lower.

It is important to note that during neither phase 1 or 2 did not develop specific content about Internet navigation and information search strategies in any of the schools and educational levels.

Instrument and procedure

Data collecting instruments included the Challenging test applied in phases 1 and 2, as well as self-perception questionnaires about performance applied at the end of phase 2. Table 2 shows the overall structure of the Challenges and contents afforded. This instrument assesses two variables: *ICT basic skills* and *Search and selection of information*. These data were obtained by means of the performance of instructions requested by the challenging.

Self-perception on performance was evaluated through the analysis of the self-perception questionnaire applied to students after the Challenge performance.

The challenges designed for elementary students consisted of 9 questions in phase1 and 6 items in phase 2. The tests had satisfactory internal consistency reliability, with an alpha of 0.85 and 0.70, respectively. The challenges constructed for secondary students were structured in 3 items, each of them with the instruction in phase1 and 11 questions in phase 2. The tests had satisfactory internal consistency reliability, with an alpha of 0.81 and 0.78, respectively.

In the challenging test different general interrogations issues were chosen in order to ensure that topics were not part of a school curriculum. Initially a brief introduction about the subject, to be investigated, was given. Then, information search situations were presented, in which the performance of instructions that should be developed on the Internet as well as by Microsoft Office, Open Office software package or on any other kind of software were proposed. The kinds of questions used were both closed and open-ended. Answers to every question were coded as right or wrong and one point was assigned to the right ones. A count scale was created to summarize issues and, as a result scores were in a range between 1 and 10. Only the item *Internet navigation* was analyzed on the basis of the sum of the interrogations performed to search engines.

An additional questionnaire was used to obtain students' self-perception variable on performance in phase 2. The first item was presented in a very easy/very difficult bi-polar

Table 2 Variables, educational level and challenging items

ICT basic skills: instrumental use of ICT tools

EE	Phase 1: File creation, kind of font, save file, font properties, paragraph properties, insert image
	Phase 2: Title format, list creation, insert image, save document, print, make poster
OSE	Phase 1: File creation (Impress/PowerPoint), save file, slide numeration, background colour, insert template, create slide, background different to previous ones, element animation
	Phase 2: File creation, title format, page format, list creation, insert image, save document, print, make diptych

ICT skills: ICT basic skills plus search and selection of information through challenging questions solving (translated from spanish)

EE	Phase 1: What dynasty king Tutankhamen belonged to?
	Who discovered king Tutankhamen's grave?
	How many years did Tutankhamen's grave discoverer lived?
	What valley king Tutankhamen's grave is located?
	In what year king Tutankhamen's grave was discovered?
	Phase 2: Poster confection to promote responsible acting of citizens about production and treatment of domestic residues. Write title with keyword, write proper introduction, create list adequate to content, insert proper image, choose proper headline, indicate copyright of both image and information consulted
OSE	Phase 1: When and how United States constitution was signed?
	In what year declaration of rights in the United States constitution was introduced?
	Draw a *bar* chart in which population of cities from the Philadelphia and New York States cities according to census on 2000
	Phase 2: Confection of a brochure intended to promote responsible acting of citizens about production of domestic residues. Writing of title with keyword, writing proper introduction, creating list adequate to content, inserting proper image, choosing proper headline, indicating image and information copyright. Indicating at least 3 "R" ("R's rules" relating to the treatment of household waste), indicating at least 3 pieces of advice, and Indicating copyright of both information and image consulted

Search and selection of information: web literacy

EE and OSE	Phase 1 and Phase 2
	Internet navigation: accessing strategies
	Interrogation of the search engine through this interrogative phrase, phrase with verb, phrase without verb, keywords, copy the question exactly, use of unnecessary signs, use of advanced search signs, add or change of words from previous search, wikipedia searching, recover of previous search
	Internet Navigation: Information selection
	Number of sites opened; opening of first link automatically, copy of response directly from google, use of image search engine

Self-perception on performance

EE and OSE	Phase 2
	Assessment on the degree of difficulty in: Comprehension of instructions, performance of instructions, search for information on internet, comprehension of information, selection of information, design of the brochure and/or diptych and distribution of time
	Indicate difficulties found: Not enough time, connectivity problems, and computer problems, others
	Answers assessment: see Challenging questions resolution, Phase 2, EE and OSE

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category, in a 4 point Likert scale (very easy, easy, difficult and very difficult). The second item was a closed answer, and the third category was presented in a fail/excellent bi-polar category, in a 4 point Likert scale (fail, pass, good and excellent).

Procedure and data analysis

Two members of the PSITIC research group were in charge of students during the test performance, without the presence of their teachers. At the beginning of the tests, the participants were informed about the purpose of the study and they were told that the screen of every computer would be recorded, through the tool available in the SMART Board digital board intended to register every movement performed during the challenging. In order to be able ensure matching of paper based test and computer performance each student was assigned an identification code, but these were anonymous. This code would allow the latter information treatment and data processing.

Questions in paper format where delivered. Students were advised to answer them individually, accessing the Internet and the software they already knew. Then the participants read the test and were given the opportunity to ask questions about the task. After this introduction, the students had a maximum of 30 min (phase 1) and 50 min (phase 2) to complete the challenging test. For all participants, the computer at the start of the test showed the desk. Specific instructions were given in phase 2 to access information to resolve the challenging in the Internet (http://fund. blanquerna.url.edu/residuos). At the end of the test, the experimenter saved the file product of the test, and in phase 2 students had the facilities to print the product which consisted of developing an informative poster (elementary students) and a diptych (secondary students).

Experimental group students performed their tests in their own classrooms, while those control group, were provided with laptops and Internet connection. All computers worked with Windows XP, and used Internet explorer version 6.0 or superior. Therefore, it is not expected that the equipment used in the different groups influenced the results.

SPSS v18.0 software was used for the analysis of the descriptive statistical variables of Internet navigation and ICT usage dimensions and T test was used for independent samples and for the comparison of continuous variables of both groups of these dimensions, with a confident interval of 95%. Pearson correlation coefficient was used to determine the relationship among quantitative variables of the Internet navigation and ICT usage was used, with a 95% confidence interval.

Results

ICT basic skills

First research question examined the general impact generated by the PdBP in the acquisition of basic ICT skills for the students. One side analysis of results shows that elementary students who participate on PdBP have a greater domain on the *instrumental use of ICT* and there are significant differences between means for *use of technology*, if they belong or do not belong to the Project only in second phase (phase 2 $t(25.8) = 2.576$, $P = 0.016$). Results from secondary students only showed significant differences on phase 1 ($t(51) = 3.634$, $P = 0.001$). Considered the supra-variable ICT skills as ICT basic skills and Search and selection of information, results show that there are significance differences in both phases in elementary and secondary students (see Table 3).

Table 3 *T* test results of ICT Skills between control (CG) and experimental (EG) groups

Variable	Level/ phase	N CG	CG Mean (SD)	N EG	EG Mean (SD)	T	P
ICT basic skills: instrumental use of ICT tools	EE 1	58	2.04 (1.99)	22	2.98 (1.38)	1.942	0.054
	EE 2	15	5.13 (2.33)	13	7.15 (1.82)	2.576	0.016*
	OSE 1	30	3.63 (2.25)	23	5.70 (1.74)	3.634	0.001***
	OSE 2	7	5.05 (1.77)	15	6.36 (2.28)	1.332	0.198
ICT skills (ICT basic skills and search and selection of information)	EE 1	58	2.39 (2.18)	22	5.89 (1.51)	8.124	0.000***
	EE 2	15	4.85 (1.79)	13	6.09 (1.25)	2.092	0.046*
	OSE 1	30	3.01 (1.78)	23	4.56 (1.41)	3.416	0.001***
	OSE 2	7	4.50 (1.33)	15	6.33 (1.29)	3.070	0.006**

Statistical significance * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$

Search and selection of information

When approaching what is the impact of the PdBP on the achievement of students' basic skills of ICT, from challenging results analysis, it was found that in both phases PdBP elementary and secondary students obtained higher means to those from control group (see Table 4). These differences are highly significant in phase 1 of elementary students ($t(74) = 9.224$, $P = 0.000$) and in both phases of secondary students (phase 1 $t(51) = 2.078$, $P = 0.043$), (phase 2 $t(20) = 5.064$, $P = 0.000$).

Web literacy: accessing strategies

This category, which corresponds also to the second research question, refers to how students develop and put into practice effective Web skills like searching strategies and the way they lead the search, by means of the proper tools. Data indicate that students belonging to the experimental group from both EE and OSE perform a great amount of requests to the search engine and, as shown Means in Table 4. This difference is significant

Table 4 *T* test results of search and selection of information between control (CG) and experimental (EG) groups

Variables	Level/ phase	N CG	CG Mean (SD)	N EG	EG Mean (SD)	t	P
Reporting of search results	EE 1	58	2.76 (2.76)	22	8.81 (2.31)	9.224	0.000***
	EE 2	15	4.58 (1.41)	13	5.03 (1.15)	0.948	0.352
	OSE 1	30	2.39 (1.62)	23	3.42 (1.96)	2.078	0.043*
	OSE 2	7	3.95 (1.25)	15	6.30 (0.89)	5.064	0.000***
Web literacy: accessing strategies	EE 1	58	3.22 (3.44)	22	5.73 (3.30)	2.939	0.004**
	EE 2	15	2.73 (2.15)	13	5.46 (3.13)	2.720	0.011*
	OSE 1	30	3.83 (3.24)	23	5.35 (3.93)	1.539	0.130
	OSE 2	7	11.29 (5.62)	15	16.67 (8.20)	1.563	0.134
Web literacy: information selection	EE 2	15	3.37 (1.90)	13	4.76 (1.18)	2.215	0.036*
	OSE 2	7	4.10 (1.23)	15	5.84 (0.94)	3.645	0.002**

Statistical significance * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$

only in the elementary students outcomes (phase 1 $t(78) = 2.939$, $P = 0.004$), (phase 2 $t(26) = 2.720$, $P = 0.011$). Results shown a positive relationship among the facts of performing more requests to the search engines and the higher amount of questions answered correctly by the experimental group in phase 1 ($r = 0.730$, $N = 80$, $P = 0.000$).

Accessing strategies to information utilized by elementary students indicates that the kind of request performed is mainly done through the Google search engine. Students from experimental group use mainly key words, non-verb phrases and interrogative phrases, while control group students use interrogative phrases and copy the question exactly as questioned in the challenging. Secondary students also show greater preference for requests to the Google search engine, using non-verb phrases and keywords.

Information searches on the Internet results indicate that elementary students belonging to the control group frequently add words or change some of the previous searches in order to start a new searching process. However, neither EG or CG have a refined strategic search handling because no students were able to retrieve previous searches in order to reflect on the navigation process or to compare information. They do not use advanced searching signs that allow for adjusting the search, establishing parameters more accurate to the information needs.

Outcomes of secondary students show that both groups used advanced searching signs even though they do it only on occasions, retrieving previous searches and changing or adding words to the previous search. These results suggests that these students used more advantage techniques, which does not necessarily mean was strategic because, at least in phase 1, the search was not followed by good results in the challenging resolution (EG Mean = 3.42, SD = 1.96; CG Mean = 2.39, SD = 1.62).

Related to information selection, it is possible to affirm that in both phases students of EE belonging to experimental group open more Web sites (phase 1 Mean = 7.09, SD = 4.15; phase 2 Mean = 4.46, SD = 4.93) than those from control group (phase 1 Mean = 2.53, SD = 2.74; phase 2 Mean = 3.20, SD = 3.12). As has already been mentioned, experimental group students input more requests to the search engines which can be interpreted in several ways. They may open more sites because they answer more questions; they may open more sites because they contrast the information showed by those sites or just because they do not know the correct answers. However, it is possible to suggest that there is a positive and significant relationship between the number of sites accessed and the correct outcomes ($r = 0.796$, $N = 80$, $P = 0.000$). In other words, the more Web sites accessed in phase 1, the greater the number of questions correctly answered in the challenging. Secondary students outcomes suggest that in both phases, experimental group students open more sites in their Internet search process (phase 1 Mean = 4.35, SD = 2.92; phase 2 Mean = 8.47, SD = 4.27) than those from control group (phase 1 Mean = 3.53, SD = 2.46; phase 2 Mean = 5.43 SD = 2.64).

Web literacy: information selection

The second research question focused on determining Web literacy levels students in searching and selecting the information on the Internet in phase 2. Results indicate that students belonging to the experimental group of elementary ($t(26) = 2.215$, $P = 0.036$) and secondary ($t(20) = 3.645$, $P = 0.002$) get higher averages than control group students and these differences are significant (see Table 4). Of the 6 categories analyzed, experimental group from elementary students stands out in: Understanding how the information is stored and organized, identifying and selecting the most accurate search or retrieval systems and using the information efficiently in order to achieve a specific purpose. The

Table 5 Means of Web literacy in Information selection categories between control (CG) and experimental (EG) groups in Phase 2

Categories	Level	EG		CG	
		N	M	N	M
Recognizing and articulating informative needs	EE	13	2.54	15	2.33
	OSE	15	3.44	7	2.02
Understanding how information is stored and organized	EE	13	6.92	15	5.00
	OSE	15	7.33	7	7.14
Identifying and selecting the most accurate search or retrieval systems	EE	13	9.62	15	7.78
	OSE	15	9.67	7	8.57
Identifying, locating and retrieving information	EE	13	3.08	15	2.89
	OSE	15	4.56	7	2.86
Analyzing, evaluating and synthesizing information	EE	13	1.79	15	0.89
	OSE	15	3.24	7	1.14
Using information efficiently in order to achieve a specific purpose	EE	13	4.62	15	1.33
	OSE	15	6.78	7	2.86

weakest aspect in students from both groups is the ability to analyze, evaluate and synthesize the information. Besides, the experimental group of secondary students obtains statistically significant differences in the categories of recognizing and articulating informative needs ($t(20) = 2.059$, $P = 0.050$); in identifying, locating and retrieving information ($t(20) = 2.105$, $P = 0.048$); in analyzing, evaluating and synthesizing information ($t(20) = 2.845$, $P = 0.010$) and in using information efficiently in order to achieve a specific purpose ($t(20) = 2.563$, $P = 0.019$) (see Table 5). However, and despite these outcomes, web literacy in both experimental group and control group secondary students is considered scarce because in half of the categories, averages are below 50% of achievement. These categories are: Recognizing and articulating informative needs, identifying and selecting the most accurate search or retrieval systems, analyzing and evaluating and synthesizing information.

Reporting of search results

There have been no significant differences by gender, for boys and girls from EE (phase 1 $t(73) = 0.515$, $P = 0.608$), (phase 2 $t(26) = 0.497$, $P = 0.623$) and OSE (phase 1 $t(50) = 0.726$, $P = 0.471$), (phase 2 $t(20) = 1.203$, $P = 0.243$). On average *reporting of search results* by gender are quite similar in both phases (see Table 6).

ICT skills

The analysis of the variable ICT skills in its 4-D: use of operative system and Windows environment, text processing, image treatment and search and selection of information showed that elementary students (phase 1 $t(54.9) = 8.124$, $P = 0.000$), (phase 2 $t(26) = 2.092$, $P = 0.046$) and secondary students (phase 1 $t(51) = 3.416$, $P = 0.001$), (phase 2 $t(20) = 3.070$, $P = 0.006$) have greater domain in both phases of this research.

Table 6 Means and standard deviations of reporting of search results on challenging test per gender

Variable	Level/phase	Boys			Girls		
		N	M	SD	N	M	SD
Reporting of search results	EE 1	44	4.72	0.56	32	4.84	0.58
	EE 2	10	4.95	1.67	18	4.70	1.08
	OSE 1	29	3.05	1.99	23	2.69	1.56
	OSE 2	15	5.81	1.28	7	5.00	1.87

Self-perception on performance

A quantitative data analysis on the self-assessment questionnaire allowed initiating the third research question refers to the students' self-perception related to their ICT skills, and development process while solving information problems on the Internet. Outcomes indicate the perception of the students both from EE and OSE on the development of the test valued as very easy and quite easy. Control group from EE considers the search for information as the most easy, whereas the most difficult for them is the design of the brochure which requires more instrumental knowledge or competence on ICT use. Experimental group considers the brochure design as the easiest issue, while the most difficult one was distribution of time. Both groups considered search, selection and comprehension of information on the Internet as the easiest part of the test, and they coincide in considering the brochure design as the most difficult.

Main difficulties in the challenging development for both EE and OSE students were time (55.3, 71.4%, respectively) and mouse blinking (73.8, 57.1%, respectively) as a result of the SMART Board software.

In almost all of the challenging questions for control group belonging to EE, answers were valued (pass) with the lowest assessment by experimental group students, unlike EG students who over self-evaluate in half of the categories in a similar way (result: fail, self-perception: good). Maturity of secondary students from both groups seemed to have influenced that in more than half of the categories, the assessment becomes equivalent to the final results (*CG* Pass, *EG* Pass).

Discussion and conclusions

Our research aimed at studying how students belonging to the PdBP solve information problems and what kind of process in searching and selecting the information on the Internet they use. In particular, we emphasize the matching results in phases 1 and 2 for its validity, and other aspects of representative significance.

The results of this study have allowed the confirmation that the systematic contact along a structured, planned and constant in time educational ICT Project provides advantages in several scopes of the student training.

The findings revealed that these students have a significant ability to use search engines and locate specific information on the Internet, they have clear searching aims and navigate in relevant schedules for working on the intended task. This includes having criteria in order to assess the reliability of the information found. This is contrary to Wallace et al. (2000) who concluded that although the students had sufficient technical skills, they were unable to use the information that they found on the Web to answer their queries.

It is not surprising that the Internet searching processes are more refined among both boys and girls between 14 and 15 years old than those ones from younger students, by retrieving previous searches and changing or adding words. It is not only probable that their cognitive skills, vocabulary and tools are more developed, but also they should have received more training on ICT as they need to use the Internet as an information source (Madden et al. 2006).

Regarding Web literacy skills, elementary students who belonged to the PdBP perform a more strategic search and section of information with high success. This can be explained on the basis that they used to do more successful searches; they prioritize the relevant information and present the obtained results in a better way. Secondary students belonging to the PdBP are more aware of the information search and selection processes in what they do not participate in, but they have a lower strategic ability. In general, this suggests that PdBP students could be considered as advanced Internet users because they know how to use this technology but they do not have the same degree of knowledge of information management. Therefore, they are recognized as competent and they have an easy computer management at basic levels which allow them to move comfortably on the Internet and also in the common software tools. In the navigation on Internet PdBP students acts with little skill and maybe for ignorance or for convenience often operates in a similar way. They expresses serious concern in navigation and in most cases, students complete in a successfully way their search, but they not very strategic, because it takes more time and effort to get it. In this scenario it is not enough to merely have the access of computers and facilities to connectivity, but it appears the need of explicit support and guidance in order to improve Web literacy skills to overcome the inconsistent, impulsiveness and impatience of students.

Contrary to other authors (Large et al. 2002; Roy and Chi 2003; Tsai 2009) regarding the gender our research observes there have been no significant differences between boys and girls in elementary and secondary students in challenging resolution, that implies using of operative system within a Windows environment, text processing, image processing, searching and selecting of information requested.

The analysis on the behaviour of beginner user of the control group students in the challenge allows it to be pointed out. They have a lack of both simple and advanced search resources; a tendency to use the same tools all the time, instruments and strategies, independently of the aim and purpose of such a search.

This study reveals that all students (experimental group and control group) who participated tend to use one Internet navigation system, one search engine and one online encyclopaedia. Students' tendency to rely on Google also may have to do with their focus on finding the right answer when using the Web, which is also mentioned in other studies (e.g., Kuiper et al. 2008; Wallace et al. 2000). This is unlike Madden et al. (2006) who worked with 11–16 years old students in the United Kingdom, who started their own Internet navigation through Google as a search engine, in addition to others like Yahoo, Lycos, AltaVista, Ask Jeeves and MSN.

Searching strategies to obtained results suggest that all students perform an accumulative and repetitive search process by which they incorporate a concept or term, explore their results and then they modify their searches, especially under the case of open ended questions. Thus, the refining of their searches is merely intuitive and simplistic, in line with other studies (e.g., Kuiper et al. 2005; Schacter et al. 1998; Wallace et al. 2000). In this context it is interesting to highlight the difference between experimental and control group. PdBP participants use mainly key words, non-verb phrases and interrogative phrases during the search, whereas non-participants use interrogative phrases and copy the question

exactly as it is in the challenge for the same purpose. In addition, most of the experimental group students from OSE usually improve their searching processes by changing or adding words to the previous search, while on rare occasions they utilize advanced search signs such as Boolean operators or the retrieving of previous searches.

Overall students from PdBP find, organize, use and assess the information better. In other words, as advanced users, they are more literate in information than those who do not participate in the Project. Despite this, web literacy level can be considered low, because both EE and OSE averages are lower in recognizing and articulating information needs, in identifying, locating and retrieving information, in using information efficiently in order to achieve a specific purpose, as well as in analyzing evaluating and synthesizing information.

As in other researches, there is a clear need to educate and promote the skills to examine the content and structure of information, articulate and implement criteria for evaluating both information resources and synthesize information to construct new concepts (Agosto 2002; Kuiper et al. 2005; Lorenzen 2001; Walraven et al. 2009). In the same way Eastin et al. (2006) and Livingstone (2003) affirmed that children are not aware of the various searching strategies available or how to effectively use them, and certainly the process of searching for content is much more complex online.

Explicit training in how to conduct Internet searches is one support that is highly recommended for sophisticated and high quality searches. In addition, we suggest some structural support or structured educational programmes to educate and encourage skills to examine equally content and structure of the information to articulate and apply assessment criteria for both information and resources as well as to synthesize information in order to build new concepts.

To have the opportunity to interact with the computer, especially the Internet every day at any time, to resolve schools work or personal tasks, provides the PdBP students with the ability to be more aware of how to navigate on the web, as well as storing, retrieving and printing the information they find. Their profile agrees with the advanced user model, due to the fact that they move comfortably on the Internet, they can perform their searching tasks by visiting more Web sites.

Summarizing the results leads us to conclude that it becomes evident that the performance of the PdBP students is possibly attributable to the level of experience in the present sample of participants, who often use the Internet as part of their school work and who have had many years of exposure and opportunities for informal training in the use of the Internet.

The results of the students show that this kind of support in infrastructure, Internet connectivity and support for the teachers in their schools can provide a valuable context for teaching and learning Web literacy skills.

With regard to the ICT skills, the overall outcome is that the project has contributed to developing a greater domain on the use of ICT tools from both elementary and secondary students. They obtained high performance in tasks that imply the use of the operative system and the Windows environment, image management and text processing.

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