



## **Information and Communications Technologies literacy of the University of Buenos Aires Engineering students**

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## **Introduction**

The students currently at the University have been described by a number of labels. These include the net generation, millennial, Google generation and digital natives. These terms highlight the importance of technology in their lives <sup>1</sup>. Some authors <sup>2,3</sup> assert that the new technologies influence is a major change in the way young people socialize, communicate and learn.

According to Prensky, who endorses the term Digital Native to this generation, these people think and process information in a radically different way than previous generations. Prensky's concepts of Digital Natives and Digital Immigrants and the classification according to the age has and is being challenged by solid research data. <sup>4,5</sup> However it remains clear that the use of Information and Communication Technologies (ICT's) will influence the way these students learn. A simple example is that, being our students commuters, chat-rooms eases a lot team meetings when some teamwork must be done.

The School of Engineers Faculty attitude towards ICT varies. Some argue that, as with proficiency in English, ICT literacy is a skill we shall ask them to manage but do not have to teach. English as a foreign language is offered free of charge in six levels for all students, along with a set of other languages. The Engineering curriculum asks for a level in English and the Language departments is responsible for the testing, but no course is mandatory. These faculty members expect that non specific ICT's should be dealt with in the same way.

On the other hand, some Faculty members believe that special time must be allotted in Lab to teach the use of general ICT which can support the academic life. These ICT include social networking. However they understand that teaching tools is not the aim of their courses and that can be a controversial task. Advanced students might get bored and lose interest while other may get stuck in syntactical (surface) detail not grasping the purpose of the tool.

There is a third group that believes that the familiarity with ICT's is related to the field discipline (majoring) our students choose. These faculty members propose to deal differently with students whose majoring is related to ICT (Computer, Software and Electronics Engineers).

Our institution decided to offer grants in using ICT's in the classroom, and we applied and obtained one aiming to foster ICT in the engineering courses. It is related to general ICT tools such as social networking, simulations, group-work and personal technology; not to specific field discipline software such as calculus where the tools are long incorporated in the courses.

In order to begin the project we decided to learn how familiar our students are with the ICT technology in their academic and social life.

## **Information Technology Literacy.**

In the US EDUCASE <sup>6</sup> publishes an annual report <sup>7</sup> on undergraduate students and Information Technology. After summarizing their findings they recommend to “Investigate your students' technology needs and preferences, and create an action plan to better integrate technology into courses and help students access institutional and academic information from

their many and diverse devices and platforms”. They also recommend to plan for the best way to support students use of core and specific ICT's.

Also in EDUCASE quarterly magazine, Kaminsky et al<sup>8</sup> studied ICT literacy and the students preferred instructional style. They also advocate to prepare students for a lifelong learning in ICT no matter their specialty.

Both studies suggest a blended approach mixing traditional and online items. However the online items have to be fully understood by students in order to get enough profit. Also different styles and students technology familiarity must be contemplated when elaborating the class support material.

## **Research questions**

We posed three research questions to be answered with a survey:

- 1) Can we expect students to learn core ICT skills independent of the curriculum as is the case with English language?
- 2) Is there a preference in core ICT tools ready to be integrated in the course to enhance students experience?
- 3) Is there any difference in ICT literacy according to the majoring our students choose?

Answering these questions will provide us an overview on the approach our students have to the ICTs. This overview will allow us to prepare a plan for integrating ITCs in the courses, beyond the standard use of course related tools.

## **Overview of the Collected Data**

### **Data Collection Methodology**

The data was collected using an on-line questionnaire during the first term of 2012. It was hosted on a free server dedicated to surveys. Students completed the survey during a 30 minutes period in their Lab course time. After completing the surveys the normal activity was resumed and 20 minutes before the end we held a group interview addressing the survey. Our aim was to learn how the student understood the different survey questions in order to aid us in the data interpretation.

The survey was anonymous and the only mandatory data was the age and course information. The students were able to skip questions at will. At the end of the survey we asked if they were willing to follow the survey with a personal interview. The interview was scheduled to be held on the second semester 2012.

The web-site where the survey was hosted was hacked in August and the data was recovered by the end of October. The site was sold and they limited free surveys to a mere ten questions and five answers. After we studied the data we decided to make a new survey on first semester 2013 using what we learned in this survey. Individual interviews were not held and an e-mail was sent with the corresponding explanation to the voluntaries. One student acknowledged the post.

## The Survey

The survey comprised five sections

- 1) **Personal details:** gender, age, course, Internet access at the place of residence; working hours, Internet access at the place of work, types of devices owned and used regularly.
- 2) **Technology formally used on the courses:** including tools that are part of the institutional online campus (moodle) and other tools and systems either personal (eg laptop, media player, etc) or are openly available online (eg. Wikipedia, social networking sites, etc.).
- 3) **Technology used for learning** but that is not formally required
- 4) **Technology used for recreational purposes.**
- 5) **Further participation in the study.**

Course's faculty worked with us in the survey and interpreting the results. We knew in advance the technology required in their course. However the answers from the corresponding section differed with the reality. It was addressed in the group interview and is a cue on the perception students have or the way they answer to survey questions.

## Students Personal Data

The survey was responded by 337 students of the School of Engineers of the University of Buenos Aires. Ages range from 18 to 48 (303 students chose to answer) from 18 to 48 with an average of 22.1 and a SD of 4; 39 students were over 30. There were 225 male and 82 female students with similar average age.

We divided the students in two groups according to their field of study: those who pursued engineering field disciplines non related to ICT (Information and Communications Technology) and those who did (Electronics and Informatics Engineers). There were 74 non ICT students (53 male and 21 female) and 263 ICT students (202 male and 61 female).

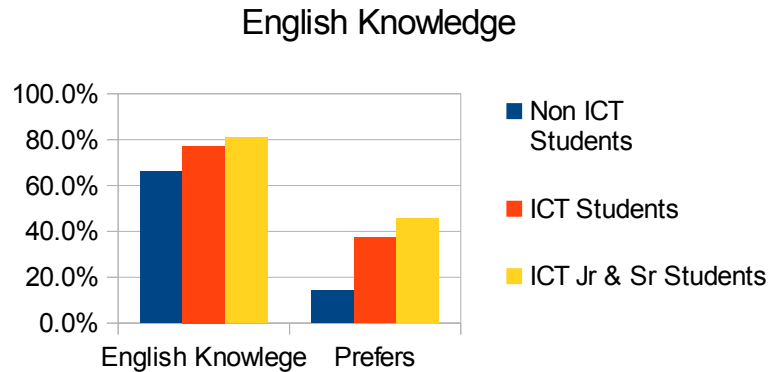
All non ICT students were sophomore students. The ICT students were a mix of freshmen, sophomore, Junior and Senior. In this paper we use the ICT vs non ICT categories, with further refinement where necessary. Data is summarized in Table 1.

	Non ICT		ICT (all)		ICT Fresh		ICT Sophomore		ICT Jr & Sr		All Answers	
Total	74		263		60		71		132		337	
avg(age)	20.4		22.9		20.5		22.6		23.8		22.1	
Male	53	71.6%	202	76.8%	50	83.3%	50	70.45%	102	77.3%	255	75.7%
avg(age)	20.6		22.6		20.52		22.6		23.6		22.2	
Female	21	28.4%	61	23.2%	10	16.7%	21	26.9%	30	22.7%	82	
avg(age)	20		24.7		21.2		22.75		24.6		23.17	

**Table 1** Demographic data

## English Knowledge and Web Access

The question was posed in two terms: “Can you read and understand an English study text?” And “If you answered Yes to the preceding question, do you feel comfortable studying from an English text or do you prefer studying from a text in your native language?”.



*Figure 1 English as Preferred Language*

Of the non ICT students, a 66% asserted proficient English knowledge but only 14 % stated it as the preferred text language. Figures change to 77% for ICT Students and 37% as the language of choice. In the Junior and Senior sub-category 81% declares proficiency and 49% chose the English written texts. Obviously they have already had experience with translation misunderstandings.

From the non ICT students only the 16% stated that they work more than four hours compared with the 38% of the ICT Students. The 28% of the ICT freshmen declared to be working and the percentage increases up to a 46% of the Junior and Senior students. *Further development of this paragraph require explicit reference to our country and institution, edited for review.*

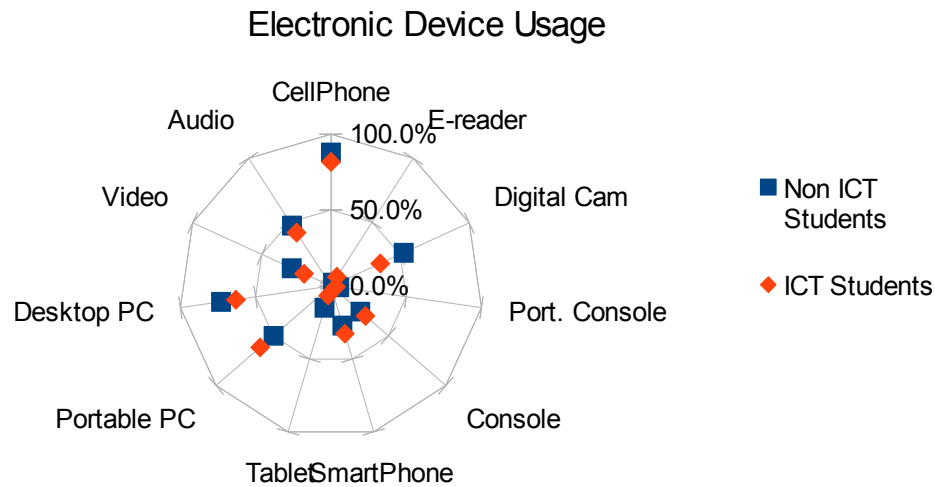
Internet access at home or place of residence was up to 88.1% with little variation and Internet at work was present in the 95% of the cases. Only 13% declared to have filtered Web access, mostly from educational institutions. For the population under study, Broadband access from 4+ Mb/sec is a commodity.

## Devices used

As a last Item in the Personal Details section we explored the devices owned and regularly used by the students.

The most popular devices were *CellPhones, Computers, Audio & Video equipment* (including *mp3/4*), *Digital Cameras. Smartphones* come next with a logical increase of ownership with age (and working status). We detected very few *game consoles* and *tablets* and practically no *e-readers* or *portable game consoles*. Only 50 of the 337 students (14%) did not declare to have some kind of Personal Computer.

A networking analysis figure like Figure 2 shows no particular clustering or difference neither between non ICT and ICT students.



**Figure 2 Electronic Device Usage**

The result rises several questions. We assume they under-reported the gaming devices, which we could not confirm without the interviews. We also suppose there is some serious overlap with the functionalities of the devices, eg audio or video players, digital camera and CellPhones. As we were interested in ICT we instructed specifically to take the devices as functions and tally every function they own. In the group interview we discovered that most of the students did not follow these instructions.

### Technology formally used on the courses

Faculty of the courses students were assisting to form part of the research group. That means we already knew the answer to this part of the survey. We included it in order to evaluate is students were able to record the kind of tool they were using.

The following tables summarize the answers (ordered by declared use)

<i>Item</i>	<i>Key in Figure</i>	<i>n</i>	<i>%</i>
e-Campus	E-c	60	81.08%
Course Web Page	C W P	54	72.97%
e-mail		54	72.97%
Groups		47	63.51%
Online Reading	O R	41	55.41%
Document Sharing	Doc Share	38	51.35%
Simulations	Sim	34	45.95%
Slides		30	40.54%
Animations		30	40.54%
Google		27	36.49%
Video		26	35.14%

**Table 2 Mandatory Technology Non ICT Students**

There are some problems with these two tables. All the courses have a Web Page and every piece of news about the course is published in it. However the fraction of students that answers using the Web Page is less than expected. E-campus use is non mandatory but all the non ICT

courses used in the survey were using it, again this fact is under-reported. Less than half of the students asserts the course uses slides as part of the material for students, and all the courses did. E-mail and groups are overlapped, several students cannot tell apart a mail-group address from a Google or Yahoo group.

### Technology used for learning.

Students need to take notes. Note taking and reviewing are labeled in the literature as *encoding* and *external storage* respectively. *Encoding* is described as generating a personalized written record of the lecture or the class activity. *Storage* is keeping this written record during the gap between presentation and evaluation and use the record for review or study guide <sup>9</sup>.

The potential productivity of reviewing notes is limited by the encoding function of the note taker. Students are notoriously incomplete note-takers, generally recording less than 50% of the critical ideas <sup>10 11</sup>. These facts are addressed by providing students with instructor's notes in the form of course slides. In all the courses we provide the slides in advance of the corresponding lecture. We had some previous experience in researching the way notes were used. <sup>12</sup>.

We asked students how they used the technology as a help in taking notes, in class and out of class when preparing to sit for tests.

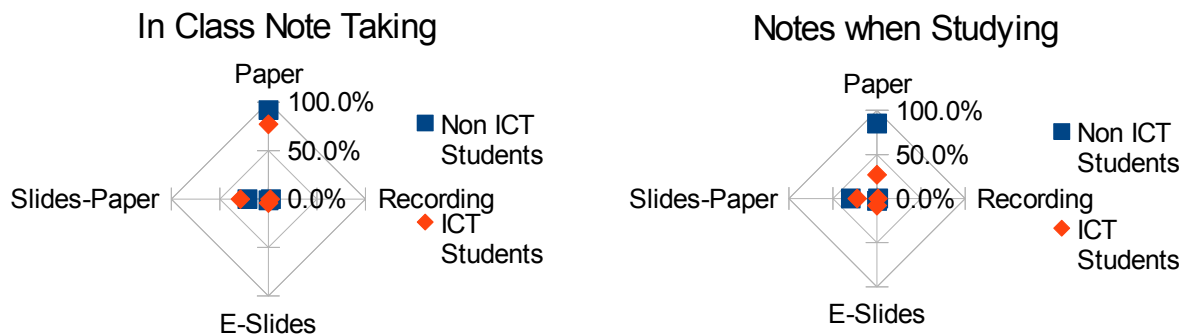


Figure 3 Note taking and reviewing

Slides are clearly under-used, ICT Students use an editor (not necessarily a note taking software) but very few used the e-slide as basis for electronics annotations. They are introduced to this tools in class and teachers use e-annotations in lectures. Also they do not report recording a class. The overall schema seems very traditional and poorly affected by the technology.

When we see the most popular ICT aids used in both groups, the same Items appear. The difference in the positions is accounted for a greater heterogeneity of the ICT Students

Non ICT Students			
Item	Key in Figure	n	%
Course Web Page	C W P	55	74.3%
e-Campus	e-C	55	74.3%
e-mail		55	74.3%
Online Reading		49	66.2%
Wikipedia		45	60.8%
Google		45	60.8%
Groups		41	55.4%
SMS	SMS	41	55.4%
Slides		38	51.4%
Doc Share	D S	38	51.4%

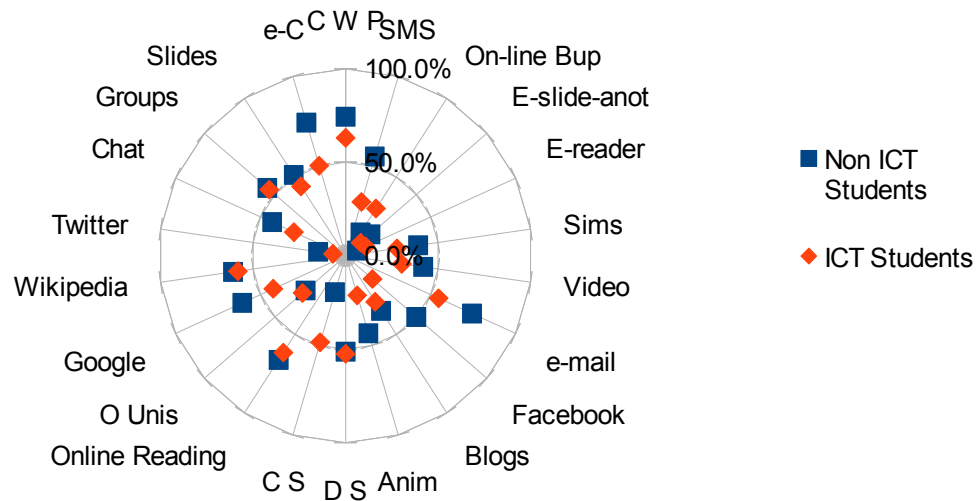
ICT Students			
Item	Key in Figure	n	%
Course Web Page	C W P	166	63.1%
Online Reading		162	61.6%
Wikipedia		153	58.2%
e-mail		144	54.8%
Groups		142	54.0%
Doc Share	D S	138	52.5%
e-Campus	e-C	132	50.2%
Code Share	C S	127	48.3%
Slides		116	44.1%
Google		112	42.6%

Tables 4 & 5 Technology used when studying

population, in age and courses. Students rely on e-mail as the preferred communication method. SMS are less used as teamwork seems to be done using the ad-hoc software available in the e-campus or general sharing technology such as Google or Yahoo groups, Dropbox or Software Configuration Management (SCM) Tools.

The clustering analysis shows no difference between the two cohorts

### ICT Elements Used When Studying



**Figure 4 ICT Elements used when Studying**

As expected, Backup is an unpopular activity even with widespread Internet access and highly automated tools such as DropBox. Simulations and Videos regarded as very helpful by faculty are low in students use. Students also do not seem to search for similar material at other Universities. It is remarkable because the authors spent a lot of Lab-time showing material from sister institutions, playing with simulations and videos to underline key concepts and using the online backup facilities to recover past classes information.

### Technology used for social life and recreation.

The most popular uses of technology in recreational activities as reported by the students are summarized in Table 6. The table is ordered by overall popularity of use, but as can be seen from the different columns, this order do not vary between ICT and non-ICT students.

Again students seem here to under-report some activities such as gaming and over-report others such as book reading. They do not specify what they understand as “file sharing” and in the group interview they further refined the activity as “sending interesting stuff”. A few of the students integrate several activities under a social networking tool such as Facebook. Students regard Facebook as a publishing tool, but when they want something to reach somebody they resort to e-mail or messaging. From interviews with high-school teachers, this trend will change as younger people integrates their messaging in the social networking software.

We did not ask about the legality of downloads or the precedence of the movies or the proper attribution of credits.

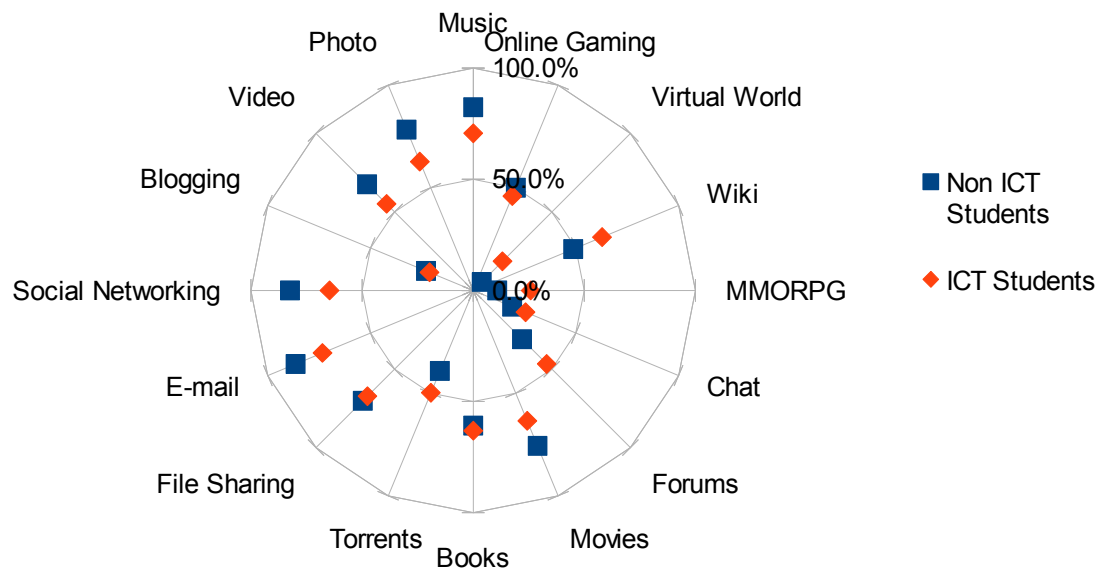


Item	Non ICT Students		ICT Students		All Students	
	n	%	n	%	n	%
E-mail	64	86.5%	193	73.4%	257	76.26%
Music	61	82.4%	186	70.7%	247	73.29%
Social Networking	61	82.4%	170	64.6%	231	68.55%
File Sharing	52	70.3%	177	67.3%	229	67.95%
Photo	58	78.4%	165	62.7%	223	66.17%
Movies	56	75.7%	167	63.5%	223	66.17%
Books	45	60.8%	166	63.1%	211	62.61%
Wiki	36	48.6%	165	62.7%	201	59.64%
Video	50	67.6%	145	55.1%	195	57.86%
Torrents	29	39.2%	131	49.8%	160	47.48%
Online Gaming	37	50.0%	121	46.0%	158	46.88%
Forums	23	31.1%	123	46.8%	146	43.32%

**Table 6:** Recreational use of technology

In the clustering analysis there is no significant differences between the two groups.

### Recreational Usage of ICT Devices



**Figure 5** Recreational use of Technology

### Discussion of the results

Some Items such as gaming appear to be under-reported and some such as books are clearly over-reported. We attribute this to a response bias<sup>13</sup> where students responds wishing to please an engineers image of themselves.

Analyzing the reported data on mandatory technology and comparing it with the technology we know is used in the courses, we found that a lot of technology went unnoticed. In the group interview we could state that students did not identify the used technology with the survey Items.

English language is perceived as a mandatory skill among students. In the case of ICT students where data from higher courses is gathered, it can be seen that mastery in English increases as they progress in their careers. It is usual for teachers to make students read material in English and the awareness of the importance of the language increases with this practice.

The use of technology when studying showed that the main difficulty laid not with the mastery in the technology but with the approach to the learning experience. Students favor passive technology such as online reading to more active such as the use of simulations to explore possible outcomes.

We also noted a impossibility to abstract the function from the device. They report broadly different numbers of mp3 players, cell-phones and cameras, but the majority of the phones share it in the same device. In the group interview when students were asked about photos or recording, they answered they did not bring the device to the classroom, and became surprised that they did have it in their phones.

Sometimes a tool is introduced in class either in an explicit way such as explicit asking Software Configuration Management tools in sophomore year of ICT students or in an indirect way, such as using it in a lecture. Survey data shows that the tool is not integrated into the student baggage of skills. They do not appear using it afterwards unless they are asked to.

Some technologies aimed to help in mobility and to protect against accidental loss of data such as Dropbox remain unused by most of the students. In some case lack of familiarity may be the cause, but generally it is the product of the way students approach to the technology.

When looking for recreational use of technology, they also rely on passive technology and use social networking as a way of connecting among themselves. There is little evidence of the use of technology in collective creative way. This is in line with the research data that rejects the notion of Digital Natives<sup>5</sup>.

### **Answers to our research questions.**

For the first research question our answer is that we cannot rely on external sources to teach technology to our students. We must allot class time to show and explain the use and advantages of the technology, balancing it with the course context. We cannot expect an independent awareness such as we do with English reading proficiency.

Internet open classrooms are a controversial issue<sup>14</sup>. It opens a lot of distractions opportunity and in some places faculty ask to unplug the lab from the Internet. Our opinion is that it is the same as open book tests. You have to change the way you test to use an open book format. It can be done in certain courses and not in others. However the presence of Internet in the classroom can be used to enhance learning and to promote critical thinking skills<sup>13</sup>.

We also did not find some preferred ICT tools which students masters and ready to integrate in the teaching and learning process. Students showed experience in browsing, messaging, mailing and file sharing. However this experience has to be enhanced with grouping, virtual meeting and forum participation. Also supporting technologies such as on-line backup and on-line annotations must be shown and used in lectures to help students to incorporate their use.

We found no difference between majors in the surveys answers. Both cohorts seek guidance in the use of technology and we must provide it.

## Acknowledgment

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