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ARTICLE

From Laptops to Competences: Bridging the Digital Divide in Education*

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Abstract

Most of the existing literature that deals with the digital divide in the educational system focuses either on schools or universities, but rarely do we see a vertical approach where the system is considered as a whole. In this paper we relate initiatives that aim to bridge the digital divide in the current situation in higher education. We discuss why policies that focus on infrastructures (e.g. laptops) are not the answer, as they mostly leave digital competences unattended, leading to (or not helping to amend) the digital void in universities in matters of skills. We end by proposing a general framework to define digital skills so that they are included in syllabuses at all stages of the educational path.

Keywords

digital divide, digital competences, digital skills, digital literacy, higher education

De los portátiles a las competencias: Superación de la brecha digital en la educación

Resumen

La mayoría de la literatura existente que trata de la brecha digital en el sistema educativo se centra en las escuelas o universidades, aunque pocas veces vemos un enfoque vertical donde se tenga en cuenta el sistema en conjunto. En este artículo, identificamos las iniciativas que intentan tender un puente sobre la brecha digital en la situación actual de la educación superior. Tratamos por qué las políticas que se centran en las infraestructuras (p. ej., portátiles) no son la respuesta, puesto que principalmente dejan las competencias digitales desatendidas, conduciendo a (o no contribuyendo a corregir) el vacío digital en las universidades en materia de habilidades. Finalizamos con la propuesta de un marco de referencia general para definir las capacidades digitales de forma que se incluyan en los programas de estudios en todas las etapas del recorrido educativo.

Palabras clave

brecha digital, competencias digitales, habilidades digitales, alfabetización digital, educación superior

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1. Introduction

There is broad agreement that (a) Information and Communication Technologies (ICTs) are having a huge impact on the world we live in, (b) that this impact is changing the established socioeconomic and power relationships, and (c) that a necessary, albeit insufficient, condition to ride the wave of changes (and not be engulfed by it) is to enter the informational paradigm by adopting and mastering digital technologies.[1]

When transposed into the educational system, this concern to catch up with digital technologies has seen three derivatives, which, chronologically, are the following:

i. Access itself to digital technologies, meaning students, and occasionally teachers and institutions, have physical access to computers, so they do not suffer from any digital divide[2], and how they learn to use computers;
ii. Exposure to these digital technologies is changing the way students learn, how they are engaged and their attitudes (Prensky, 2001a, 2001b, 2005; Wesch, 2007, 2008);
iii. Impact of the previous two combined on academic performance; that is, how academic performance changes when there is access and in line with the students' "new" attitudes (Hung & Russell, 2006; Castaño, 2009).

Not surprisingly, these have normally been dealt with using three respective approaches from a static point of view, analyzing the status quo at the K-12 *or* secondary *or* higher education levels and, when specific changes are introduced in this scenario, analyzing the results within the same scenario.

We want to introduce here a dynamic approach: on the one hand, briefly analyze the state of the digital divide at the educational levels[3] and compare the findings at different stages of the education system, especially in secondary and higher education. On the other hand, we highlight the main characteristics of three projects aiming to bridge the digital divide in primary and secondary education – Plan Ceibal, in Urugay; Habilidades Digitales Para Todos, Mexico; Plan Escuela 2.0, Spain – and relate them to the need to bridge the digital divide in higher education.

To do so, we use Peña-López's (2009a) comprehensive 360º digital framework

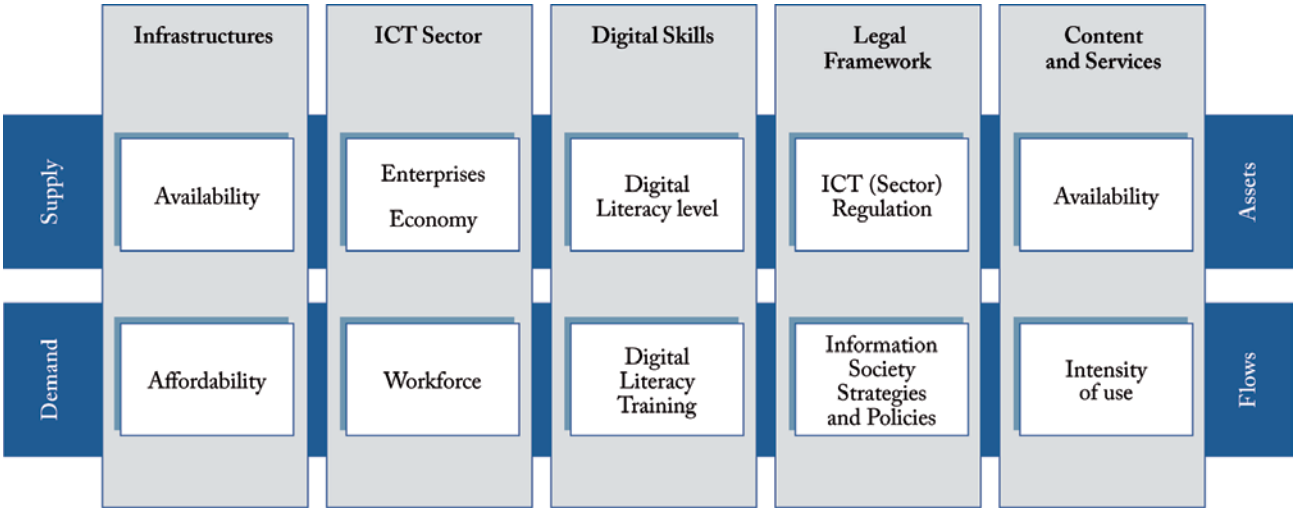

FIGURE 1: A comprehensive 360º digital framework to model the digital economy
Source: Peña-López, 2009a

1. Amongst the hundreds of references, we chose CASTELLS (2007) to support our ideas, as the author points in the same direction as this paper, well beyond infrastructures and technology.
2. In a very narrow sense, as we see later on. For a selection of publications with this approach, see PEÑA-LÓPEZ (2009a), chapter 3, and the corresponding bibliography.
3. We use data specifically from higher income countries, though some conclusions might also apply to lower income countries if we consider that there is a common path of digital development with several stages, as viewed in PEÑA-LÓPEZ (2009a).

which can be adapted and, moreover, simplified for educational purposes as follows:

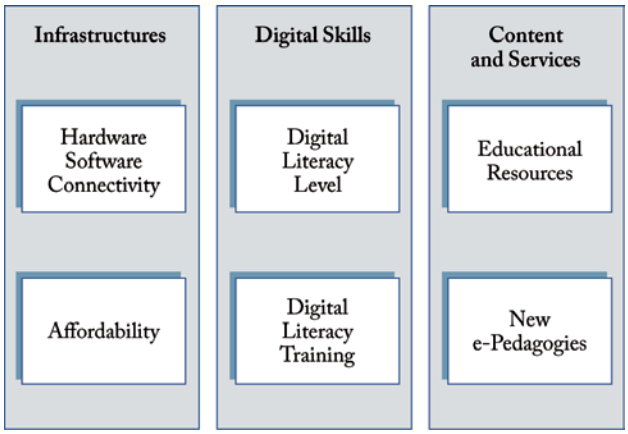

Figure 2: A comprehensive 360º digital framework to model e-education
Source: own material

Here, the initial pillars have been reduced to just three, leaving aside the ICT sector and the legal framework as they belong to higher tiers of policy-making, way beyond the reach of the educational system's usual decision-making spheres.[4] The six key issues pictured in Figure 2 are:

- Infrastructures: self-explanatory, what is needed and introduced in the classroom to enable physical access to Information and Communication Technologies
  - Hardware, software and connectivity: Normally solved by providing desktops or, more recently, laptops to students, equipped with free software or prepaid proprietary software licenses and connected to the Internet or each other by installing WiFi antennas at school and/or at home and/or mesh connectivity to create mesh networks for students' computers.
  - Affordability: Hardware, software and connectivity are provided – totally or partially – by the government, when these are not free (see above).
- Digital Skills: whatever is needed to use the infrastructures. We keep under the same definition both literacy skills and competences, acknowledging that the difference is significant.
  - Digital literacy level: the point of departure, the "stock" of digital skills.
  - Digital literacy training: what is done to change the digital literacy level, both formal and informal training. Projects usually include teaching teachers and/or students digital competences, explicitly or implicitly, in the use of Infrastructures.
- Content and Services: what is used on or from computers for teaching or learning purposes.
  - Educational resources: handbooks, webquests, quizzes and all kinds of digital educational materials. The solutions provided for the educational level range from digitalised versions of handbooks to collaboratively generated user content on wikis and other teamwork platforms.
  - New e-pedagogies: normally the most overlooked part of the whole process, ranging from slight changes in syllabuses to whole redefinitions of teaching and learning methodologies which now include ICTs as a tool. Hence, e-pedagogies could stand for *enhanced* pedagogies and not electronic pedagogies.

Keeping the schemes of Figure 1 and Figure 2 in mind, let us see what the digital landscape looks like in the education system.

2. State of the digital divide in the education system[5]

One of the best studies available on the educational system is featured in the OECD's Programme for International Student Assessment, better known as PISA (OECD 2002, 2007a, 2007b). Its main limitation – at least for our purposes – is that it only covers secondary education,[6] but we believe, and try to demonstrate, that extrapolating its findings back and forth serves our goals while not implying an incorrect conceptual leap.

Some of the main conclusions of the PISA programme for their 2006 assessment in matters of ICTs were as follows:

4. The five original pillars could have been preserved and adapted to the educational system, but we would rather keep the model as simple as possible for clarity rather than for completeness.
5. This section focuses mainly on OECD countries, either directly or indirectly analyzing the case of Spain and Catalonia. Notwithstanding, FARRELL & ISAACS (2007) and FARRELL, ISAACS & TRUCANO (2007), though in less detail, mention what is happening in African countries and how they might be following a similar path to OECD economies.
6. Only covers 15-year-old students.

- 35% of the students write documents once or twice a week and 17% do it almost every day. If we add the ones who do it a few times a month (24%), 76% of the students regularly use word processors.
- This figure of 76% drops to 40% when measuring how frequently they collaborate through the Internet: almost every day (10%), once or twice a week (16%) or a few times a month (14%).
- Computer usage is mainly at home, with 67% using the computer almost every day at home, while at schools, just 3% use it almost every day and 37% do so once or twice a week. On a monthly basis we see that 86% of students used a computer at home at least a few times a month (including the former daily usage).
- Not surprisingly, although 67% of the students stated that they followed training courses on ICTs at school,[7] the majority also stated that they had learnt through practice (90%) or with help from friends (78%). It seems reasonable to infer that they follow a compulsory subject on ICTs at school but most actual learning happens outside the classroom.
- The previous statement is reinforced by the fact[8] that 17% of schools denounce a shortage or inadequacy of audiovisual resources, computer software for teaching (21%), Internet connectivity (9%) and also a shortage or inadequacy of computers for teaching purposes (18%).

This last point, with just a fifth of schools having shortages on ICT issues, may appear quite positive, but is less so when considering teachers' use of ICTs at schools: it is possible that only a fifth of schools denounce shortages but the remaining four fifths do not even consider using them. Using data for Spain (Sigalés et al., 2008; 2009)[9] – perfectly matching the general case of OECD countries – we see that:

- 47% of schools state that ICTs are being introduced on most subjects
- Teachers use ICTs on a weekly basis to create documents (48%), to prepare their classes (40%) or to keep track of student assessment (20%). But only seldom use them to collaborate with other colleagues (12%), to update the website on their subject with new content (8%) or to get in touch with parents (4%).
- Only 26% of teachers use ICTs in the classroom on a weekly basis (28% never, 30% occasionally, 15% monthly)
- Among teachers, 79% state that they have used ICTs *at least once* in the classroom to support oral presentations, while between 53% and 62% affirm having used them *at least once* to support an explanation during a traditional lecture. Only 26% say they have used ICTs *at least once* to communicate with students and a mere 19% have set up a virtual classroom where traditional lectures are alternated with online sessions.
- Students affirm having used ICTs *at least once*, for information searches on the Internet (81%-89%), for writing assignments (69%) and in other areas (59%). Only very few state they have used ICTs *at least once* for communication with fellow students (29%), teamwork (20%) or virtual environments (19%).

Overall, the scenario is quite interesting: students show basic computer and information handling competences which are occasionally put into practice in the classroom, while almost all of them are used at home; skills training comes mainly from outside school. Teachers reinforce a traditional way of lecturing with some ICT support, limiting more intensive use for managing and organizing lectures rather than directly applying them in innovative pedagogical ways.

The OECD's Teaching and Learning International Survey (TALIS) clearly states: "The aspect of their work for which teachers most frequently say they require professional development is 'Teaching special learning needs students', followed by 'ICT teaching skills' and 'Student discipline and behaviour'". Teachers know how to use ICTs, but do not know how to introduce them into classrooms.

This scenario in secondary education is not very different from higher education. According to Duart et al. (2008a, 2008b):

- 54% of students have never taken and 46% of teachers have never taught a subject that used the Internet in the classroom.
- 71% of higher education teachers have never studied online.
- Most teachers (51%) and students (71%) agree on the positive impact of the Internet in the learning process, although they acknowledge it is not faster or easier.

7. Data from INE (2007).
8. OECD data.
9. This work follows a methodology already developed for Catalonia (MOMINÓ et al., 2008a; 2008b; 2008c), finding similar results, though they are slightly better for the Catalan case. See also RUIZ TARRAGÓ (2009).

- Most students (93%) consider themselves to be average to expert users of the Internet.
- At the same time, they don't think online information is better (70%) or more accurate (72%).
- Students use the Internet generally to communicate with the teacher (74%) or to look for different kinds of information (84%-95%), to collaborate (65%), or generally to follow the course (46%).
- There is no clear preference among students for online materials nor do they state that online materials imply better academic performance, though the majority acknowledge that the overwhelming amount of information is difficult to manage. Maybe this is because what they find is plain text (94%) or web pages (61%) and some multimedia (71%), but no other richer educational technologies.
- Teachers use the Internet to contact their students (90%) or support their lectures (86%), but less than half of them (46%) use it for student assessment or tutoring.
- In fact, besides e-mail (96%), web pages (75%) or forums (50%), all other online tools have negligible usage levels.
- The barriers to ICT adoption for teaching are many and all equally important. We can summarize them as lack of institutional e-awareness which turns into lack of recognition, support and resources, and lack of training. But never lack of will or a negative attitude.

Briefly, the diagnosis is similar to that of secondary schools: both students and teachers believe they are tech savvy, there is a certain degree of infrastructure and content available, but none of it is specifically designed for teaching purposes, and even less has the traditional lecture been adapted or substituted by a pedagogic approach enhanced by ICTs.

Pedró (2009) summarizes it this way: "When considered independently of other factors, this close link to computers does not automatically transform higher education students into new millennium learners". Nor does it transform teachers, we could add.

3. Laptops in schools

Having seen the nature of the digital divide in the educational system, especially in secondary and higher education, let us now turn to the programmes that are being set up to fight it. We will assume that actively bridging the digital divide in secondary school implies more equal opportunities for future students during their time at university, that is, we want to fight the digital inequalities at university before they take place, hence, at secondary school.[10]

Let us take three quite recent programmes to bring ICTs into secondary school classrooms and let us briefly characterize them according to our comprehensive 360º digital framework to model the e-Education:

Table 1: Comparison of ICTs in school programmes

Programme Category	Plan Ceibal (Uruguay)[11]	Habilidades Digitales Para Todos (Mexico) [12]	Escuela 2.0 (Spain) [13]
Infrastructures	Laptops Educational Software Connectivity	Laptops, Desktops, Interactive Whiteboards	Laptops, Desktops, Interactive Whiteboards
Digital Skills	Training in a comprehensive set of digital skills for students, teachers and the community	Training in unspecified digital skills for students and, seemingly, teachers	Unspecified technological literacy training
Usage	Ad-hoc online educational materials Ad-hoc ICT enhanced pedagogical methodology	Ad-hoc online educational materials Unspecified ICT enhanced pedagogical methodology	Digitized traditional handbooks No specific methodology

Source: own material

10. We believe this assumption to be a fair one, as fighting this inequality at the university might be too late.
11. http://www.ceibal.edu.uy/
12. http://www.aulatelematica.com.mx/
13. http://www.plane.gob.es/escuela-20/

The first thing that we want to highlight from the previous table is how counterintuitive it is. We know that Mexico and Uruguay are similar in terms of purchasing power parity (PPP) of GDP per capita, based on the US$)[14] and in terms of e-Readiness[15] while Spain scores much higher on both indicators. However, the Spanish programme is absolutely biased towards infrastructures – where Spain does not perform badly, as we saw in the previous section, and the World Bank and the World Economic Forum confirm this – while it leaves aside almost everything related with digital content (part of the programme is devoted to that issue, but without any kind of innovation) and absolutely no comprehensive strategy in matters of digital skills and competences.

In his assessment of the One Laptop per Child project in Ethiopia, Hollow (2008, 2009)[16] suggests three key aspects that perfectly apply to any project of this kind:

- Teacher training – pedagogical and technical
- Strategic plan for integration into classrooms
- Communication with parents and community

Indeed, Luyt (2008) strongly stresses what he calls the "negotiation of technological meaning", and how the future of a programme to put laptops into classrooms and, more ambitious, into the educational system will necessarily be based on a common interpretation of technology, where "common" refers to a meaning acknowledged by technologists, politicians, educators and the community at large.

Maybe because of this lack of negotiated meaning, maybe because of lack of strategic plans or teacher training, we have yet to find sound evidence for laptop-only based programmes to bridge the digital divide in education. Mouza states that "a better understanding of *how*, *when*, and *to what degree* they work to support student learning, particularly with student populations that have not received much attention to date is needed", admitting that most of her findings are inconclusive in matters of impact, although they might work at the engagement level.

This is similar to what Warschauer (2007, 2008) found in his study on use of laptops in secondary schools. In fact, he goes one step further and, though he finds little impact in the levels of digital literacy as a positive benefit of using laptops in the classroom, he also finds that, without any accompanying measures – such as reinforcing socioeconomic status related variables like income, cultural level, etc. – the impact might even be negative. In other words: laptops in the classroom are only multipliers of the present skills and attitudes of students: if they are good at school, they will be better; if they are good at getting distracted, they will master distraction. Not a very different conclusion from what Neuman & Celano (2006) found for public libraries.

So, going back to our examples, we see that as we move towards the right in Table 1 things deteriorate, as the programmes become more technology-centred and lose their skills/competences component. Surprisingly, when we consider the profile of university students, how and where they use computers and the Internet, we find that infrastructure is *not* the issue and not even *an* issue, what is important are skills and competences, especially when put into practice within the learning process – and the teaching process, if we look at teachers. If we understand these laptops-at-school programmes as a way to fight the digital divide in education of the future (i.e. in higher education), it seems that we are "solving" what was not a problem (physical access) and we are setting aside what really was (content and, especially, competences). Thus, the comprehensiveness that made those projects candidates for success is increasingly lost as we keep away strategic considerations as effective usage of ICTs by means of the appropriate digital competences.

4. A digital skills divide

Although our point is quite clear at this stage, we do still want to reinforce our belief that the digital divide in education – and especially as we move along and up the educational system until reaching university – is not a matter of physical access but a matter of digital skills and how competent students (and teachers) are at computer and Internet usage.

Of course, there are places (if not all) were access is deficient or can be improved, but as the Uruguay and Mexico programmes show, there is no *real* access if only infrastructures are supplied. On the other hand, the data we have presented clearly show where the bottleneck is, at least for OECD countries.

Carvin (2000), Hargittai (2002) or Warschauer (2003), among many others have repeatedly given arguments for the crucial importance of digital competences as the key factor between infrastructures (hardware, software and connec-

14. THE WORLD BANK (2009).
15. DUTTA & MIA (2009).
16. We also suggest Tim UNWIN's "Towards a framework for the use of ICT in teacher training in Africa" (2005) as a good complement to HOLLOW (2008, 2009).

tivity) and their expected output and impact (digital content and services, and effective usage for specific purposes).

But as the Internet and digital communications evolve, it is not only a matter of mastering technology, or even mastering the handling of information. It is how we are present in the global – timeless and spaceless – conversation that does matter. Castells (2007) and Hargittai & Walejko (2008) already speak, respectively, of how "media have become the social space where power is decided" and how "the existence of such a participation gap will have increasing implications for social inequality".

And though Prensky's (2001a, 2001b) metaphor might be useful to identify the pivot of the analogue/digital continuum, it is also true that while "youngsters in higher income countries have been born in an environment where ICTs are completely socialized, this shouldn't lead us to false expectations about their real digital competence" (Mir, 2008).[17]

But, what kind of digital competences? Empirical evidence provided by, among others, Empirica (2006) and Carstens & Pelgrum (2009) clearly shows that the usual technological or even informational skills – that would in some way describe Prensky's natives – are far from being enough. Beyond attitudes, there is a whole constellation of strategic digital competences that are needed so that the mix of ICTs in education can have an impact, both in terms of digital literacy and in terms of academic performance. Pettenati et al. (2009) talk about personal knowledge management skills while Jenkins (2006, 2009) and Jenkins et al. (2006) depict the convergence of old and new media to shape a brand new culture.

All these different approaches to digital skills imply changes in teaching, in syllabuses, in learning practices or in organizations. In the next section we chart our own comprehensive approach to digital skills and how they are required in several stages of life. This is where we think the emphasis should be when talking about bridging the digital divide in education at large and, most emphatically, in higher education, where critical citizens are shaped.

5. Conclusions? Towards a comprehensive definition of digital skills

Digital literacy (or digital literacies), e-skills, e-competences, skills for the information society, etc. There is plenty of literature on digital literacy in a broad sense.[18] And there are as many names as publications to describe concepts, all similar to each other, but with shades and subtleties that give them very different meanings.

In our opinion, two problems are both the cause and the consequence of this lack of understanding, closely linked and a major barrier when facing a digital divide that needs to be bridged.

The first one is that digital skills are usually examined at a micro level. For instance, the most instrumental digital literacy (i.e. technological literacy) can be described without taking into account informational literacy, knowledge management, the sociocultural framework and so forth.

The second one is that, quite recurrently, digital skills are not taken dynamically, but as a fairly static, closed, black box. If we take media literacy as an example, we believe that a necessary corollary to the acquisition and mastering of instrumental multimedia skills should be followed by reflections on the change of the Fourth Estate or the rise of the Fifth Estate (Dutton, 2007).

It is indeed this second aspect, the dynamics of digital literacy and its actual application to everyday life – education, work, leisure, politics, social engagement – that is most closely related to education, especially when we focus on higher education and lifelong learning. Nevertheless, it is the most unattended one, as we have seen in the previous sections.

This dynamics in digital skills building can be represented as shown in Figure 3.

Where the concepts are:

- technological literacy: the skills to interact with hardware and software;
- informational literacy: the competences to deal with information, normally by means of ICTs (applying technological literacy). We could define two stages here: a more instrumental one, related to how (relevant) information is obtained, and a more strategic one related to how that information (or knowledge, if we speak of personal knowledge management) is managed;
- media literacy: skills and competences to deal with several media, make them interact and integrate them in a single output. A lower level could also be defined,

17. A statement definitely along the same lines as quoted before by PEDRÓ (2009).

18. Visit http://ictlogy.net/bibciter/reports/types_categories.php?idcat=31 for a collection of works on digital literacy. For an abridged version of the former, please see http://ictlogy.net/bibciter/reports/bibliographies.php?idb=45

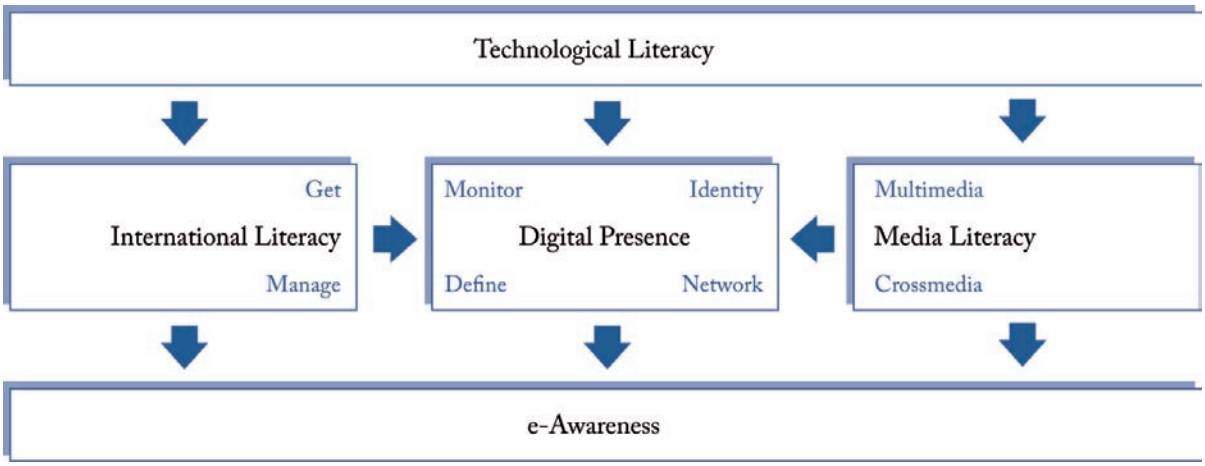

Figure 3: Towards a comprehensive definition of digital skills
Source: own material

multimedia, where interaction would be more mechanical, and an upper one, crossmedia, where interaction and integration would respond not to technical possibilities but to a strategic design, building an ecosystem of different media, not a simple multimedia output;

- digital presence: Is centred on the individual. These are the digital skills needed to monitor and establish a digital identity, and the skills to actively define it and use it for networking or interacting with other people digitally;
- e-Awareness: the most strategic (even philosophical) stage is the one related to being aware of how the world and our position – as a person, group, firm, institution – varies because of digital technologies.

These concepts could be rephrased as:

- Technological Literacy: HOW
- Informational Literacy: WHAT
- Media Literacy: WHERE
- Digital Presence: WHO
- e-Awareness: WHY

Some examples of what these digital skills and competences mean in everyday life are as follows:

Table 2: Application of comprehensive digital skills in everyday life

	School	Firm	Government	Citizen
Technological Literacy	Acquisition Evaluation			
Informational Literacy	Acquisition Evaluation	Life-long learning		Empowerment
Media Literacy	Acquisition Evaluation		4th & 5th Estates Open government Goverati	Empowerment User Generated Content
Digital Presence	e-Portfolios Personal Learning Environments	Networking e-Portfolios	Transparency Accountability Participation	Identity Socialization
e-Awareness		Business models Self-programming Connected worker	Participation Connected institution	Privacy & Security Participation Connected citizen

Source: own material

If, yet again, we understand the university as the crossroads of learning and citizenship, learning and entrepreneurship, and learning and governance, bridging the digital divide in higher education is a much more complex thing than supplying students with laptops.

The approach above is completely exploratory and far from complete. It is, however, a reflection of what we sense is happening at the applied level, when sometimes too many concepts have to be put to work at home, in school, at work or in social and political engagement. In other words, how do we put the tools – and problems, and questions – of the information society in the hands of leaders, decision-takers and policy-makers?

We do not need static frames, but dynamic paths. From the simplest needs to the deepest understanding. And build bridges between these stages.

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