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MONOGRAPH

Redefining the Digital Divide in Higher Education

Ismael Peña-López (coord.)

Summary

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Monograph "Redefining the Digital Divide in Higher Education"

INTRODUCTION

Framing the Digital Divide in Higher Education

Ismael Peña-López

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Abstract

This is the introductory article to the monograph "Redefining the Digital Divide in Higher Education". The article describes a comprehensive approach to the phenomenon of the digital divide and digital access, based on Marc Raboy and Mark Warschauer's research. This approach depicts the evolution from mere physical access to effective use of information and communication technologies in the field of higher education. Within this framework, the articles in the monograph are presented highlighting their role in contributing to a comprehensive approach and reflection on the digital divide in Higher Education.

Keywords

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

Contextualizando la brecha digital en la Educación Superior

Resumen

Este es el artículo de presentación del monográfico «Redefiniendo la brecha digital en la Educación Superior». El artículo describe un enfoque integral sobre el fenómeno de la brecha digital y el acceso digital, basándose en las investigaciones de Marc Raboy y Mark Warschauer. Este enfoque representa la evolución desde un acceso meramente físico al uso eficaz de las tecnologías de la información y la comunicación en el ámbito de la educación superior. Dentro de este marco de referencia, los artículos del monográfico se presentan destacando su papel en la contribución a un enfoque integral y reflexión sobre la brecha digital en la educación superior.

Palabras clave

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

1. What digital divide?

Most articles on the digital divide – and especially one written to introduce a monograph on it – are expected to provide a specific, univocal, sound definition of what the digital divide is, normally relating it to the notion of 'access'. But the digital divide is a flexible, changing concept, particularly when taking into account the dimensions of space and time, the latter with a static or dynamic approach. As regards space, the different conceptions vary depending on countries or even regions of the world[1]; as for time, the advancement of technology has changed the concepts of access and digital divide and has also evolved over time;[2] and finally, our appreciation of the digital divide also varies at any point in time as, when looking at different age groups in the population, what children understand as digital divide is quite different from what their grandparents do.

Faced with such a changing landscape, we believe it is safer to avoid providing yet another definition of digital divide – or, positively stated, digital access – and provide instead a framework in which a variety of approaches can fit while keeping a minimum level of coherence and consistence.

We think such an approach can be achieved by referring to the articles by Marc Raboy[3] (1995, 1998) and Mark Warschauer[4] (2002, 2003), and focusing on what they call the Telecommunications Model, the Literacy Model and the Broadcasting Model, the latter renamed the e-Readiness Model in a previous publication (Peña-López, 2009).

Marc Raboy argues that, in the Telecommunications Model, the "emphasis is on the sender, on the capacity to get one's messages out, and access refers to the means of communication". That is, digital access under this model means mainly making infrastructures available to send a message (literally), to connect to the Internet, to be able to use specific web services, etc. In other words, this approach focuses on hardware, software and connectivity, which are the main components that enable 'reaching out' in digital terms.

It is easy to see that while this is still the approach of many today – especially telecom operators and other service providers – it is an outdated vision of ICTs, where deploying infrastructure is a must and a priority, upon which all the digital content and services that make up the Information Society can be built.

This model – labelled the 'device model' or the 'conduit model' by Mark Warschauer[5] – falls short when adding the human factor to the equation: infrastructures do not work on their own, they need to be operated and, indeed, operated in a specific way by a specific person. It is the Literacy Model that takes into account the individual's capacity and ability to use their infrastructure for their own purposes and benefit.

In a certain way, the Literacy Model focuses on the area between infrastructures and the object upon which these infrastructures are applied: digital content and services. If we take skills and competences as an axis of symmetry, we can go back to Raboy and his definition of the Broadcasting Model, which is the opposite of the Telecommunications Model: "in the broadcasting model, emphasis is placed on the active receiver, on free choice, and access refers to the entire range of products on offer".

Hence, the Broadcasting Model includes everything related to usage, usually even considering the context of this usage. This is exactly the case of the World Economic Forum's Networked Readiness Index (Dutta & Mia, 2009) and the Economist Intelligence Unit's e-Readiness Index (2009), the two most emblematic examples.

How should we understand these approaches or models in the field of higher education?

2. The digital divide in higher education

Though every categorization, every attempt at classification, is necessarily artificial, reality being neither binary nor categorical, we believe that in doing this mapping exercise we can help the reader to locate and, more especially, frame concepts and thoughts so that they can be retrieved easily.

When we speak of the Telecommunications Model in higher education, the first thing that comes to mind is hardware. Wiring classrooms and providing students with physical access to computers – normally desktops – has

1. See, for instance, RODRÍGUEZ & WILSON (2000), REDING (2007), ÇILAN et al. (2008) or HOWARD & MAZAHERI (2009).
2. See, for instance, the huge gap between ALBERY (1995) and HARGITTAI & WALEJKO (2008).
3. Although Marc Raboy speaks about communications and not strictly about Information and Communication Technologies, his discourse can be easily extrapolated to the case of the digital divide and digital access.
4. All citations and quotes of these authors always refer to the aforementioned articles.
5. The Conduit Model can be understood as an enhancement of the Device Model, where there is a change in philosophy from a concept of access as ownership towards access as use.

been (and, in fact, still is) either a way for institutions to bridge the digital divide or a way of measuring how deep and wide the digital gap is.

Mobile technologies mean that not only desktops but also laptops – and the myriad of other mobile devices like smartphones, portable gaming consoles, etc. – are now being taken into account when considering 'wiring' a classroom.

Yes, "wiring", or connectivity, is necessarily and increasingly a must when speaking about bridging the digital divide inside and outside classrooms. And even though "wiring" meant being connected, wires are being put to one side by the pervasiveness of wireless connections.

Of course, hardware does not finish at an individual level but has to be extended to the collective. Interactive blackboards – on lower levels of the educational system – and overhead projectors – on higher ones – are increasingly supporting the interaction between teachers and students.

As for software: it is not only what makes computers run, but what also extends the classroom to far beyond its walls and its courses. It is a powerful tool to bridge the digital divide in remote areas, provided connectivity is ensured. Hence, there has been a great deal of debate on the topic of Free/Open Source Software (FLOSS) and FLOSS for educational purposes (FLOSSE), its flagship being the virtual learning environments (VLE) and personal learning environments (PLE) which allow for more and better educational programmes.

On the literacy side of things, the first concern is still how to acquire digital skills and, more importantly, how to turn them into digital competences. The debate around digital skills has nevertheless ended quite often in a clash of cultures or, rather, a clash of generations: are students the ones that have to be trained in these skills, or are these so-called digital natives the ones who will end up training their analogue teachers? Probably a bit of both, because, as new educational patterns and theories emerge, neither group completely masters the digital arena.

Moving on to the e-Readiness Model in higher education, these new educational patterns, methodologies and theories have emerged both to provide education with a context in the digital era and with a new type of content and services. Along the lines of FLOSSE, but now applied to content, the debate has focused on open content – with MIT's OpenCourseWare and Creative Commons' licenses as flagships – as a means to provide free and flexible content to all students, and to provide free, flexible and cooperative content to their teachers.

The Telecommunications, Literacy and e-Readiness Models have, of course, all been analysed not only from the point of view of mere access or usage, but their impact on access, measured in several ways: economically, as the returns on investment made in digitizing classrooms; educationally, as the increase or decrease of quality in learning and/or better academic performance, etc.

3. Framing the digital divide in higher education

This monograph relies heavily on the previous conceptual framework. Not that the authors had it explicitly in mind – though they all know these developments very well – but we, as editors, thought it would be useful to carry out a comprehensive review, from simple physical access to infrastructures to the more complex and philosophical challenges of digital empowerment emerging from education.

Though the following articles clearly overstep the boundaries between the models we have just introduced, we have tried to interweave approaches that, put in a logical order, can give the reader an approximate but fairly comprehensive view of ideas on the digital divide in higher education.

Matti Tedre, Frederick Ngumbuke and Jyri Kemppainen are the authors of "Infrastructure, Human Capacity, and High Hopes: A Decade of Development of e-Learning in a Tanzanian HEI", a most interesting article for many reasons. First of all, because southern voices are rarely heard in generic academic journals, i.e. based in non-southern or higher income countries. Secondly, because of their profound knowledge in the field and the duration of the project, the authors have the right to speak of short and long term events, depicting not only the final achievements, but also the whole process over the years. Lastly, because the article begins with the basic components of digital access – infrastructures and our Telecom Model – but quickly moves on to skills training as a necessary next step towards digital empowerment.

Ismael Peña-López takes over from that point with "From Laptops to Competences: Bridging the Digital Divide in Higher Education". He first speaks about the state of the digital divide in Europe in the field of education, warning about the existing bias towards infrastructure-based indicators. He then passes quickly on to several government projects aiming to bridge the digital divide – based on these indicators – and the existing literature that supports or rejects the expected success of these policies. Finally, he focuses on the crucial role of digital skills and competences, and drafts what could constitute the keystone in this field, to make sure investments in infrastructures are used effectively and have an impact on education.

Neil Selwyn goes one step further in "Degrees of Digital Division: Reconsidering Digital Inequalities and Contemporary Higher Education". Arguing within the context of the e-Readiness Model, in new and unexpected ways he lists the complexities of the continually evolving digital divide, and how former conceptions might prove useless as technologies evolve and people adopt, or refuse to adopt them – in new and unexpected ways. He pleads for a redefinition of the educational system as a whole, in order to make it compatible with a new global, digital world that has radically changed since the World Wide Web came into our lives. The importance of Selwyn's paper lies especially in the understanding of the dynamic component of the digital divide and the transforming power of ICTs that are reshaping our daily lives in unprecedented and unpredicted ways.

Our last paper, Jonatan Castaño's "Digital Inequality Among University Students in Developed Countries and its Relation to Academic Performance", focuses on what we mentioned in the previous section: impact. Castaño also begins with a general description of the panorama in higher education in terms of digital development, then goes on to analyse the relationship between usage of the Internet, digital skills and impact on academic achievement. Needless to say, Castaño's point of view should be the beacon to lead all applied research, and the point where all research should converge in the end: we put this monograph together following a path, first laying the paving stones as the necessary infrastructure, then leading to human training, and continuing towards context and reflection. But the whole path, the whole way, should lead towards a goal, towards the improvement of human lives. Poets often say that travellers should enjoy their journeys, and they are right. But clear destinations to set one's hopes on make the journey even more enjoyable.

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About the author

Dr. Ismael Peña-López
Lecturer of Public Policies for Development, Department of Law and Political Science
Universitat Oberta de Catalunya

Av. Tibidabo 39-43
08035 Barcelona, Spain
ipena@uoc.edu

PhD in the Information and Knowledge Society, Open University of Catalonia (UOC). Bachelor in Economics, Autonomous University of Barcelona (UAB). Master in environmental auditing and planning, Instituto de Investigaciones Ecológicas (IIE). Specialist postgraduate in Knowledge Management, Open University of Catalonia (UOC). Lecturer of Public Policies for Development, Department of Law and Political Science, Open University of Catalonia (UOC). Researcher of the Interdisciplinary Research Group on ICTs (i2TIC), Internet Interdisciplinary Institute (IN3). Works in aspects related with Information and Communication Technologies for Development (ICT4D), with special emphasis on education, governance and empowered participation. He is editor of ICTlogy (http://ictlogy.net).

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ARTICLE

Infrastructure, Human Capacity, and High Hopes: A Decade of Development of e-Learning in a Tanzanian HEI

Matti Tedre
Fredrick Ngumbuke
Jyri Kemppainen

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Abstract

Tumaini University, Iringa University College in Tanzania began to develop technology-enhanced learning in 1999. At the beginning of the process, the college had no public computer laboratories. The e-learning capacity was gradually developed over the following 11 years: computer laboratories, a local area network, an electronic library collection, a dedicated IT support department, Internet connections, electronic presentations, a B.Sc. program in IT, video lectures, and online learning. In this article, we analyse the complex network of challenges that we faced during the development process. We discuss technical issues with ICT equipment, system administration, and networks, and we analyse socio-cultural issues with training, funding, and pedagogy.

Keywords

e-learning, developing countries, IT education, technology enhanced learning, e-pedagogy

Infraestructura, capacidad humana y grandes esperanzas: una década de desarrollo de e-learning *en una institución de enseñanza superior de Tanzania*

Resumen

La Escuela Universitaria Iringa, de la Universidad de Tanzania, empezó a desarrollar el aprendizaje mejorado gracias a la tecnología en 1999. Al principio del proceso, la escuela universitaria no disponía de laboratorios informáticos públicos. La capacidad de e-learning *se desarrolló gradualmente durante los 11 años siguientes: laboratorios informáticos, una red de área local, una colección de biblioteca electrónica, un departamento de soporte TI dedicado, conexiones a Internet, presentaciones electrónicas, un programa de licenciatura en TI, conferencias de vídeo y aprendizaje en línea. En este*

artículo, analizaremos la compleja red de desafíos a los que nos hemos enfrentado durante la fase de desarrollo. Tratamos temas técnicos con equipos TIC, administración de sistemas y redes, y analizamos temas socioculturales mediante formación, financiación y pedagogía.

Palabras clave

e-learning, *países en desarrollo, educación TI, aprendizaje mejorado gracias a la tecnología, pedagogía electrónica*

1. Introduction and background

Various kinds of e-learning solutions are frequently presented as panacea for all problems in education (e.g. Bork, 2003). There is a plethora of initiatives that aim at improving education through the introduction of information and communication technologies (ICTs), each initiative from its own viewpoint. Take, for instance, mobile learning (Masters, 2004), the One Laptop Per Child initiative (Kraemer et al., 2009), open content repositories,[www1] TV-broadcast classes (Bitew, 2008), and lecture podcasts (McKinney et al., 2009). There are massive online repositories of all kinds of best practices and guidelines for using ICT to support all levels of education, published by, for instance, the United Nations Educational, Scientific, and Cultural Organization (UNESCO), the Institute of Electrical and Electronics Engineers (IEEE), as well as numerous other groups in the EU and the United States.

Implementing various e-learning solutions in developing countries has, however, often turned out to be problematic (e.g., Bitew, 2008; Masters, 2004). Differences in geographical and economic conditions, different educational backgrounds and pedagogical views, language and content issues, usability and technical literacy issues, attitudes and prejudices, and even differences in climate have posed challenges to initiatives in technology-enhanced education. There definitely are success stories in e-learning, but the challenges unfortunately often go unrecorded and unreported. In this article we portray a story of a long process of developing e-learning in a Tanzanian higher education institution, along with the successes and challenges of the process. Our process is not over – and it never *should* be over – but after more than ten years of work on this topic at one location, our experiences in this field have crystallized into a number of lessons learned. In this article, we describe a number of ups and downs of the process that has taken us to successfully and sustainably utilize e-learning in Sub-Saharan Africa.

1.1. Tumaini University, Iringa University College

Iringa University College (IUCo) of Tumaini University is a higher education institution (HEI) organized under the Evangelical Lutheran Church of Tanzania. The college was established in 1994, and today IUCo is one of Tumaini University's six constituent colleges, others being Kilimanjaro Christian Medical College, Makumira University College, Dar es Salaam College, Stefano Moshi Memorial University College, and Sebastian Kolowa University College. Iringa University College is located in the north-eastern corner of Iringa town in the southern highlands region of Tanzania, 502 km inland from Dar es Salaam. Iringa town is the capital of the Iringa region, and the town has a population of about 150,000 people.

Iringa University College is the largest of Tumaini University's constituent colleges, and it offers degree courses in five faculties: Law, Business and Economics, Arts and Social Sciences, Science and Education, and Theology. Student enrolment at IUCo has increased steadily throughout fifteen years of history. Currently the college hosts around 3,000 students with a roughly 1:1 female/male ratio. Most students are high school graduates from Tanzania and neighbouring countries (e.g., Botswana, Burundi, Rwanda, Uganda, Zimbabwe, and Kenya), and the college annually attracts foreign exchange students. Although the college was founded by the Lutheran (Christian) church, students from all religions are admitted, which contributes to the diversity of the college's student population: IUCo's students form a diverse mixture of cultural, ethnical, tribal, national, and religious backgrounds.

[www1] http://ocw.mit.edu/

1.2. Historical overview

The first plans for developing IUCo's ICT and e-learning capacity were drawn up in 1999. An American volunteer drafted plans for IUCo's future ICT activities, and those plans involved a general vision, goals and objectives for ICT-related development of IUCo (Kemppainen, 2006:64). At the beginning of 1999, IUCo had eighteen 486/386-level computers running Windows 3.1 / Microsoft Office 4.2, as well as twelve matrix printers for students, teachers, and staff to use. The technical aspects of the plan were gradually developed by local staff and a foreign expert who worked for the Finnish Evangelical Lutheran Mission. Iringa's climate and environment, as well as IUCo's existing infrastructure, posed severe challenges to the whole project, which took several years to overcome (Kemppainen, 2006).

The first plans, however, did not take the local context into account sufficiently well, and more tangible steps for developing IUCo's ICT facilities and e-learning strategy were taken in 2000 in a plan that outlined development of a local network, a library, computer classrooms, and technical support (Kemppainen, 2006:64). ICT facilities were improved in a project between 2001 and 2003, the Internet connection was updated in 2002, the ICT department and its own budget were established in the 2002–2003 academic year, library facilities were improved between 2001 and 2003, and the ICT facilities improvement project continued in 2004.

Since then, Tumaini University has focused on maintaining and expanding its computing infrastructure, on developing shared resources (such as shared printers as well as shared teaching folders for teachers to distribute their material), and on educating teachers to use modern presentation tools to support their lectures. In 2005, we upgraded our Internet connection from 128/64 kbps (operated by TTCL, who at the time lacked qualified staff and suffered from service problems) to a 704/128 kbps (operated by SimbaNet). In 2006 the Tanzania Education Authority (TEA) donated 100 new Pentium 4-level computers to the college, which enabled us to take all Pentium 3-level Windows 98 computers off the local area network, tremendously increasing network security. In addition, TEA provided IUCo with two heavy-duty printers, which made it possible to centralize printing for staff and students. Before that, if students wanted to print out documents, they gave their text on a disk to an assigned printer operator, who printed the text and returned the printouts and diskette in an envelope.

After several years of planning, IUCo started a modern, contextualized IT program in 2007 (Tedre et al., 2009b). This program was established to educate IT professionals who have the necessary knowledge and skills for IT work in the environmental, economic, and sociocultural context of Tanzania and the Iringa region. The next steps in development of e-learning were taken along with the establishment of the IT program. The program introduced the e-learning and content management platform *Moodle*, and the aim of the program coordinators was to first introduce *Moodle* in a few classes, then extend its use first to all classes in the IT program, after that to all classes in the Faculty of Science and Education, and finally to introduce *Moodle* throughout the university. The overall history of development of technology-enhanced learning at Tumaini is presented in Figure 1.

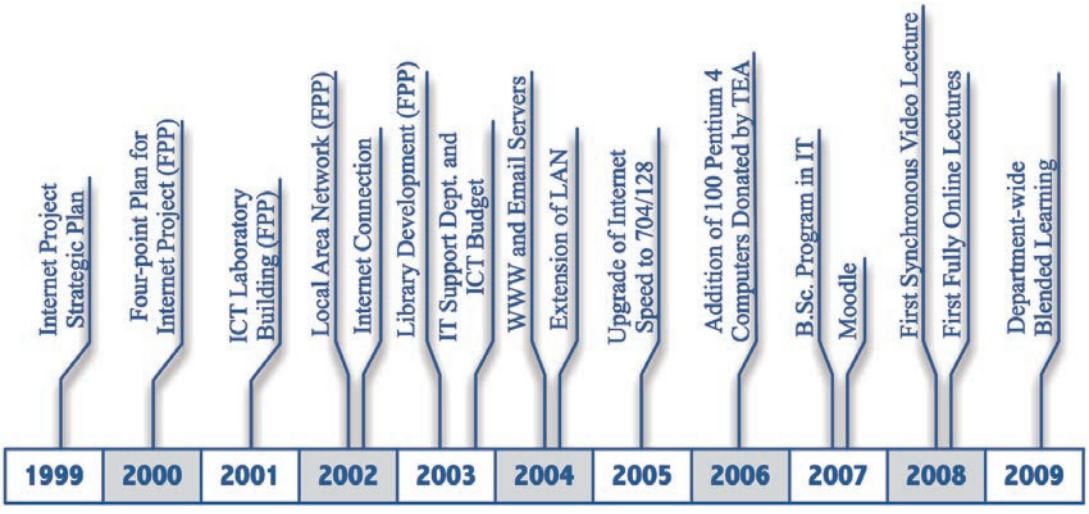

Figure 1. History of e-Learning at Tumaini University / IUCo
Source: Own material

The pace of development in Figure 1 may seem slow, but it certainly did not feel like that at the institution (see, e.g., Kemppainen, 2006). A number of international visitors have contributed to IUCo's e-learning as well as to the college library's electronic databases and collection. Previously, charities donated most of IUCo's ICT equipment, which was a mixture of various brands, ages, and conditions, and thereby meant a significant amount of technical work at the college. The development was planned in collaboration with local university management, foreign experts, and, at some point, with the end users.

We, the authors, have been with the university from the beginning of the development of technology-enhanced learning at Tumaini University and over the years we have gained significant first-hand knowledge about technology-enhanced learning in Tanzania. In the following chapter we discuss six aspects of e-learning that must be understood in their context of implementation in order to successfully utilize ICT in everyday teaching practices. We describe some of our successes, as well as some of the challenges we have faced along the way (some of which we have not yet overcome). First we discuss the technical issues of the equipment. Secondly we discuss some well-known issues of networking in Sub-Saharan Africa. Then we give an overview of the challenges of system administration work in Iringa followed by a discussion of staff training issues in a broad sense. In the fifth point, we briefly consider some financial concerns and finally, we present some open questions about e-pedagogy in Tanzania.

2. Challenges and Prospects of e-Learning

It is often the case that project successes are reported to funding agencies, at conferences, and in journals, but challenges and mistakes are glossed over (e.g., Smillie, 2000). There are various reports of miracle projects that have used modern information and communication technologies in novel ways to empower individuals, communities, regions or groups. Numerous success stories have been told about transformational technological interventions in developing countries (e.g., Jensen, 2007). In addition to our successes, in this article we also discuss some of the challenges that we have faced during more than ten years of development of technology enhanced learning at our institution.

The reasons for successes and struggles with development of e-learning at Tumaini are various, yet in this chapter we paint a picture of the complexity of myriad factors for development that we faced during the development of various aspects of e-learning at IUCo. Although some aspects presented in this chapter are unique to IUCo, many of them can be generalised to East Africa, other developing countries and industrialised countries.

2.1. Equipment

One of the most topical issues at IUCo is the lack of computers available for students. A sufficient number of available workstations on campus is a *sine qua non* of computer-based learning – especially at IUCo, where we cannot expect students to have computers at home. Although quite a large percentage of IUCO's students (38%) have access to a computer at their homes (Tedre & Chachage, 2008), not all of these computers are in good working condition or can only run very old software. In addition, although in a previous study 8% of students reported that they have an Internet connection at home (Tedre & Chachage, 2008), the costs of pay-per-megabyte Internet and slow speed usually render distance learning over the Internet unfeasible.

The current number of computers on IUCo's campus does not permit large-scale e-learning or blended learning practices, except in the IT program, where the student/computer ratio is 1.9:1, and where students can access computer labs around the clock. A calculation of how much computer time is allocated to each of Tumaini's 3,000 students paints a bleak picture. The current ratio of 3,000 students to 50 public computers, with 94 hours per week of operational time in the public computer laboratory, equals a weekly quota of 1.5 hours per student. We have, however, set a target of 4 hours per student per week.

A time quota of 4 hours per week per student does not allow e-learning on a large scale. In order for e-learning to succeed, students should have enough computer time to first read lecture material on screen; secondly, search the web for additional readings, and then do their exercises and type them in at the computer lab. The first item on the list – being able to read class material on-screen instead of printing it out on paper – is essential to e-learning. This is due to the fact that printing out material on laser printers is prohibitively expensive for IUCo's students (roughly 600 Tanzanian shillings per page), and the benefits of electronic content delivery do not justify such extra costs for students. If large numbers of paper copies are needed due to a lack of computers they can be used for class reading material, as offset printing is significantly cheaper than laser printing in Tanzania.

The second item on the list – being able to search the web for resources – is often necessary for homework and essays, as well as for supporting students' own study and

research interests. And the third item on the list – being able to return homework in e-learning or content management system – is one of the basic functionalities of e-learning. Taking only these three basic functions into account, four hours per week is barely enough for one course, not to mention several courses. Furthermore, any additional e-learning function, such as self-administered quizzes, collaborative learning, or streaming video, each requires additional computer time per student. In order for each student to get 20 hours of computer time – which we consider to be enough for abandoning the system of time allocation – the college would have to install 588 additional computers for students. That is a tenfold increase: we have calculated that it would require a large new building with 10 large computer laboratories, it would triple IUCo's electricity bill, and if those computers were connected to the Internet, it would render our outgoing Internet connection useless. As most large grant and funding agencies have a policy of only working with national universities, our funding applications have often been rejected out of-hand without reading our application.

Also, the small number of available computers causes problems with practical examinations. Practical examinations and computer-administered examinations are difficult to set up, because each student should sit at one computer for a certain period of time. As groups are quite large, there are not enough computers for the whole class to take the test at the same time, which causes logistical problems at the college. In addition, as all the computers are running at maximum usage, they are prone to mechanical wear and tear, recurring hardware and software problems, and epidemics of viruses. We have recurring problems with power: brownouts, shortages, blackouts, and power spikes. The harsh natural environment damages computing equipment through, for instance, dust, dirt, heat, humidity, and UV radiation (Brewer et al., 2006). When equipment breaks down, we find that manufacturers' support networks are far from sufficient in Sub-Saharan Africa, that warranty terms are usually poorer than warranty terms in industrialised countries (Tedre & Bangu, forthcoming), original parts and quality tools are not readily available, and counterfeit business as well as piracy are rampant. Most of the time several computers from the students' computer lab are undergoing maintenance, waiting for spare parts to arrive.

2.2. Networks

The high cost of bandwidth constitutes a serious obstacle for IUCo to benefit fully from e-learning efforts. Until June 2009, Tanzania's only Internet connections were satellite-based, and the Seacom cable[www2] that arrived in Dar es Salaam in July 2009 is not expected to relieve IUCo's situation in the very near future. That is due to the fact that there is no national Internet backbone that can deliver cheap and fast connections to Iringa. It is also uncertain how much the Seacom cable and the competing Eassy (Eastern Africa Submarine Cable System) cable[www3] will lower prices, for according to the current plans neither will be opened for free markets, which could potentially discourage price drops and hamper the reach of the national network. Although the Tanzanian government has made great progress in this matter, there are some voices of pessimism. Southwood (2009) attributed the failures of broadband cables in West Africa and Kenya to governments' and service providers' self-interests and blocking tactics, and called some aspects of that regulation "highway robbery".

Currently IUCo pays more than 4 million shillings (2140€ ≈ 3100$)[1] per month for a dedicated 704kb/128kb satellite connection that serves the college's 300 computers. In comparison, a basic European home Internet connection of 2Mb/2Mb fixed bandwidth costs roughly 20€–30€ per month. In addition, IUCo's Internet connection is often down for hours, sometimes days. With the current transmission speeds, even with the current number of computers at IUCo it is difficult to utilize externally stored e-learning material in teaching. Currently it is almost impossible to read online e-books. It is impossible to watch streaming educational videos or do distance video teaching between 8:00 and 22:00. Local mirrors and caches do help, but they do not allow free search of material on the Internet.

Mobile phone operators play an important role in providing Internet connections to Tanzania. The mobile phone data connection is potentially very fast in urban areas, notably in Dar es Salaam where 3G or HSDPA (High-Speed Downlink Packet Access) can theoretically reach 14Mbps speed. But in rural areas, GPRS (General Packet Radio Service) speed is the norm. Second-generation GPRS usually provides 56kbps speed, which in Europe and the U.S. was a common modem speed at the turn of the century.

1. Currency amounts calculated using October 3, 2009 mid-market rates.
[www2] http://www.seacom.mu/
[www3] http://www.eassy.org/

Our experience of mobile Internet in Tanzania, outside Dar es Salaam, is that it is sufficient for text-only email and very light web surfing. Mobile network coverage in Tanzania is, however, far from extensive (no official data is available). In addition, unlike the typical situation in industrialised countries, the bottleneck in Internet connections in Iringa is not always the last-mile connection between the user and the mobile phone tower. That is because instead of a fibre-optic cable, Iringa is connected to Dar es Salaam by microwave links, which have narrow bandwidth and are affected by environmental effects, such as rain fade. Microwave links are, nevertheless, usually UPS-protected and generator-powered, which keeps Internet connections up even during large-scale blackouts.

The concerns with networks in Tanzania are not limited to the Internet and mobile phone networks. Tanzania's power-distribution network poses another major challenge to nation-wide prospects of e-learning. According to the African Rural Energy Enterprise Development (AREED) project of the United Nations Environment Programme (UNEP), only 6% of Tanzanians are connected to the national power grid (AREED, 2009), and most schools do not have power. In addition, the electricity supplied is not stable, and fluctuates during use, which affects durability and reliability of ICT equipment. Uninterruptible power supplies (UPS), power surge protectors, and voltage stabilizers can be used to protect equipment from power problems, yet protective equipment is costly and requires additional knowledge of the whole system, that consists of computing equipment and software, power protection equipment, electrical grid and wiring, grounding, shielding, and the environment.

2.3. System administration

Most system administrators in Tanzania hold a certificate in IT, often from a theoretical track, and many get their practical experience through trial and error during their first years in the job. Similarly, IUCo's IT staff gain their practical experience slowly, by working at the college, which means that occasionally, small problems escalate to system-wide problems. In Tanzania it is not always the case that system administrators work proactively and methodically to secure systems from failure, secure data from loss, or ensure availability of spare parts in advance. Instead, problems are often fixed when they arise, which causes minor problems to grow disproportionately before anyone deals with them and which slows down service and sometimes halts productivity. The country's prevailing theoretical orientation to ICT teaching, lack of practical training, and the unique challenges of the Tanzanian infrastructural and socioeconomic context contribute to the poor situation in all institutions.

As an example of issues with inadequate training of system administrators, we found that the reason for our Sun Solaris thin client system's frequent problems was the practice among some staff members to just switch off the server power instead of properly shutting down the system, which led to broken files, broken links, and accumulation of cache garbage, which in turn led to system irregularities and finally to complete malfunctioning of the system. The reason for the problem is clear: when the system was set-up, our IT staff were never trained to shut down a Unix system, nor were they taught about the problems that a hard shutdown or cold boot can cause in the system. Similarly, in 2004, all our servers and UPSs were configured for automatic shut-down in case of power cuts, but in 2007 none of the configurations worked anymore due to hardware problems and system re-installations. At some point each power cut (which are frequent in Iringa) indeed cut all running systems off, which compromised the university's email system, Active Directory and file servers, proxy and printer servers, and all other vital IT functions. Many users are still unaware of the importance of shutting down the system properly in case of a power cut – many continue to work until the UPS batteries run out. Usually, power cuts are shorter than 15 minutes, and a UPS can provide power over the whole blackout period, which gives some users a false sense of security.

Counterfeit products are a continual problem for system administration in Tanzania as well as in other developing countries (OECD, 2007). It is often hard to distinguish a counterfeit product from an original one, and sometimes vendors sell counterfeits as originals (at the price of an original product). Economic constraints also often force system administrators to purchase cheap alternatives – which may, in the long run, turn out to be more expensive as cheap equipment breaks down more often, causing lost workdays and increasing the need for spare parts. Major manufacturers have set their computer prices high in developing countries, and currency exchange rates are rarely favourable to Tanzania.

Rampant malware (viruses, adware, Trojan horses, spyware, and worms) is another headache for system administrators at IUCo. In fact, malware seriously hinders the use of ICTs for effectively supporting higher learning throughout Tanzania. Popularity of Internet cafes (we call them "virus cafes") makes matters worse, as students use their USB sticks in Iringa Town's Internet cafés, where there is usually no virus protection. Students then use these

USB sticks on campus. This is something of a paradox, as Internet cafes offer a wonderful service for people who cannot afford to buy their own computers or cannot afford a permanent Internet connection, yet those same cafes put our systems at risk. As with vaccination, there needs to be a certain level of saturation of anti-virus measures in order for them to be really effective. Over the 11 years of developing Tumaini's ICT facilities, the virus situation has gradually improved, but vulnerable points remain, and once in a while a virus attack paralyses our network. IUCo pays an annual fee to an antivirus software company, but, occasionally, late payment of fees or failure of centralised updates cause virus definition databases to expire.

2.4. Staff and Training

Resistance to change is another hindrance to e-learning all around the world (Henderson, 2003). A notable portion of Tanzania's academic and support staff received their education in the conventional, rather instructivist or even behaviourist educational system, where the teacher is a guru and where the students' role is to receive and store knowledge instead of actively processing or creating it. In addition, most staff members in Tanzanian higher education institutions never used modern e-learning tools in their own studies, and hence have no previous knowledge on how those technologies could or should be used.

At IUCo we started teaching the basics of technology-enhanced learning by introducing teachers to electronic presentation tools as well as by teaching them to use shared "teaching folders" on our intranet. Each teacher has a shared network folder, which is used for delivery of study material. Many teachers utilize those folders for content delivery, but implementation level is still relatively low. In addition, teaching folders are only available on computers running under Windows. Regarding presentation tools, the university management attempted to support electronic presentations by obtaining a number of data projectors and laptops, which could be moved between lecture halls. Unfortunately, a number of enthusiastic staff members adopted the laptops for their own offices, and other dedicated staff members locked the data projectors in their offices so that they could always have a data projector available for their lectures. We solved the issue by installing a ceiling-mounted fixed projector and a dedicated, cable-locked laptop computer in each larger lecture hall. Staff members use this equipment very often for their presentations, although the implementation and development process is still underway.

Another of the problems that we face concerns lack of confidence in the security of e-learning material and equipment. There is a widespread opinion in Tanzania that electronic data transfer and email are not as secure and private as paper-based traditional methods. For instance, Tanzanian lawyers are discouraged from using electronic correspondence with clients. When we suggested a highly reputed CEO a total online solution for his company's banking needs, his response was: *"I don't trust these online services, I want to sign all my checks personally."* This fear is also reflected in the worry that it would be easier to steal teaching material if this were stored on-line, than if the same material were on paper. The issue of immaterial property rights is, in fact, one of IUCo's biggest hindrances in shifting to blended learning using *Moodle* or other content delivery platforms.

The issue of immaterial property rights arises from some deep-rooted misconceptions about education. Many staff members in Tanzanian universities consider their lecture slides and other lecture material to be the biggest asset in their work. It seems to us that many lecturers feel that if their material is made available to students for downloading, the lecturers will risk their most important asset being copied from student to student, finally spreading to competing organizations and to competing educators. They seems to reason along the lines of: *"If all my competence is packed on a series of lecture slides available for students and staff, what ensures that the university will not fire me and continue to use my lectures after I am gone?"* Rarely do teachers seem to think that their expertise and teaching abilities are more important than the material they use. Not only do such attitudes undermine e-learning but they especially discourage creation of open courseware, even though teachers are not opposed to *using* open courseware.

The attitudes of universities' managers towards ICT tremendously affect the success of e-learning in Tanzanian institutions. Management gives permissions to acquire ICT facilities, approves staff training days, authorizes digital content delivery and open courseware, and is responsible for many other things. Sceptical and resistant management can bring down otherwise well-planned e-learning initiatives, whereas enthusiastic and supportive management can strongly foster e-learning initiatives. We have seen both happen in Tanzania. Luckily, IUCo belongs to the latter group: the university management has been very progressive and open-minded about the possibilities of e-learning, and they have strongly supported e-learning initiatives through various financial, organisational, and pedagogical arrangements.

Finally, governments set policies, laws, and regulations that may support or undermine e-learning initiatives. The

situation is the same worldwide: some governments fail to understand or appreciate the benefits of ICT, whereas other governments have unrealistic plans concerning ICTs in education. Government decisions have proven to be crucial to many aspects of e-learning in Tanzania. For instance, the Tanzanian government has set a 0% import tax on computing equipment that is bought for educational purposes. However, regardless of the tax exemption, computers are still more expensive in Tanzania than in Europe and the United States (Tedre & Bangu, forthcoming). Government decisions on regulation of Seacom and Eassy submarine cables will be crucial for broadband prices and connection speeds, and, coupled with proper building and pricing of a national Internet backbone, could potentially bring Tumaini's connection speeds on a par with the rest of the world. There is, however, widespread pessimism about Africa's submarine cables, as a result of experiences in Kenya and West Africa, where the gatekeepers of the new bandwidth – bandwidth providers and governments – have not been willing to bring the prices down, but instead reap massive profits by selling today's cheap bandwidth at former high prices (e.g., Southwood, 2009).

2.5. Funding

Another factor that hinders IUCo's e-learning aspirations is the common use of part-time staff. Part-time teachers come from other institutions of higher learning and from IT industries, which limits the time and commitment they are willing to spend on implementing e-learning or blended learning solutions. Furthermore, there is a high turnover among regular staff, caused by a nationwide lack of skilled manpower and the pull of industry, where salaries are higher than in universities.

Money, of course, is a persistent question. The income base of many private universities in developing countries is based on student fees, donations, and sometimes government support. Each of these income sources is volatile: numbers of students fluctuate depending on the national and global economic situation, donations depend on the goodwill of donors, and governments vary the amount of their support. In some developing countries, governments seem to consider private universities a competitor to national universities, and sometimes impede their operational preconditions. When a university's financial assets depend on the number of incoming students, there is a constant push to increase student enrolment in order to increase revenue. In the case of technology-enhanced learning the needs for equipment and training constitute a high initial investment cost, along with running costs of supplying the services, increased electricity bills, and maintenance of e-learning equipment.

2.6. Pedagogical issues

In many developing countries, most students who join higher learning institutions have no ICT-related knowledge or skills at all. Although many schools in Tanzania do have a small number of donated computers (which might actually work and be up-to-date), generally speaking our students are not computer literate when they enter the university. Students' ICT skills come mainly from their experience with mobile phones (Tedre & Chachage, 2008). Upon entering Tumaini University, however, students become frequent computers users. In an earlier study (Tedre & Chachage, 2008) we found that 84% of IUCo's students use the college computer systems weekly or daily, with additional use at Internet cafes (51% use them weekly). In the same study, we found that 92% of students have an email address, and every respondent (n=61 out of IUCo's 2526 students in 2007) owned a mobile phone.

A great number of things that are usually not a concern in industrialized countries – extreme poverty, the post-colonial condition, and tribal traditions – affect the pedagogical approach in Tanzania (Tedre et al., 2009a). Tumaini University students come from a variety of religions, tribes, and cultures, the combination of which makes it almost impossible to find a "fit-for-all" pedagogy (a fit-for-all pedagogy might not be even desirable). Differing views of ethics, debate, modes of working, and linguistic backgrounds create diversity in Tumaini's programs. That variety of backgrounds offers great possibilities for Tumaini's e-learning insofar as it can be used to support students' own learning styles, yet the same variety poses challenges in terms of adjustability and adaptability of e-learning systems.

Today Africa's educational system is a mixture of Western education, Islamic education, and traditional African education (Farrant, 1981, p. 34). These different educational traditions pose a challenge to constructivism-oriented e-learning. One of the challenges of constructivist learning is that often a student's previous education has relied on learning by rote, with individual learning initiatives not encouraged (cf. Tedre et al., 2009a). Hence, many students do not feel they are capable of finding information or coming up with answers or solutions themselves. That leads to challenges in independent work. In addition to lack of confidence, African communalism discourages students from struggling alone with their tasks, although a deep-rooted communalist culture of sharing and helping

others is a good base for a dynamic culture of sharing and collaborating in academia (e.g., Farrant, 1981, p. 31).

Farrant's (1981, p. 31) notion of communalism in African schools is supported by independent studies conducted at Tumaini. Larsen and Loft Rasmussen (2008, p. 51) reported that Tumaini's IT students collaborate through group discussions, doing assignments together, and explaining lectures and concepts to each other. Teachers in the BSC-IT program have found that collaboration is a much more productive motivator than competition. In line with Farrant's (1981, p. 31) argument, Tumaini's IT students often unite when they demand change. Some clashes arise, however, from different student and staff views on education, for instance, on the syllabus and collaboration. Whereas students perceive only the benefits of collaboration, teachers struggle with side effects such as plagiarism from the Internet as well as copying home assignments from each other (Larsen & Loft Rasmussen, 2008, pp. 58-59).

Western educators have often, and in many ways, failed to understand that an educational system that works well in one context may be a profoundly disturbing force in another (Farrant, 1981, p. 33; Freire, 1970: p.75). Developers of e-learning must take this into account. Farrant (1981, p. 39) argued that the key to successful African education is in an educational system that is truly national, democratic, modern, and authentically African. We do not know what a successful, truly Tanzanian e-learning pedagogy would be, but are currently keeping our e-learning open to all kinds of technical, organisational, and procedural innovations.

A survey conducted at IUCo in 2009 supports continuing development of e-learning at Tumaini University (Tedre & Kamppuri, 2009). In that study, second-year IT students at IUCo, who are the most experienced students at IUCo in terms of e-learning, ranked e-learning to be among the easiest IT-related part of their studies. There was an almost unequivocal (95%, n=20) feeling among respondents that the learning management system *Moodle* made studying easier, and most respondents (85%) also wanted to use *Moodle* in the future (Tedre & Kamppuri, 2009).

In IT students' ranking of the most important issues in their learning, aspects of e-learning ranked high on their lists. Access to Internet was ranked second out of 22 items, good web material ranked fourth, PowerPoint slides were considered to be the sixth most important item in studies, yet the availability of PowerPoint slides after classes ranked thirteenth and *Moodle* environment for each course fourteenth on the 22-item list (Tedre & Kamppuri, 2009). A high number of computers per student was at the other end of that list (16th), as was 24-hour access to computer laboratories (19th). Nevertheless, it ought to be noted that IT students are not a representative sample of the college's student population, as they get unlimited computer time and have dedicated IT labs for themselves, whereas other students have to cope with a 4-hour weekly quota.

3. Future challenges

E-learning offers a number of promises, but the escalating digital divide blocks developing countries from making these a reality. Bandwidth-intensive activities are increasing in number but remain out of reach of students in developing countries. Such activities include, for example, podcasts and video material, video lectures and video conferencing, synchronous collaborative learning over the Internet, as well as most aspects of web 2.0. The arrival of new submarine cables to East Africa have awoken great expectations among universities in Sub-Saharan Africa, but discouraging experiences from West Africa curb enthusiasm. The Tanzanian government has given Tanzania's national telecommunications company the mandate to extend the connection to the whole nation, and the current developments are encouraging. There is, however, little open discussion on this matter, and rationales for decisions are not always made public. We prepare to continue with the current connection situation indefinitely, prepare for a drop in national backbone prices, but we are already looking forward to Google's O3B high-bandwidth satellite launches.[www4]

The growing student population requires heavy investments in ICT to maintain the current level of services. Capital-heavy investments, such as imported technology and buildings, are a problem in most African countries, and as today the European aid is increasingly channelled to budget support, private universities are often ignored. It is important to have a clear plan that links increase of student numbers with ICT purchases – and it is important to also stick to that plan. But even on the technical side, having IT equipment is not enough. When IT equipment is in place, the next challenge that arises is IT support and administration staff. Without competent professional staff, it is not possible to sustain a quality service that is required for e-learning. In addition, sustainable development of IT

[www4] http://www.o3bnetworks.com

services is only possible when there are enough skilled people who are motivated to stay with the college long enough for planning and implementing IT projects at technical, organisational, and pedagogical levels.

Our biggest challenges in e-learning on the teaching side are, however, social, cultural, and educational challenges. A small number of technical experts cannot cope with the constantly changing pressures and requirements of technological change. Our first and foremost challenge is getting the staff to feel at home with e-learning software, methods, and pedagogy. We aim at making blended learning the normal mode of learning and teaching at IUCo. This requires continual staff training and development of ICT facilities. Collaboration with our international partner universities, such as the University of Eastern Finland, the University of Southern Denmark, North West University in South Africa, and the University of London at Royal Holloway, offers us possibilities for sharing knowledge and lecture material, for student and staff exchanges, and for research collaboration for developing novel innovations for e-learning.

Success of our e-learning aspirations also depends on institutional issues: governments must stick to the promises of international, national, and regional connectivity. Multinational corporations, such as Cisco, HP, Dell, and Apple, have a special responsibility to get their prices in Africa down to European and American levels. As we are a small private university, we do not expect much support from international aid projects, but they do play an important role in bridging the digital divide in Sub-Saharan Africa at large.

We started our blended learning experiment with one program, and over the next two years we aim to extend it to all courses in that program. After that, the aim is to involve the whole faculty in e-learning development, followed by extension to all faculties at the IUCo. In 2007 we defined our approach to adoption of e-learning starting with some courses in one department, then extending them throughout the department, then to a faculty, and finally to all relevant courses at the university. Being a leading Tanzanian institution in terms of implementation of blended learning, we hope to lead the way for the whole nation.

4. Conclusions

Comparisons between Tanzania and industrialised countries are not always valid, and neither are recommenda-

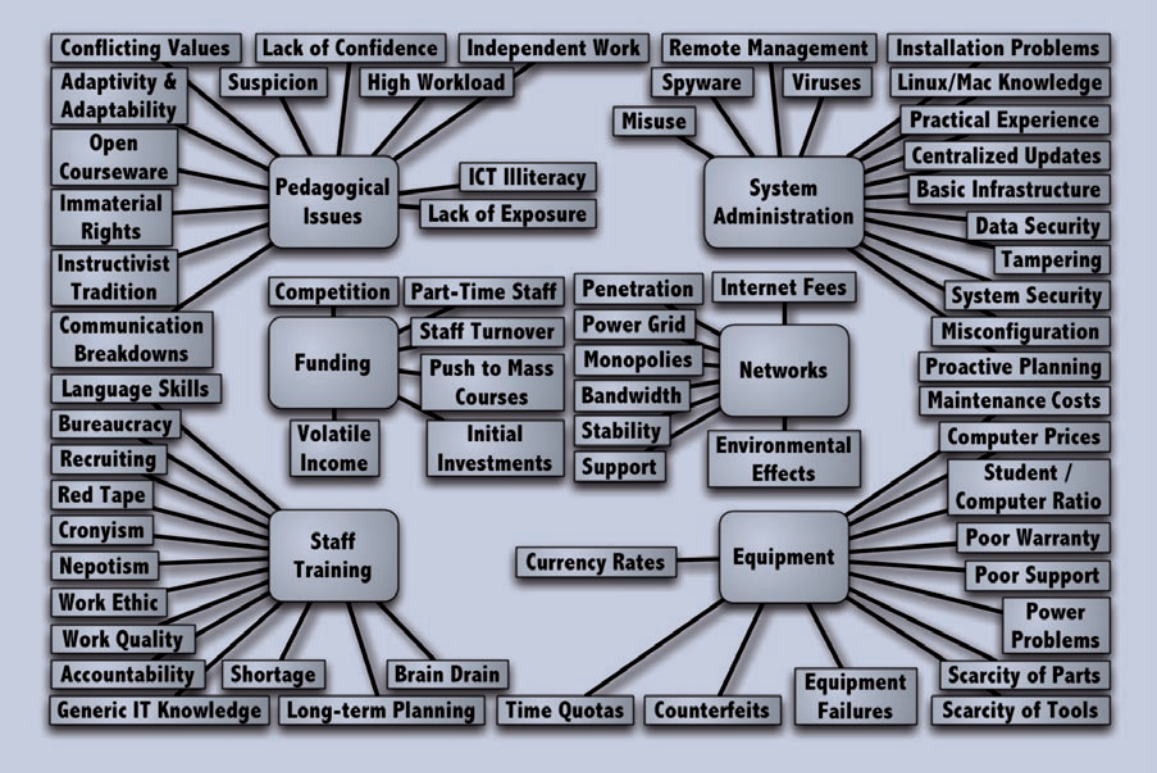

Figure 2. Some Challenges of E-Learning in Developing Countries
Source: Own material

tions for Tanzania's e-learning based solely on success stories in industrialised countries. Online educators in the country must come up with solutions that utilize local strengths, get around the obstacles, and while preparing for global collaboration, respond to local challenges. Many imported technologies do work well, we have successfully used a number of technical tools for supporting learning, but e-learning systems are socio-technical not technical systems. And as socio-technical systems, knowing technology is important, but understanding the sociocultural, economic, and geographical context is imperative for successful projects.

Developing e-learning at the IUCo has been a long process, but we have already witnessed numerous successes that have greatly improved the quality of education at the IUCo. Access to learning material has been centralised and made simple, teacher presentations have improved through the use of presentation software, students will no longer leave the university computer illiterate, a large number of courses have already been taught in a blended mode as well as fully online, and there is an increasing body of knowledge of e-learning pedagogy as well as experience on e-learning. During the development process, however, we have faced many problems which have sometimes required quite innovative and unconventional solutions (e.g., Kemppainen, 2006). Numerous technical and social issues are interweaved throughout the process into a fabric of challenges, where none of the issues stood alone, but were linked with other issues. We present our list of challenges for e-learning in Figure 2.

We faced most of the problems presented in Figure 2 personally. Some of them were dealt with as a result of discussions with colleagues in other Sub-Saharan universities, some remain unsolved, and some cannot be decisively solved but require coping strategies to be designed. While many of the items shown in Figure 2 are very local by nature, many others are also issues in industrialised countries.

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About the authors

Matti Tedre
Responsible Project Leader, Academy of Finland Project #132572

University of Eastern Finland
P.O. Box 111
FI-80101 Joensuu, Finland
matti.tedre@acm.org

Adjunct Professor Matti Tedre is the research project manager for the Academy of Finland project #132572, "Technological and Pedagogical Development of Contextualized IT Education" at University of Eastern Finland. He also holds the position of Associate Professor and Head of B.Sc. Program in IT at Tumaini University, Tanzania (currently on leave), based in Iringa, Tanzania, roughly six months a year. Tedre's research interests include IT education, ICT for development, social studies of computer science, the history of computer science, and the philosophy of computer science. He has worked and studied at the University of Joensuu in Finland, studied at the universities of Ajou and Yonsei in South Korea, worked as a visiting scholar at the University of Pretoria in South Africa and Ajou University in South Korea, and worked in the software industry.

Fredrick Ngumbuke
Ag. ICT Director at Tumaini University

Helsinki Metropolia University of Applied Sciences
PO BOX 4000 (Bulevardi 31)
FI-00079 Metropolia, Finland
fredrick.ngumbuke@tumaini.ac.tz

Fredrick Ngumbuke is the Ag. ICT Director at Tumaini University, Iringa University College though for the past eighteen months he has been on research leave at the Helsinki Metropolia University of Applied Sciences in Finland, where he is taking his Master's degree in Computer Engineering – Mobile Programming. He has been with Tumaini University for four years, and has worked in both teaching and technical support. His research interests include mobile phone technology and Society, ICT for Development (ICT4D) and information technology education in developing countries. Previously, he studied at Espoo-Vantaa Institute Technology in Finland.

Jyri Kemppainen
Development Coordinator of the Finnish Evangelical Lutheran Mission (FELM) in Tanzania

Finnish Evangelical Lutheran Mission
Tanzania
jyri.kemppainen@mission.fi

Jyri Kemppainen works as a Development Coordinator of the Finnish Evangelical Lutheran Mission (FELM) in Tanzania. He graduated from Jyväskylä Institute of Technology 1989 as an automation engineer. After graduation, he worked for a few years in Finland as a programmer and later as a member of the ICT support and development team in a large Finnish company. He started his work in Tanzania at Tumaini University, Iringa University College in 1998. At the beginning he taught computer literature for two years as Assistant Lecturer in Computer Science and later spent five years in charge of all ICT support and development activities concerning the computer facilities in education and administration. After seven years of ICT work in Tanzania he returned to Finland for further ICT studies. He received his Master's degree in Computer Science from the University of Joensuu in 2007 and immediately returned to Tanzania to take up his current position as FELM Development Coordinator. Since then he has been coordinating all development projects funded by the Finnish Ministry of Foreign Affairs through FELM in Tanzania.

Mr. Kemppainen's research is linked with the Academy of Finland project #128577, "Improving the Contextual Impact of ICT Education in Southern Tanzania: Engaging Stakeholders Towards Innovation", led by Prof. Erkki Sutinen, University of Joensuu, Finland.

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Monograph "Redefining the Digital Divide in Higher Education"

ARTICLE

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

Ismael Peña-López

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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

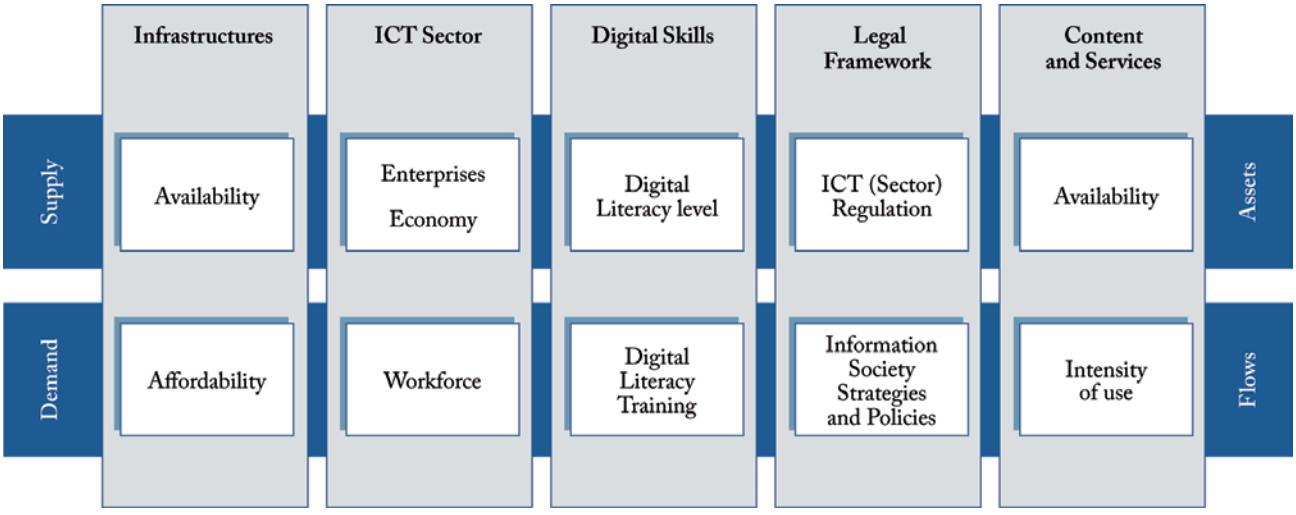

FIGURE 1: A comprehensive 360º digital framework to model the digital economy
Source: Peña-López, 2009a

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:

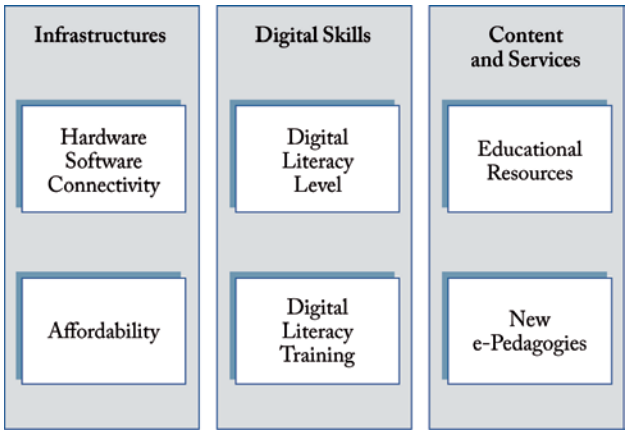

Figure 2: A comprehensive 360º digital framework to model e-education
Source: own material

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

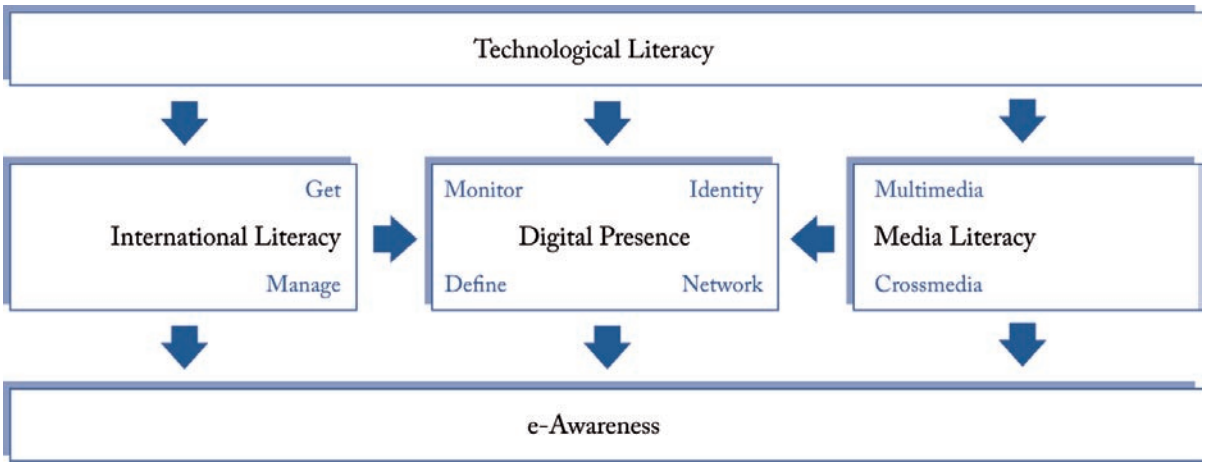

Figure 3: Towards a comprehensive definition of digital skills
Source: own material

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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About the author

Dr. Ismael Peña-López
Lecturer of Public Policies for Development, Department of Law and Political Science

Universitat Oberta de Catalunya
Av. Tibidabo 39-43
08035 Barcelona, Spain
ipena@uoc.edu

PhD in the Information and Knowledge Society, Open University of Catalonia (UOC). Bachelor in Economics, Autonomous University of Barcelona (UAB). Master in environmental auditing and planning, Instituto de Investigaciones Ecológicas (IIE). Specialist postgraduate in Knowledge Management, Open University of Catalonia (UOC). Lecturer of Public Policies for Development, Department of Law and Political Science, Open University of Catalonia (UOC). Researcher of the Interdisciplinary Research Group on ICTs (i2TIC), Internet Interdisciplinary Institute (IN3). Works in aspects related with Information and Communication Technologies for Development (ICT4D), with special emphasis on education, governance and empowered participation. He is editor of ICTlogy (http://ictlogy.net).

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Monograph "Redefining the Digital Divide in Higher Education"

ARTICLE

Degrees of Digital Division: Reconsidering Digital Inequalities and Contemporary Higher Education

Neil Selwyn

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Abstract

Whilst many authors are now confident to dismiss the notion of the digital divide, this paper argues that inequalities in ICT use in contemporary higher education are of growing rather than diminishing importance. In particular, it argues that there is an urgent need for the higher education community to develop more sophisticated understandings of the nature of the digital divisions that exist within current cohorts of university students – not least inequalities of 'effective' use of ICT to access information and knowledge. With these thoughts in mind, the paper presents a review of recent research and theoretical work in the area of digital exclusion and the digital divide, and considers a number of reasons why digital exclusion remains a complex and entrenched social problem within populations of higher education students.

Keywords

digital inequality, ICT use, higher education, digital divide

Grados de la división digital: Reconsideración de las desigualdades digitales y educación superior contemporánea

Resumen

Aunque muchos autores ya rechazan con seguridad la noción de brecha digital, este documento razona que las desigualdades en el uso de las TIC en la educación superior contemporánea tienen una importancia creciente en lugar de decreciente. Concretamente, razona que existe una necesidad urgente de que la comunidad de la educación superior desarrolle conocimientos más sofisticados de la naturaleza de las brechas digitales existentes en los grupos actuales de estudiantes universitarios, particularmente desigualdades del uso «efectivo» de las TIC para acceder a la información y el conocimiento. Con estos pensamientos en mente, el documento presenta una visión global de los estudios recientes y teorías en el ámbito de la exclusión digital y la brecha digital, y tiene en cuenta una serie de motivos del por qué la exclusión digital sigue siendo un problema social complejo y profundamente arraigado en los grupos de estudiantes de educación superior.

Palabras clave

desigualdad digital, uso de las TIC, educación superior, brecha digital

Introduction

It is now widely accepted that information and communications technologies (ICTs) lie at the heart of education in the twenty-first century. In particular, much faith continues to be placed in technologies such as the internet as catalysts for the substantial 'digital remediation' of educational processes and practices. For instance, through ICTs learners are argued to enjoy increased levels of access to a diversity of learning opportunities, as well as greater freedom to choose the educational options that best fit their needs. Technology is also seen to offer a 'personalisation' of the time, place and pace of learning. In short, ICTs are seen to be supporting the reconfiguration of education and learning along more engaging and efficient lines – an 'education 2.0' as some researchers are now putting it.

Whilst these changes are seen to apply to all forms of education, they are felt to be especially applicable to higher education (HE). According to many researchers, higher education is now characterised by an increased fairness of choice facilitated by ICT use. Thus contemporary HE, is now seen to involve "an increasingly pick-and-mix approach from students, who are likely to slip between full- and part- time study, take different courses at different institutions, and learn in different ways – be it online, face-to-face or virtual world – depending on mood and preference" (Swain 2009, p.1). All told, digital technologies are felt to support forms of university teaching and learning that are more efficient, engaging and equitable.

Digital technology has certainly had a profound bearing on the appearance of contemporary higher education provision. Most universities are now rich in technology resources and technology-based activities. Ever-increasing levels of funding continue to be directed towards the on-campus application of ICTs. Expenditure on universities' ICT infrastructures has risen dramatically over the last decade as institutions attempt to blend new technologies into most aspects of face-to-face teaching and learning, as well as into students' independent study. Lately the burgeoning use of virtual learning environments has seen the concept of the university campus moving away from a 'bricks and mortar' to a 'clicks and mortar' model. As Higginbottom (2009, p.1) argues, ICTs are now "fundamentally altering the way" that universities operate.

There are many reasons why HE has been party to more technological change than other sectors of education provision. At a practical level, universities are far more autonomous than schools, tertiary colleges or adult education providers, and therefore able to invest in technological systems with greater ease. Like many areas of education provision, universities have had to respond to a profound demographic shift in their customer-base, now catering for incoming cohorts of 'digital natives' who were born during the 1980s and 1990s and subsequently 'grew up bathed in bits' (see Tapscott and Williams 2007, Prensky 2008). Yet unlike most other areas of education provision, much of the non-teaching 'business' of higher education is also entwined with technology use – from the integral role of the university sector as a driver of the knowledge economy to university involvement in technology R&D. As Higginbottom (2009, p.1) concludes, the pace of ICT use in HE is being driven "by forces such as globalization, demographics, technology, increasingly demanding student expectations and a new world in which high levels of knowledge and technology amongst workers are required for an increasingly competitive economy".

In this sense most researchers see the main problem posed by ICT for universities as one of being able to keep up with the pace of technological change.

Ultimatums continue to be made that universities must either "transform or die" in the face of technological progress (Bates 2004). As Swain (2009, p.1) recently wrote with regard to current generations of 'cyber students', new ICTs are "transforming higher education, and students are driving the changes. Can [university] institutions keep up?". As all these excerpts suggest, growing numbers of educational commentators are viewing the use of ICT in HE in defiantly transformatory terms. Much of this enthusiasm is based around presumptions of an enhanced equality of opportunity, with much popular and academic comment celebrating (at least implicitly) the capacity of ICTs to recast social arrangements and relations along open and democratic lines. This is currently evident, for instance, in ongoing enthusiasm for the educational potential of so-called 'web 2.0' technologies such as wikis, social networking and blogging. In this sense, many of the concerns about inequalities in the use of ICTs that may have been prevalent during education technology debates in the 1990s have all but subsided.

Indeed, the notion of the digital divide in HE is now notable only by its absence in contemporary education debate, with most commentators content to dismiss the digital divide as "a last century anxiety" (Brown 2005, p.13). By 2010, we were assured, "only the homeless and the jobless will be webless" (Sutherland 2004, p.7). As relatively well-educated, middle class and young individuals, university students are seen as highly unlikely to fall into the categories of low- or non-users of ICT. If anything, the only digital dilemma within twenty-first century higher education is seen to be that of university students having *too much* access to ICTs.

This concern is evident, for example, within the growing consternation amongst some university educators about the academic and scholarly de-powering of a 'Google generation' of undergraduates who are seen to be overly digitally dependent (e.g. Fearn 2008). Especially prominent here has been Tara Brabazon's depiction of the current 'net generation' of undergraduate students - bemoaning a situation where 'clicking replaces thinking' and students' scholarship consists of little more than 'Googling their way' through degree courses and engaging in forms of "accelerated smash and grab scholarship" (Brabazon 2007, p.39).

As might be expected from its title, the remainder of this paper presents a rather different perspective on ICT use in contemporary higher education. As we enter the 2010s this paper argues that, if anything, the digital divide is gaining, rather than losing, significance in contemporary higher education. Moreover, there is an urgent need for the higher education community to develop more sophisticated understandings of the nature of the digital divisions that exist within their current cohorts of students. Against this background the paper now goes on to present a review of recent research and theoretical work in the area of digital exclusion and the digital divide, and considers a number of reasons why digital exclusion remains a complex and entrenched social problem within populations of higher education students.

Recognising multiple levels of ICT use in higher education

It is first necessary to establish what is meant by 'ICT use' – a distinction often glossed over by those commentating on the digital divide. In this respect, ICT use encompasses a number of integral elements of successfully participating in twenty-first century higher education. At a basic level, what a student knows, who they interact with, and what they are able to do is contingent upon being connected adequately to the information flows of contemporary society. For example, computer-mediated communication and mobile telecommunications technologies are at the heart of many social interactions, however mundane or life-changing. Similarly, the worldwide web is now established as a key setting where students access and interact with information. Outside of education and learning, ICTs now play an integral role in students' employment, their involvement in civic or political affairs as well as consumption by consumer groups and entertainment services. In all these instances, ICT use is increasingly implicated in what it means to be socially, economically, culturally and politically involved in twenty-first century society and twenty-first century higher education

Yet in recognising the importance of 'ICT use', we must be clear of its multiple components. As our discussion so far has implied, any talk of 'ICT access and use' in contemporary society refers to much more than access to a desktop or laptop computer, having basic keyboard skills and a familiarity with common software applications. Firstly, the digital activities and interactions outlined above can take place via a range of different types of ICT. The convergence of new media platforms such as digital television, mobile telephony, games technologies and other portable devices has led to a multi-modality of technology access and use – ably illustrated in the recent development of Apple's *i-phone* device. As such there is a wider number of portable and personalised ICT devices with which one may, for example, use the internet. However, it is important to recognise that the technical and social qualities of such use can vary considerably across different platforms – for example, the difference between searching the world-wide web on a mobile telephone and on a desktop PC. Secondly, alongside this variety of ICT hardware we also need to acknowledge the importance of the differing range of connectivity into information and telecommunications networks. Whilst the connectivity debate which raged within Europe and North America during the late 1990s and early 2000s centred around the necessity of 'broadband' rather than 'narrowband' access to the internet, other spectrums of connectively now exist, most notably wi-fi and other forms of wireless connections, all with varying speeds and quality of data transmission, and all suitable for different types of users.

Crucially, being able to use these ICT configurations is reliant on a variety of competencies and literacies above and beyond basic technological literacy of being able to operate common ICT tools effectively. This much broader view of 'multi-literacies' sees individuals requiring the language, number and technical skills which give them access to the evolving digital world, alongside a set of creative and critical skills and understanding to productively engage with technology use in their lives (New London Group 1996). As Andy Carvin (2000) has outlined, these competencies include the ability to be 'information literate' (the ability to discern the quality of content), 'adaptively literate' (the ability to develop new skills whilst using ICTs) and 'occupationally literate' (the ability to apply these skills in business, education or domestic environments). These competencies are underpinned by levels of basic literacy in reading and writing and the functional

literacy of being able to put these skills to daily use. Crucially, then, the various forms of 'digital literacies' required of the individual learner mirror but also go beyond the traditional twentieth century literacies of 'lettered representation' (Lankshear *et al.* 2000). As Thoman and Jolls (2005, p.4) conclude:

> "No longer is it enough to be able to read the printed word; children, youth, and adults, too, need the ability to both critically interpret the powerful images of a multimedia culture and express themselves in multiple media forms".

These points and caveats withstanding, we should finally consider the fundamental yet often unvoiced element of the digital divide debate - the outcome, impact and consequences of accessing and using ICT. Indeed, much contemporary debate on inequalities and ICT concentrates only on the means rather than the ends of engagement of ICT use. As Wise (1997, p.143) acknowledges:

> "the problem with questions of access is that they reify whatever it is that we are to have access to as something central to our lives without which we would be destitute. They, therefore, redirect debate away from the technologies or services themselves".

To be of any lasting significance any conceptualisation of the digital divide in HE must combine questions of access and use of technology with the impact and consequences of engagement with information and communications technology for individual students. In this way, we are challenging the prevailing assumption within much discussion of technology and education that ICT is inherently beneficial and 'a good thing' for all individuals. Instead it should be acknowledged that the consequences of using and engaging with ICTs are not automatic for all. As Balnaves and Caputi (1997, p.92) reason, it follows that where the impact, meaning and consequences of ICT use are limited for individuals then we cannot expect sustained levels of engagement:

> "The concept of the information age, predicated upon technology and the media, deals with the transformation of society. However, without improvements in quality of life there would seem to be little point in adopting online multimedia services".

In particular, this notion of meaning can be seen as being at the heart of the digital divide debate within the context of higher education. For example, a host of authors have pointed towards understanding the *situational relevance* of access to technology and information from the point of view of the individual student, and, in particular, the relevance of the consequences or potential consequences of engagement with ICT (see Balnaves & Caputi, 1997). In this sense, the consequences of meaningfully engaging with ICT could be seen in terms of the effect on the various dimensions of a student's participation in higher education. They may include: *production activity* (engaging in an academically valued activity, such as education/training); *political activity* (engaging in some collective effort to improve or protect the social and physical environment of the university) and *social activity* (engaging in significant social interaction with teaching staff and fellow learners, or identifying with academic groups, communities and cultures). Thus the impact of ICTs could be seen in those terms which reflect the extent to which technology use enables learners to participate and be part of the university settings in which they are studying, i.e. the extent to which "ICTs enhance our abilities to fulfil active roles in society, or being without them constitute[s] a barrier to that end" (Haddon 2000, p.389).

Recognising multiple levels of digital division in higher education

With all these factors in mind we can now begin to reconstruct the concept of digital divides within the context of higher education in more sophisticated terms; as a hierarchy of access to various forms of technology in various contexts, resulting in differing levels of engagement and consequences. On the one hand, we are still concerned with inequalities in students' opportunities to access and use different forms of ICT. On the other hand we are also concerned with different inequalities of outcome resulting either directly or indirectly from students' engagement with these technologies. Thus it makes little sense to talk of a single dichotomous division as these inequalities of opportunity and outcome run along multiple lines. The different elements that need to be taken into consideration and factors that make up the digital divide are shown in Table 1. Here the progression from formal/theoretical access to effective/perceived access is followed by basic use of ICT that then may, or may not, lead to meaningful engagement with ICTs, information and services. This process culminates in the potential short-term outcomes and longer-term consequences of this engagement with ICTs.

Table 1. Stages in the digital divide

Formal/ theoretical access to ICTs and content	Formal provision of ICTs in home, community and university settings that is available to the individual in theory.
Effective access to ICTs and content	Provision of ICTs in home, community and university settings that the individual feels able to access.
Use of ICTs	Contact with ICTs in any form. May or may not be 'meaningful' use. May or may not lead to medium/long term consequences.
Engagement with ICTs and content	'Meaningful' use of ICTs. Where the user exercises a degree of control and choice over technology and content. Use could be considered to be useful, fruitful, and significant and has relevance to the individual.
Outcomes - actual and perceived	Immediate/short term consequences of ICT use.
Consequences - actual and perceived	Medium/long term consequences of ICT use in terms of participating in society. Could be seen in terms of: production activity; political activity; social activity; consumption activity.

Source: own material

If we see students' ICT use in these terms then the digital divide is obviously more than simple issues of ability to access technological resources and availability of content. In this sense there is a need to move beyond a conventional understanding of the digital divide as a simple case of technology 'haves' and 'have nots' and begin to address the area of digital inclusion in more nuanced terms.

Firstly, it is important to note that making use of digital technologies does not, in itself, constitute a student's digital inclusion. As Mark Warschauer (2003, p.46) has argued, "the key issue is not unequal access to computers but rather the unequal ways that computers are used". From this perspective, a number of authors have begun to map out multi-dimensional definitions of digital exclusion that encompass the multiple levels of ICT use outlined above. For instance, Lievrouw and Farb (2003) propose four basic elements of digital equity above and beyond matters of physical access to resources – namely skills, content, values and context. Similarly, Yu (2006) discusses ICT use in terms of skills, literacies, support and outcomes of activity and practice (such as the differences in outcomes between ICT-based entertainment as opposed to education). Also of use is Jan van Dijk's (2005, p.21) delineation between the motivations behind making use of ICTs, possession of operational, information and strategic ICT skills, and the nature of usage (e.g. usage time, the number and diversity of applications). Crucially, van Dijk sees the success of these stages of engagement with ICTs as contingent on the following aspects of resourcing:

- Temporal resources (time to spend on different activities in life);
- Material resources above and beyond ICT equipment and services (e.g. income and all kinds of property);
- Mental resources (knowledge, general social and technical skills above and beyond specific ICT skills);
- Social resources (social network positions and relationships – e.g. in the university setting, home or community);
- Cultural resources (cultural assets, such as status and forms of credentials).

With these components in mind, growing attention is being paid to inequalities in terms of the quality of students' ICT use. The type of ICT tools that an individual uses, the ways in which they are used, and the outcomes that accrue as a result all appear to coalesce into what can be described as these second order digital divisions (Hargittai 2002). In particular these can be seen to include the difference between the use of ICT for the passive acquisition of information and knowledge, as opposed to the use of ICT for the active and communal creation and sharing of information and knowledge – the so-called consumption/production divide. Indeed, Kennedy's recent study of ICT amongst Australian undergraduate students made the careful distinction between what was termed 'advanced technology use' (i.e. social bookmarking, contributing to wikis, and publishing and uploading podcasts) and what they termed 'standard web' use (i.e. information retrieval, downloading of content) (Kennedy *et al*. 2008).

It is also important to note the socially shaped nature of an individual's engagement with ICTs, and acknowledge that students' perceptions and understandings of the affordances of ICT use are likely to be organisationally and socially based. If the wider cultural context of use (such as the university setting) does not fit well with the culture of the ICT application, then use will not easily follow. As such, ICT use is not just based on the individual student being able

to understand the potential benefits of ICT use, but on how well ICT-based activity fits with the wider contexts within which they are operating. In this sense an integral aspect of ICT (non-)use is that of individual agency and choice. Above and beyond having the necessary access to resources, digital inclusion is therefore predicated on the ability to make an informed choice when *and when not* to make use of ICTs. So digital inclusion is not simply a matter of ensuring that all individuals make use of ICTs in their day-to-day lives, but a matter of ensuring that all individuals are able to make what could be referred to as 'smart' use of ICTs, i.e. using ICTs as and when appropriate. In this sense not making use of ICTs can be a positive outcome for some people in some situations, providing that the individual is exercising an empowered 'digital choice' not to do so (see Dutton 2005).

Evidence of the continued inequalities of ICT access and use in higher education

It is worthwhile taking some time to consider the patterning of digital exclusion within HE in more detail. In doing so there is a wealth of empirical evidence on which we can draw. For instance, a host of large-scale and well-executed studies have sought to map the digital inequalities throughout the general populations of developed and developing countries alike (Dutton and Helsper 2007, Notten *et al.* 2009, Broos and Roe 2010). Whilst there is some variation in the magnitude of difference, the social groups most likely to be characterised as being 'digitally excluded' in these data are most commonly delineated in terms of gender, age, income, race, educational background, geography and disability (see also Yu 2006). Such has been the recurring importance of variables such as age, socio-economic status, education, family composition, gender and geography, that the Pew '*Internet and American Life*' study was to observe that "demography is destiny when it comes to predicting who will go online" (Pew 2003, p.41). This conclusion has been reinforced year by year by a variety of digital divide surveys and statistical analyses produced by governments, the IT industry, charitable foundations and market researchers the world over.

Rather than be found to be distinct from the rest of society, there is considerable evidence that these divisions are apparent and often amplified within populations of university students. From a quantitative perspective, for example, recent surveys of university students confirm significant variations and divisions with students' ostensibly high levels of cohort ICT use (e.g. Kennedy *et al.* 2008, Oliver & Goerke, 2007, Salaway & Caruso 2008, Selwyn 2008). In particular these studies tend to show that whilst there are high levels of use of particular types of technology among the majority of students (not least social networking, chatting, downloading and information retrieval), other activities are pursued at far lower and inequitable levels.

In particular, recent empirical studies of web 2.0 use by learners in formal and informal settings suggest a lack of what could be considered 'authentic' or even 'useful' participative learning activity amongst young people. Ongoing Norwegian research by Brandtzæg (2008), for example, has identified nearly three-quarters of students as what can be termed 'non-active users' of web 2.0 tools, with recent UK and Australian studies also highlighting a general lack of 'sophisticated' or 'advanced' use of web 2.0 services and applications (Kennedy et al. 2008, Chan and McLoughlin 2008, Nicholas *et al.* 2008). These variations in the type and frequency of use have been found to vary especially in terms of students' gender, race, socio-economic background, age and educational background (see Cotton and Jelenewicz 2006). As Kennedy concludes, university students' (non-)use of ICTs shows there is "substantial diversity in usage patterns that is not explained by age" alone (Kennedy *et al.* 2008, p.489).

The complex nature of these inequalities of use is perhaps best illustrated in Caruso and Salaway's (2008) recent survey of over 27,000 students at 98 US colleges and universities. Whilst the authors found that almost all students engaged in using college and library websites and slideshow presentation software, conversely only some students engaged in more sophisticated ICT uses such as blogging, social bookmarking, virtual worlds, multiplayer online games, contributing to wikis and photo/video sharing websites – and then on an infrequent basis (i.e. monthly or less). These uses were found to be delineated by age, gender, whether students resided on or off campus, area of student (e.g. business or engineering as opposed to fine arts or humanities subjects), and the type of institution attended. As the authors concluded:

> "Net Generation students, along with older students, report that they are not looking for extensive use of IT when it comes to their academic courses. They do not take lots of entirely online courses, and most indicate that even when course lecture materials are posted online, they still attend classes. Instead there is a widespread attitude that IT resources are best situated in learning environments where technology is balanced with other learning activities, especially face-to-face interactions with faculty and students in the classroom" (Caruso and Salaway 2008, pp.10-11).

The subtlety and complexity of these digital inequalities is also revealed by a number of qualitative studies of university students' ICT use. For instance, in terms of the type of internet applications used by individuals, recent studies have suggested that preferences for particular applications over others follow sophisticated class-based patterns of taste and distinction. In terms of social networking services, for example, Hargittai (2007) reports that preferences for applications such as *MySpace* as opposed to *Facebook* appear to be patterned along lines of social class and educational background. Similarly, in terms of the nature of internet activity, the likelihood of a user engaging in the creation of online content has been found to be patterned by socioeconomic status (Hargittai and Walejko 2008).

Other qualitative studies have highlighted the contextual shaping of students' ICT use – not least the influence of the 'lived' experiences of individual students, i.e. understanding ICT use as part of the act of being a student in social, economic, political as well as educational terms. Here, research suggests that many students act as 'savvy' but pressured consumers of higher education, often engaging with their studies in ruthlessly pragmatic, strategic and tactical ways. In terms of surviving or even thriving during their university education many students are compelled instead to adopt 'low-level' surface and/or strategic approaches to studying with the aim of achieving high grades with little incentive to make sustained uses of ICTs. As their degrees progress, it is argued that students fast become 'portfolio people', with ICT often seen as being a basic, but not ultimately essential, element of developing their 'marketability' to employers (Selwyn *et al.*, 2000).

Other studies have also shown how students working in subject disciplines and universities with rigid pedagogical and epistemological cultures will often rarely have a contextual need to use ICT. Even within degree courses using ostensibly 'high-tech' provision of learning, the practical significance of digital technology can be limited. For instance, Kate Orton-Johnson's auto-ethnography of web-based distance-learning showed that online communicative and communal activities are often, in effect, only secondary activities which contribute little to the 'real' practices of university study which remain "grounded in traditional offline activities; reading, note taking and the production of assessed work" (Orton-Johnson 2007, para 11.2). In this sense university students' use or non-use of ICT for their studies may not always be due to a disadvantage *per se* but "more due to matters of 'digital choice' rather than 'digital divide'" (Brotcorne 2005).

Conclusions

It should be clear from even this brief discussion that 'ICT use' in higher education is a multi-faceted concept which encompasses a variety of activities and practices, via a range of hardware platforms and means of connectivity, requiring a number of different competencies and resulting in a number of outcomes. It follows that digital divisions can – and will – persist along all of these lines. As many of the empirical studies highlighted in the latter part of this paper suggest, ICT use continues to be a source of subtle but significant social inequality amongst university students in enduring ways. As such, higher education authorities that wish to ensure the fair and equitable use of ICT use within and between cohorts of university students must reach well beyond issues of technological resourcing and availability of content to address the persistence of a number of digital divides, information divides and knowledge divides.

In this sense there is a clear need for the education debate to begin to address the area of digital inclusion in more nuanced terms. We hope that the issues and arguments raised in this paper – and throughout this journal – can act as the catalyst for a sustained period of debate, discussion and development concerning digital exclusion and the establishment of more equitable higher education provision. Whilst it is trite to talk of 'digital divide 2.0' within higher education, in many ways this paper is arguing for a wholesale re-imagining of digital exclusion as a social issue, and a wholesale rethinking of the responses required by higher education providers. Although digital exclusion may well have started as a twentieth century problem, it looks set to remain a key issue in HE for many decades to come.

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About the author

Neil Selwyn
London Knowledge Lab

Institute of Education, University of London
23-29 Emerald Street,
London, WC1N 3QS, UK
n.selwyn@ioe.ac.uk

Neil Selwyn is a sociologist working at the Institute of Education, University of London, UK. His research and teaching focuses on the place of digital media in everyday life, and the sociology of technology (non-)use in educational settings. He has written extensively on a number of issues, including digital exclusion, education technology policymaking and the student experience of technology-based learning.

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Monograph "Redefining the Digital Divide in Higher Education"

ARTICLE

Digital Inequality Among University Students in Developed Countries and its Relation to Academic Performance*

Jonatan Castaño-Muñoz

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Abstract

Research on the digital divide has shown that it is important to study more than just the differences between those who do or do not have Internet access. Other dimensions that should currently be studied are: Internet skills, time spent on the Internet and, in particular, the use people make of the Internet. For each of these it is important to study the determinants and social consequences. In this paper we first present an overview of these dimensions and their determinants, and secondly analyse the influence of the dimensions with respect to the academic performance of university students. The analysed data, in agreement with international research, demonstrate that a) the effects of the Internet on academic performance are not direct, but mediated by variables and, b) the positive effects of the Internet are more pronounced in those students whose background is already more favourable for achieving better academic results without using the Internet, in agreement with the knowldege gap hypothesis.

Keywords

academic performance, digital divide, digital inequality, higher education, knowledge gap

La desigualdad digital entre los alumnos universitarios de los países desarrollados y su relación con el rendimiento académico

Resumen

La investigación sobre la digital divide *ha puesto de manifiesto cómo no solo es importante estudiar las diferencias entre la gente que tiene acceso a Internet y la que no, actualmente existen otras dimensiones que cabe estudiar: habilidades en el uso de Internet, tiempo en la red y especialmente los tipos de usos que la gente hace de Internet. Igualmente, para cada una de estas dimensiones es importante estudiar sus determinantes y sus consecuencias sociales. De acuerdo con lo anterior, y llevando el campo de análisis a la influencia de Internet en el rendimiento académico de los estudiantes universitarios, este artículo presenta en primer lugar una panorámica del estado actual de estas dimensiones y de sus determinantes para después analizar la influencia en el rendimiento académico. Los datos analizados, en consonancia con la investigación internacional, muestran*

* Original title: *La desigualdad digital entre los alumnos universitarios de los países desarrollados y su relación con el rendimiento académico*

cómo: a) los efectos de Internet en el rendimiento académico no son directos sino mediados por variables intermedias y, b) los efectos positivos de Internet son mayores para aquellos estudiantes con un background *que favorece ya de por sí, sin la intervención de Internet, la obtención de mejores resultados académicos, o dicho de otra manera, los datos nos indican que los efectos positivos de Internet en el rendimiento académico siguen el patrón de la hipótesis del* knowledge gap.

Palabras clave

rendimiento académico, brecha digital, desigualdad digital, educación superior, knowledge gap

1. Introduction

If we go back to the early studies on digital inequality we see how, from the beginning, the term most often used was "digital divide". This term was coined in the mid-90s, and the first time it was officially used was in the fisrt survey by the National Telecommunications & Information Administration (NTIA) "*Falling Through the Net: A Survey of the 'Have Nots' in Rural and Urban America*", (NTIA, 1995), an analysis of the dichotomy of groups which did or did not have access to and use of the Internet. With time, however, the concept has evolved from an analysis of the differences in access and effective use from a dichotomous point of view (those who do or do not have access to or use the Internet) to a more complex analysis of the differences in various dimensions between those who access the Internet, resulting in a certain conceptual ambiguity.

More recently, in search of more conceptual clarity, some authors have proposed the term "digital inequality" (Di Maggio *et al*, 2004) as a better definition of the social inequality related to the appearance of the Internet and its incorporation and use in society getting over the semantic dichotomy and the imprecision of the term "digital divide". The term "digital inequality" takes into account all the dimensions which have become included in the concept of digital divide, and includes a social vision of the technology which goes beyond the differences in the defined dimension. The term also takes into account the determinants and the resulting social implications, so allowing exploration of the construction of inequality through the combination of technical and social resources. This exploration requires explanatory models which distinguish between different modes of use and adoption of the Internet and directly linking behaviour to the social and institutional context where they take place.

Attempts have been made (Van Dijk and Hacker, 2000; Hargittai, 2002; Di Maggio et al, 2004; Van Dijk, 2006) to define the dimensions of inequality and the digital divide, and there is some agreement that at least four are key factors: *access* which includes the motivational differences for the first move towards ITC (motivational access) as much as the differences in access to technological infrastructure (the classic digital divide), *digital literacy*, the different skills for Internet use, *intensity of use* (differences in the time of use) and finally, the *purpose of use* of the Internet by individuals (differences in adopting the Internet and behaviour).

The concept of digital inequality referred to in this paper refers to these four dimensions, a concept which is central for the two objectives:

- Present an overview of the state of each dimension of digital inequality in universities in developed countries and establish what their determinants are.
- Analyse the role played by each of the aforementioned dimensions and the relations between them in studying the syllabus content outlined by higher education institutions, that is, the academic performance of the students.

To achieve these objectives, this paper is mainly based on various analyses (some published, some in process and some not published) of the data of the "University and Network Society"[1] project, the aim of which was to identify and analyse Internet use in the Catalan university community, particularly in the area of education and the repercussions. In addition, the contrasting and amplifying of the results with international research in the area are also presented, without the intention of giving an exhaustive theoretical revision. In this way, although the majority of the results

1. The report of investigation in Catalan can be found at: http://www.uoc.edu/in3/pic/cat/universitat_societat_xarxa.html. A summary in English can be found at: http://www.uoc.edu/in3/pic/eng/university_network_society/report.html

presented deal with the local situation in Catalonia, contrasting them with international research may allow for a more general analysis of developed countries.

The results presented here, more than basic research, are important for public educational policies and more so at a time when the way of using the Internet is being discussed in the European Space for Higher Education and when there is still time to attenuate, as much as possible, the social inequalities in the digital world and their propagation. However, it is important to state that the analyses presented which link digital inequality to learning are mainly focussed on acquiring knowledge for the syllabus designed by higher education institutions, meaning that it does not take into account acquiring other skills which could be very useful in the information society but are not incorporated or assessed in tests on academic performance.

2. Digital inequality among university students

This point describes the current state of the four dimensions which make up digital inequality: access, digital literacy, intensity of use and purpose of use. Given that the differences in each of the dimensions are not distributed randomly, we review the determinants for these dimensions in Catalonia, and compare them with international research.

2.1. Access to the Internet: Motivation, infrastructures and place of connection

Analysing the difference in access to the Internet (both motivational and in infrastructure access) it can be seen that they are practically of no significance in the university community. There is little published on the effects of motivation in university students, but Bozionelos (2004) has demonstrated that, in this group too, socioeconomic status is related to "computer anxiety', with students from families with lower socioeconomic status more likely to have negative emotions when using a computer, one of the reasons why they use the Internet less. Despite this, those who have a motivational barrier to connecting to the Internet are without a doubt a minority not quantified in any study.

Focussing on the differences of access to infrastructures, we see that virtually all students have their own ways of accessing the Internet, in contrast to the situation in other educational levels (Huang and Russell, 2006). In state universities in Catalonia, in the 2005-2006 academic year, more than 91% of students had their own computer with Internet connection. The data are corroborated by other studies in developed countries which demonstrate that, among university students, the classic digital divide, referring to who has or has not access to the Internet, is irrelevant. This is normal considering that university students have two of the basic characteristics which augur connection to the Internet: youth and a high academic level.

With a more detailed analysis, some differences are seen regarding the kind of device used for Internet access. In Catalonia we see that 43% of university students use a laptop since when the Catalonia Internet Project (2006) was being carried out, there was a tendency among students to switch from desktops to laptops. However, other devices for accessing the Internet were emerging, the mobile phone the most widely used one representing 6.85% of Internet users. When it comes to the bandwidth used, more than 90% of the students connect to the Internet via broadband connections, in this way greatly limiting the differences between broadband users and users of conventional connections, such as the time spent online, the greater number of activities carried out and the higher level of content creation by those using broadband (Matthews and Schrum 2003).

As well as their own connections, the students generally have Internet access at an institutional level. Universities in developed countries have arranged for the necessary infrastructures to be within reach of the university community, with sufficient technological facilities for the small minority who do not have their own computer with Internet connection. In Spain, for example, the student to computer ratio decreased from 24 in the year 2000 to 12 in 2003 (OCDE, 2005).

The differences in the devices used, and having an own connection or depending on public facilities for access, have repercussions on autonomy in Internet use. An own connection and portable devices offer more autonomy as to the location for connecting to the Internet which some studies (Asanni, 2006 in Hargittai and Hinnant, 2008) have correlated with uses considered beneficial for increasing personal capital, such as the search for information on health, products, shopping online, banking etc.

To summarise, university students in developed countries, in general, do not have major differences with respect to connection infrastructures and almost all are able to use their own broadband, with a minority having an advantage or disadvantage with respect to the level of autonomy of connection. But does this mean that they can all derive the same benefit from Internet? Is equal access sufficient to make sure that the degree in which students are able to benefit from Internet use (for improving academic per-

formance as well as in other areas) ceases to be a cause of existing social inequality but rather of personal inequalities and options?

As various studies have demonstrated (e.g. Neuman and Celano, 2006), while the playing field - access to technological resources – is levelled in a student group, the advantages that each individual takes of these are not equal, and it may even cause an increase in the differences between advantaged and disadvantaged groups as a result of other variables. Having technology is not sufficient for social transformation and the reduction of inequalities, as, in contrast to the thesis defended by technological determinism, technologies alone have not been the motor of social change. Social, institutional, and ultimately human problems are factors which can result in failure of any improvement initiative, in any environment, which is based on ICT (Warschauer, 2001). This is why it is interesting to go further and study what is known as the "second level of digital divide" (Hargittai, 2002): the differences in skills and uses between people who use the Internet, including university students.

2.2 Digital literacy: differences in Internet skills

The data on Catalan university students demonstrate that the level of Internet skills in the university community is very high compared to the general population. Within Catalan universities, only 7.35% of students claim to have an elementary or basic level (the 2 lowest levels on a scale of 5) while 51.55% claim to have a high or expert level. However, it is interesting to study who has the best user skills, looking at whether there are specific characteristics which influence these skills. Once again, our analysis of Catalan university students gives some clues to this, indicating that, while this is a more homogeneous collective than the rest of the population, there are still differences between the students.

There are differences with respect to the variables which determine the way technological skills are acquired: formal and informal learning. In agreement with other studies (Tien and Fu, 2008) our data show how the most effective way of increasing Internet skills is to study a degree where the syllabus incorporates computer skills (with all other variables being equal, engineering students have most skills and humanities students the least). This is followed by informal self-study, which shows that a lot of time on the Internet leads to skills improvement (Hargittai and Hinnant, 2008). Therefore it is normal that those students in Catalonia who have more years of experience in using the Internet, those who use it more than five days a week, and those who spend many hours a day online, have better Internet skills than other students.

In society there also exist differences as a result of maintaining social roles over generations, of gender as much as socioeconomic status, and it is important to see what role they play in digital literacy. Firstly, with respect to gender, it can be seen that, excluding all other variables (including those, such as women being in the minority in technological studies, which could introduce major bias), women are still at a disadvantage in acquiring skills which goes further than formal education and has more to do with the persistence of cultural stereotypes and social roles linking man with technological knowledge. This is consistent with studies in other countries such as Taiwan (Tien and Fu, 2008). Secondly, with respect to socioeconomic status, it is noticeable that, again with all other variables taken into account, the socioeconomic status of the family, measured by the education and profession of the parents, does not influence the acquisition of technological skills. It would therefore seem that the hypothesis of cultural reproduction does not apply to the acquisition of technical skills in university students in the online society. There are two explanations for this. One is the major cultural and economic homogeneity of the families of university students compared to the population in general, as the system works against children from less favoured families at earlier stages in their education so they are less likely to reach higher education. The second explanation is that parents do not have technological skills as part of the cultural capital they can transmit to their children as they are part of a generation who grew up without the Internet and at most they are "*digital immigrants*" normally with a low level of skills (Prensky, 2001).

In spite of this there is evidence that socioeconomic status plays an indirect role in acquiring technological skills, reaffirming the importance of formal education. The fact is that students from private secondary schools have better skills, because, as shown by Mominó et al. (2008), even though state schools in Catalonia have more technological resources, they are less effectively used both in the syllabus and in strategic plans.

2.3. Time online: The intensity of Internet use

Another dimension of the inequalities of Internet use which appears in the literature is intensity or time spent online. Analysing the results available, as with skills, the university students as a group show higher levels of connection and more frequent and intensive use of the In-

ternet (Katz, 2005). Once again, the explanation lies in two defining characteristics of the students: their high educational level and youth. This is confirmed by a study in Catalan universities, which shows that 79.5% of the students connect to the Internet five, six or seven days a week and only 1.59% one or less days a week. With respect to the duration of the connections, 17% of the students say their daily session on the Internet last less than one hour, 61.49% between 1 and 3 hours, and 21.05% more than 3 hours. If we look at which variables are related to greater use, the results for Catalan university students are consistent with international research in the following aspects: again there is a digital divide in favour of men (Chen and Peng, 2008), and it is clear that the students with better connection (ADSL), those who connect from home and those with better skills, are those who spend more time online (Hargittai and Hinnant, 2008).

But how can these differences in time of use be explained? Do the variables listed in the previous paragraph have a direct relation to the time spent or is there an intermediate variable which helps explain the relationship? It seems clear that at least one intermediate variable exists as much of the literature shows that the time of use is linked to the purpose of going online (Kubey et al, 2001; Howard et al, 2002; Matthews and Scrum, 2003; Chen and Peng, 2008), and this is no different in Catalan universities. It is not the aforementioned characteristics, therefore, which directly explain the time of use, but rather the reasons for using the Internet, which is the intermediate variable. We go on to analyse these differences in purposes of use among students.

2.4. Adopting the technology: purpose of use of the Internet

What activities do university students do when they are online? The study of Catalan universities has led us to the conclusion that they use the Internet for ends other than those specifically related to being a student, not forming a specific user group but along the same lines as those of young people in general in Catalonia (Castells et al, 2007). This means that their main use of the Internet is related to leisure, communication and downloading files, with a special use of time to play online games and use of real-time communication systems. These results are in agreement with most studies in developed countries (Kubey et al, 2001; Jones, 2002; Matthews and Schrumm, 2003; Tien and Fu, 2008; Hargittai and Hinnant, 2008), where the use of Internet does not in itself form part of a university student culture, while in less developed countries, where Internet access is only available through university connections, the use is more academic, in this case forming part of the student culture (Tella, 2007). With respect to educational use, which *is* part of the student culture, it is seen to take up a small amount of time spent online, with the only exception being to communicate with other students, which is also a social use and not necessarily done for educational purposes. A main reason for this low use is the lack of incorporation and use of Internet tools in the teaching-learning process by educational institutions (Duart *et al*, 2008).

Up to now, the dynamics which the student follows, in general, with respect to the purpose for using the Internet have been discussed, but, as always in analyses of the digital divide, it is important to look at whether differences exist as a function of certain characteristics. Some differences have been shown to exist. In the study by Peter and Valkerburg (Peter and Valkerburg, 2006 in Claro, M., 2007), they show how students with the highest socioeconomic status use the Internet more to obtain information and less for entertainment, also shown to be the case for students in Catalan higher education. Differences in use have also been detected depending on gender (Ying and Fang, 2008), with women using it more for academic purposes, communication and shopping, while men use it more for games, searching for adult content and looking for more general information.

If we focus on one of the most recent innovations on the web, the Web 2.0, we also see that differences in use exist among university students. The data for Catalan students are in agreement with those of a study by Hargittai and Walejcko (2008) and show how, in spite of the age homogeneity among the students, age as a variable plays a major role in the case of innovations, with younger students using the Web 2.0 more frequently. We also see that the socioeconomic status of the family, taken as the cultural and economic level of the student's parents, also has an influence on the use of the Web 2.0. The cultural capital transmitted by these parents may have a relation to the creation of social networks, collaborative work and an entrepreneurial spirit, elements which have an influence on the more innovative and social adoption of the Internet which the use of the Web 2.0 implies, and which now already forms part of the habitus of the upper classes.

3. Digital inequality and academic performance

Having analysed the state of the four dimensions of digital inequality and the determinants of the differences existing

in each one, we move on to the second objective, and take a further step by analysing the consequences these differences may have in student learning. We focus in particular on the students' academic performance related to the syllabus content set by higher education institutions.

The analysis of Internet access shows how infrastructures alone have no effect on students' academic performance (Neuman and Celano, 2006; Warschauer, 2001 and 2008), while the place where Internet is used should be taken into account. According to the data for Catalonia, the few students who only connect from the university have better academic results than those who do so from more locations. This is because the use they make of the university connection is largely related to academic work. This produces an interesting situation where the restricted autonomy imposed by the faculty leads indirectly to at least one positive consequence: improved performance. This is confirmed by a study at the University of Botswana (Tella, 2007) where it was found that students who most use the Internet are those with the better academic performance as, in contrast to students in developed countries, their main point of connection is at the university and so the use is generally for academic purposes and not leisure.

With respect to the level of digital literacy, having a high level of Internet skills does not have a negative effect on academic performance, more likely positive provided these skills are integrated in the syllabus. We will see that certain sophisticated uses of the Internet, such as participating in Web 2.0 or advanced searches, can have a positive effect on performance. Taking into account that a certain level of skill is required for these sophisticated uses, an indirect positive effect of the skills on academic performance can be observed, leading us to assume they are a necessary requisite for specific uses.

Research shows how the different reasons for using the Internet and the time dedicated online do have an effect on academic performance. Use for leisure purposes such as chats and online games may have negative effects, but, once again, they are not direct but mediated by other variables such as spending the time needed for academic activities on leisure activities. A peak is found in those students who are addicted to Internet leisure activities, which leads to an excessive amount of time spent online as well as psychological disorders such as sleeplessness, social isolation and depression, factors which have a direct influence on academic performance (Kubey et al, 2001, Chen and Peng, 2008). Several publications describe how these effects only occur in the minority of people who spend an excessive amount of time online, and that the negative relation to academic performance is not linear, but increases dramatically after a high threshold. This means that negative effects are not clearly seen in the majority of students, and in the literature there are cases where positive effects on academic performance have been seen mediated by the improvement in information handling and communication skills (Gil Flores, 2009), teamwork (Ramboll Managament, 2006 in Claro, 2007) and self-study (Law, 2006). These indirect effects of non-academic use of the Internet explain findings such as those in the PISA report where, although at the secondary level, excluding all other variables, the academic performance of those students who use the Internet the least and the most is lower than those who use it moderately (Claro, 2007). As such, it would seem that, in contrast to general belief, the use of the Internet for leisure purposes may have a positive effect on academic performance when it is within certain limits, not too low, and, in particular, not too high.

Concerning the academic use of the Internet, various studies show that, in general, academic performance is improved (Tien and Fu, 2008), but it is still important, as always, to deal with general terms in greater detail, as this use of the Internet does not directly mean performance improves. Another study indicates that various conditions must be met for this improvement to occur (Castaño and Duart, 2008). The first is that the student is interested in learning. This is not as evident as it may seem, as the academic performance of those students who try use the Internet to make studying easier and to pass exams, not to learn, is worse than that of other students. The second condition is that the higher education institution integrates Internet use within its pedagogical framework. If not, there exists the risk that groups of students with a learning style favouring Internet use, even though they are eager and willing to learn, come up against a university teaching methodology which does not value the skills for this type of learning. As a result, as well as the possible lack of motivation which could result from not being able to use the Internet in the classroom (Balanskat et al, 2006), they are likely to get worse academic results.

The strategy for academic use of the Internet which most clearly increases academic performance is to follow the teaching-learning methodology of the university (whatever it may be, classic or innovative in the use of technologies), and complement this with another strategy obtained through social uses of the Internet which are designed for academic purposes (Fuchs and Woesmann, 2004; Castaño and Duart, 2008). In this strategy the intermediate variable between the use of the Internet and academic performance is the interest or will of the student

to increase their knowledge, but also to share and discuss with other interested students. In this case, the use of the Web 2.0 for learning could be useful technology to channel this curiosity and extend what is learnt on the syllabus. A good strategy for using Internet resources for self-learning may well be to combine these resources by an initial guided teaching method. The institutional "guide" can help with the basic knowledge necessary to move on to self-study, and once this has been achieved learning should be promoted through more social and collaborative networks, along the lines of e-learning 2.0 (Downes, 2005), so that students can acquire more expert knowledge in their field of study, on their own.

4. Conclusions

University students are a more homogeneous collective than the population in general (at least when considering the academic level, socioeconomic status and age), but major differences can still be seen in their relation with the Internet. As such, it is also important to study different aspects of digital inequality, its determinants and its consequences, in this collective.

Connection to the Internet is available to all students in developed countries, and the majority of them have a personal connection and so a high level of autonomy. But access to infrastructures is not sufficient to guarantee equal opportunities for all students, as in the other dimensions of digital inequality (skills, intensity and purposes) there are differences in function of a number of variables discussed in this paper, which could have an important role in relation to academic performance.

Possibly the most interesting relation is that which links the different purposes of Internet use with academic performance. To reduce the inequality generated herein, it is necessary to know which uses are and are not beneficial for improving academic performance, as well as their determinants. The data presented in this paper are in line with the "knowledge gap" hypothesis, which postulates that those students most advantaged in the knowledge of the Internet are those who then take most advantage of it, here, the greatest improvement in academic performance. This is the case because having better Internet skills as well as being from a family with high socioeconomic status are good determinants of more sophisticated uses and furthest from the dynamics of leisure uses by the young population in general. This is beneficial for the individual, it favours what Hargittai and Hinnant have called "*capital-enhancing uses*" (Hargittai and Hinnant, 2008).

Among the beneficial uses which increase the capital of the students in our study, one which stands out for its major usefulness in improving academic performance is using the Internet as a social medium to extend, share and discuss the information obtained in formal education. However, this use is not randomly distributed within the population, but is found more in students who have more Internet skills and who come from families with a high socioeconomic status, recreating the habits typical of their social class (handling information, constructing a network of contacts, discussion groups, etc.). This confirms Van Dijck's (2005) hypothesis of the appearance of a "usage gap" which separates those who use the Internet for leisure purposes and those who use it for work and education. Therefore, although the usage skills are not directly conditioned by the family cultural capital, the student's types of uses are. Social dynamics are maintained, putting those students who use the Internet for leisure at a greater disadvantage, as they will have worse academic results because they have less time to dedicate to academic tasks, have less benefits from good use of the Internet (although it should be remembered that moderate use may result in some indirect benefit, albeit less than from proper academic use) and they run a greater risk of suffering from the negative effects due to excessive use, such as addiction and all its consequences.

As we have shown, the explanation for the relation between the Internet and academic performance is always influenced by determinants and with intermediate variables. It is in the study of these two factors where we think the emphasis should go for future research, away from the search for a direct relation with technological determinism. Variables such as student interest in extending, sharing and discussing knowledge, the extra motivation of using the Internet in the classroom, the time set aside for academic tasks and that dedicated to using the Internet, addiction to the Internet and its psychological consequences, the improvement of information handling, communication, teamwork and self-study skills, are some of the variables which are considered important in the mediation between the uses of Internet and academic performance. But it is important to continue along these lines to move toward the construction of a model that can explain the relationship, not to consider it as a black box at which untested hypotheses are launched.

Moving forward with knowledge on the relationship between the Internet and academic performance could be of great use for public educational policies. Empirical studies have already demonstrated that simply having technology available does not provide equal opportunities for all

students, that it is necessary to go further and ensure that all have the same skills to enable sophisticated uses and the interest in uses which are shown to be beneficial. This is where planners and educational institutions have to see which measures are most useful for encouraging awareness and bolstering advanced digital literacy and for carrying out these uses, particularly in the most disfavoured groups of students. It is also sure that progress along these lines of research will result in new challenges leading to social improvement.

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About the author

Jonatan Castaño-Muñoz
Researcher at the Internet Interdisciplinary Institute (IN3)

IN3 - Universitat Oberta de Catalunya
Av. Canal Olimpic, s/n. Edifici B3.
Parc Mediterrani de la Tecnologia.
08860 Castelldefels (Barcelona), Spain
jcastanomu@uoc.edu

Degree in Political Science and Administration. Masters in Applied Social Research. He was a researcher on the Project Internet Catalonia[www1] and is co-author of the book *La universidad en la sociedad red* published by Ariel. He is currently doing research in the field of technology and education, focussing on digital inequality of students in higher education and its relation to academic performance. He is completing his doctoral thesis at the Internet Interdisciplinary Institute (IN3) of the Universitat Oberta de Catalunya (UOC), with a grant from the UOC.

[www1] (http://www.uoc.edu/in3/pic/esp/)

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