The personal research portal: web 2.0 driven individual commitment with open access for development

Ismael Peña-López

Introduction: Access to knowledge and development

Fundamentally, the main problem developing countries face might be said to involve access: access to food, to health, to education, to capital, and to knowledge. Consequently, if knowledge means progress, gaining access to innovation and research results has always been a primary goal for each and every nation. While this has been the case for decades past, it is even more fundamental in the current 'Knowledge Society', where data, information and knowledge – by means of Information and Communication Technologies (ICTs) – become an asset in themselves, being raw input, capital and commodity at the same time. Reversely, in a network society, almost equally important to accessing knowledge is the capability of being accessed, because it is only by being a node of a network that participation becomes relevant.

Digital technologies have forever changed the way knowledge is disseminated and accessed, in at least two crucial ways. First, diffusion procedures (publishing, broadcasting, etc.) have been getting infinitely easier and cheaper for those digitally initiated (the '*digerati*'), but still remain surprisingly arcane for the ones on the dark side of the digital divide, less digitally literate and, thus, less prone to benefit from all the advantages of '*online casting*'. Second, intellectual property rights – and their trade – have seen their basements dynamited by the fact that a digital copy has certain characteristics of a public good insofar as it is a copy and as such can be duplicated and disseminated. Under this approach, the tension between 'coffee for all' and private property has caused an increasing strengthening of copyrights with a parallel adoption of new licenses aimed for the maximum spreading and sharing of content.

In view of this scenario, researchers, scholars and civil society organizations from developed and developing countries are pressing governments and institutions to foster Open Access (OA) for their documentation: this means that documents are 'digital, online, free of charge, and free of most copyright and licensing restrictions' (Suber 2005a). OA can be considered a way to achieve universal reach of research diffusion at inexpensive and immediate levels (see for instance Chan 2005). Most OA efforts have been aimed at the institutional level, devoting little energy to what the individual can do to contribute to this goal. Even though there are some valid reasons for this imbalance, there is ample opportunity for the individual to make a difference.

This paper aims to explore how individuals can contribute to the diffusion of research in the OA paradigm by means of social software and web 2.0 technologies. The example of the Personal Research Portal (PRP) – a concept more than an artifact – can contribute to making knowledge more accessible to researchers in developing and developed countries alike, but also provides a model by which international research

networks might be fostered. In detail, the paper analyzes how the PRP can contribute to creating an 'online identity', how this identity can help to create a network and how digital publishing is the currency of this network.

The Open Access paradigm and Open Access for development

Access to knowledge is crucial for the development of research and, hence, for the progress of society. In 2002 the Open Society Institute initiated the Budapest Declaration, supported by a group of scholars and seconded since then by thousands of signatories. The Declaration stated:

> *Open access to peer-reviewed journal literature is the goal. Open access to peer-reviewed journal literature is the goal. Self-archiving (I.) and a new generation of open-access journals (II.) are the ways to attain this goal* (Budapest Open Access Initiative 2002).

This set the basis of OA and was later complemented by the Bethesda Statement on Open Access Publishing (2003) and the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities (2003). These all aimed to provide definitions and commitments related to the OA paradigm. The discussion was transposed to a development context through the Salvador Declaration on Open Access: the developing world perspective (Brazil 2005), later revisited in the Bangalore Declaration: A National Open Access Policy for Developing Countries (2006). As stated by Suber and Arunachalam (2005) '[f]or researchers in developing countries, OA solves two problems at once: making their own research more visible to researchers elsewhere, and making research elsewhere more accessible to them'.

Most of these manifestos emphasized the role of institutions in fostering OA, being the main target of scientific journals. But, in Peter Suber's words (2005b): 'OA archiving is even more promising than OA journals. It is less expensive, allows faster turnaround, and is compatible with publishing in conventional journals'. Hence, the key benefit of OA archiving is that 'global participation could take place without further delay' (Chan and Kirsop 2001). Open archiving usually occurs within 'institutional archives, administered by universities or research institutes for members of their community' (Kirsop and Chan 2005). The initially identified benefits of open archiving – cost, immediacy, flexibility – can play havoc with institutional procedures, where dedicating personnel to new initiatives is costly, tempos are slow and bureaucracy inflexible. Indeed, institutional repositories might still be isolated, not contributing to a researcher's visibility or content availability.

The personal research portal

One problem facing developing nations is that 'access to high-quality research information has historically ranged from being extremely limited to altogether non-existent' (Brooks 2005); even so, this does not mean that its citizens do not produce high-quality research information themselves and that they cannot act individually to close 'the existing gap between those countries that have ample access to electronic research information and those that do not' (Brooks 2005). This can be a

complementary trajectory to initiatives emerging at the institutional level, such as those described above (Kirsop and Chan 2005).

The approach presented here is closely related to the concept of 'e-portfolio':

> *An e-portfolio is a digitized collection of artifacts, including demonstrations, resources, and accomplishments that represent an individual […]. This collection can be comprised of text-based, graphic, or multimedia elements archived on a Web site or on other electronic media* (Lorenzo 2005).

E-portfolios are usually associated with students and teaching rather than with researchers, their main goal being for students to gather and present their work for assessment; therefore the term 'personal research portal' (PRP) is introduced here as an alternative, whereby its main goal is to act as a knowledge 'gatherer', contributing to

1. Enhanced access to international research output;
2. Access to research generated in developing countries;
3. Promotion of institutional research output;
4. Improved citation and research impact;
5. Improved access to subsidiary data; and
6. A strongly facilitated peer review (adapted from Chan 2005).

To achieve this, the PRP should be a low cost, highly flexible virtual space, which supports:

- Hosting a repository for personal production, with public aim, with past and present (work in progress) information and documentation;
- Gathering digital resources, news, general information and materials on the same platform, accessible from each computer with an Internet connection;
- Self-archiving and self-publishing research results, in terms of ongoing research, reflections, doubts, findings – avoiding waits and delays;
- Informing the broader public what one knows and that one knows (Peña-López 2006b); and
- Increasing one's visibility, enabling networking and knowledge sharing.

All in all, a PRP tracks the 'read-think-write' routine performed by scholars and scientists involved in research. The big difference with publishing is that a PRP not only keeps record of *stock* knowledge – formal knowledge that lasts or should last – but also of *flow* knowledge – non-structured, flexible knowledge devoted to fostering exchange (definitions adapted from Peña-López 2006a).

As it happens with Personal Learning Environments, there is not such a thing as *the* PRP, because it can be built from a mesh of different applications (a practical PRP guide is included below), which the user can choose and adapt as needed, for instance:

- A static web site with personal and professional information, drawing the researcher's profile;
- A blog, where to note news, reflections and 'flow' knowledge arising from readings, research results and hypotheses;
- A blogroll, understood as both a live reader for the researcher and a live bibliography of bookmarks for the community;

- A wiki, where 'stock' knowledge is stored but allowed to evolve along time and with the collaboration of third parties;
- A bibliographic manager, with online access to all or most records;
- A personal repository to (self-archived) published papers and (self-published) preprints, working papers, presentations, syllabuses, etc.;
- Other tools, such as social bookmarking, file stores (image, sound, video), and so forth; and
- RSS feeds.

In other words, the PRP can be imagined as a lifetime personal web space 'magnificently equipped (with software, communication, search, and multimedia tools), beehive[ly]-configured […] that possesses sufficient organizational plasticity to accommodate the user's developmental capacities and needs across a lifetime' (Cohn 2001). These capacities and needs are related with a researcher's inputs (readings, conversations), transformation processes (reflections, peer reviews), and outputs (communications, preprints, papers).

There are nevertheless two caveats to be made: first, this individual publishing alternative is in no way a complete substitute to the stated ways of institutional OA publishing, but a complementary one that has some exclusive characteristics only attainable by this means. Second, along the same line, this is in no way a substitute for mainstream ways of publishing and validating scientific outcome but, again, a complementary one. We will deal with these issues below.

The applicability of this tool for researchers in developing countries is explored below.

Social software, Web 2.0 and DIY web technologies

In the last years new, user-friendly web tools have appeared which moreover are often interconnected in such a way that communication and collaboration can take place. Such 'social software' – blogs and content management systems, wikis, message boards – is embedded in a wider concept, the 'web 2.0'. This is a model whereby peers contribute to the development of tools, content and communities, all taking place on the Internet. Such technologies are designed to simplify online publishing, simultaneously creating a network of both content and authors.

An important feature of these 'do-it-yourself' (DIY) web technologies is that they are usually licensed under free software licenses, so they can be installed and used for free, or are hosted by a provider that allows free usage, sponsoring the service through advertising. In either case, the cost for the user is restricted to a personal computer connected to the Internet, while the benefits are significant.

- The tools and technologies provide a way for researchers, who might otherwise have more trouble finding appropriate dissemination outlets, to easily share, make public and diffuse findings;
- Equally, information published using these technologies is made easily accessible;
- The more everyone joins a community, the richer it becomes.

The high level of economic sustainability of the proposed PRP model is one of its main highlights. Besides the required tools, the cost of hosting services for those aiming to install free software applications to be run under their own domain is constantly decreasing. In fact, some universities provide basic hosting, and many technology providers offer free hosting in exchange for locating advertisements on a site. One of the major problems that researchers face in poor countries is lack of necessary funding (Brooks 2005); decentralized web 2.0 tools as described above can contribute to alleviating this aspect, by providing an alternative means for researchers to circumvent costly infrastructures and formal institutions, yet allowing them join international research communities, access relevant information and make results known.

Three barriers stand in the way of widespread usage of this model in a development context. First, infrastructure: while affordable and easy access to ICTs and the Internet are pending issues around the globe, public libraries or civic centers increasingly provide free or low cost access, as do private telecentres. Although an in-depth analysis of these issues goes beyond the scope of this paper, it is worth stressing that web 2.0 technologies demand relatively low computing power and connectivity quality, and therefore can be considered an interesting knowledge sharing framework for a development context. A second major barrier is user capacity, which is often limited in developing countries, in part due to the limited exposure to ICTs as described above. Computer skills are however increasingly addressed in development programmes, and moreover, web 2.0 applications and social software are designed for non-technological users. Thus, even with a relatively low level of digital, technological and informational literacy can a user achieve interesting results and foster a 'conversation' (Levine *et al*.1999) among peers and scholars. Third, dissimilar cultural backgrounds and different mother tongues affect the ease of knowledge flow on online fora, but this aspect extends beyond ICT-enabled interaction; moreover, precisely the adaptability of web 2.0 technologies can stimulate the formation of local communities, providing a way by which this problem can be circumvented.

All in all, social software can contribute to the development of a network of peers. It is a form of technology stewardship by means of encouraging participation in conversation (Levine *et al*. 1999): wikis, fora, blogs, and many other tools provide perfect companions for newcomers to make their way into the web 2.0 arena.

'How to' hints: a PRP prototype

So what does a PRP look like? What does it involve? The underlying principle is that 'instead of building new applications from scratch, […] it makes sense to concentrate in the future on systematic combinations of existing Open Source tools for learning and competency development' (Kalz 2005). In this light, the design and implementation process is as interesting as the goal.

> *The combination of e-portfolios, social networks and weblogs may have immense benefits for the learner. These tools and the ethos behind them enhance the prospect for deep learning. Creation of a learning landscape where learners engage in the whole process both academically and socially*

> *should increase the opportunity to build one's learning instead of just being the recipients of information* (Tosh 2004).

A 'one minute handbook' on how to build a Personal Research Portal would include the following components:

- *Domain and hosting*: A domain name is automatically associated with specific content and its managers and contributes to the 'digital identity' of the owner, as discussed above. Hosting allows autonomous tools to be integrated into the portal, in terms of services, shape, contents and so forth.
- *Content management*: Static pages and most of the dynamic ones can be built using a content management system (CMS). Drupal or Joomla are open source varieties of such systems, with the advantage that they also feature blogs. Reversely, WordPress is a blog engine that can also be used as CMS. Alternative tools are e-portfolio applications such as OSPI and Elgg.
- *Collaborative tools*: In terms of collaborative tools, the options are clear: if the expected output is content, a wiki is probably the best option. If the goal is the process, the debate itself, then discussion fora are required. Appropriate applications might include Mediawiki – for the wiki – and phpBB – for the message board.
- *Bibliographical tools*: While different bibliographic managers are available, there is little consensus in terms of the best bet. However, Refbase and BibCiter fit the PRP purpose: both are web based and have RSS output. EPrints and Open Journal Systems work well for self-archiving and self-publishing, respectively.
- *Social software*: Many other applications exist to share bookmarks, photos and slideshows, podcasts, vodcasts, etc. Most of them are online services provided – and hosted – by third parties. An important consideration when choosing such tools is their capacity to import and export a user's data and the ease by which they can be linked in a PRP.
- *RSS*: 'Really Simple Syndication' (RSS) is an alternative means of accessing the vast amount of information that now exists on the world wide web. Instead of the user browsing websites for information of interest, the information is sent directly to the user (source: epolitix.com). In any case, RSS output, as the glue of such portals (Kalz 2005) is a must.

When connectivity is not available and a user intends to work predominantly 'locally', XAMPP makes it possible to (re)install all these social software applications – in fact the whole PRP – on a hard drive or a USB pen drive. Indeed, it can work as a backup for our PRP and/or make it portable across different operating systems.

Box 1: some examples of PRPs in practice

On education:

George Siemens	http://elearnspace.org
Stephen Downes	http://downes.ca
Helen Barrett	http://electronicportfolios.com

On ICT for development (ICT4D):

Victor Mbarika	http://www.vmbarika.com
Ismael Peña-López	http://ICTlogy.net

PRP and the knowledge divide

Digital Identity

One of the main problems that researchers face in developing countries is invisibility to the broader research community. This invisibility has at least two major consequences:

- Minimum awareness and recognition of findings, fields of work, interests and existence;
- Difficult access to mainstream publishing circuits.

In order for researchers and their work to be recognized in academic and practitioner circles at the international level, their visibility needs to be enhanced. Setting up a PRP can thus be understood, at a primary level, as the creation of a personal home page, 'building a virtual identity insofar as it flags topics, stances and people regarded by the author as significant' (Chandler 1998). This digital identity, or the researcher's presence on the Internet, is complementary to the academic identity shown by authorship in academic journals and conference proceedings. While the latter are strongly tied to the development of the researcher's concepts and his or her contribution to the development of formal knowledge, the digital identity builds on these, providing additional information on:

- The owner's identity (who am I);
- The owner's activities and interests (what do I do);
- The owner's achievements (what have I done);
- The owner's contact details (where am I).

If mainstream systems – congresses, journals, seminars – act as diffusion hubs for offline identities, search engines, portals, third parties' blogs and institutional pages, signature files in e-mails (specially when placed in discussion lists and message boards) act as diffusion hubs for online identities.

Nevertheless, there are two main advantages of online media versus 'offline' dissemination mechanisms:

- A higher potential reach;
- More up to date information. If managed properly, PRPs can show the latest news about a researcher's institutional affiliation, can include recent research trends and so on. In fact, if updated pages use RSS feeds and are correctly meta-tagged, human intervention is not necessary for the changes to be echoed in specific search engines and feed aggregators.

Overall, the main component of a PRP should be evolving, up-to-date information of one's own. Search engines are web 2.0-friendly and award high rankings to dynamic pages with rich and focused content. Descriptions of one's research and interests, as well as providing documents, other relevant materials and links to and from other people with similar interests, enhance the possibility of being found under specific keywords. This information can be created by means of simple HTML documents or, better, using a CMS – or CMS-like features from other applications such as blogs, which can play a significant part in terms of linking and networking.

Reading, live storing and the public notebook: reinforcing the digital identity

The research process generally involves extensive note taking, as highlights of what has been read, reflections that arise after the reading or simply as a record of the fact that something has been read. Social software empowers researchers in such a way that their notes can be 'published to the World Wide Web as a way to 'display and reflect on their learning' to an audience that is broader than just their classmates' (Ittelson 2001). Moreover, '[knowledge] only works if each person makes links as he or she browses, so writing, link creation, and browsing must be totally integrated. If someone discovers a relationship but doesn't make the link, he or she is wiser but the group is not' (Berners-Lee 2000).

Such a digital notebook – in the shape of a blog, an important part of the PRP – allows the process of reading, writing, analysis, reflection and learning to be fully public: 'Eventually, there will be publications in scholarly outlets, but there are both more immediate and more long lasting benefits. In the near term, ideas can be more readily implemented, data automatically collected' (Piccoli 2000). Another immediate consequence of this way of working is that 'less knowledge [is] left behind' (Cohn 2001), as a live digital store is created each day, a store that is categorized, searchable and fully accessible. The PRP here 'represents a space where the relationship between memory and promise, the link between past and future is made possible' (Rossi 2006). Hence, a factually driven dynamic identity evolves by tracking the researcher, creating new knowledge in the framework of his community.

This identity is reinforced by the fact that content is categorized – tagged – according to specific keywords. And, besides the fact that categorization (and 'searchability') can be useful to the researcher, full accessibility is the key: not only data and information are accessible everywhere to the owner or creator of the PRP, but also to other researchers. In view of enhancing accessibility to knowledge and visibility for people in developing countries, this can make a difference. Through its inherent characteristic of immediacy, a PRP provides access to knowledge without filters and without waits: the PRP becomes a digital store of resources, news and current events, general information, academic materials and state of the art research. It should be noted that in some countries Internet censorship can obscure this aspect; however, this is a political problem rather than a technological or conceptual one, and so goes beyond the scope of this paper.

As a collector of 'flow' knowledge, contributing to a wiki, joining a blog or uploading files to a server can add to the 'stock' knowledge of a PRP (Berners-Lee 2000). In this context, bibliographic tools are also worth exploring. Their purpose is to organize one's references and to ease the task of citation. Some varieties of bibliographic tools are web applications, installed on a web server and run on web browsers. This allows not only managing but publishing one's references and bibliographies. This feature reinforces one's digital identity by allowing cross-referencing in a body of knowledge, and providing more rigour to the content shared on a PRP.

Writing and participating in conversation: network building

Social software is all about meeting colleagues, exchanging impressions and collaborating. Interconnecting PRPs capitalize on this capacity by taking advantage of automated linking methods. Of the different software varieties and perhaps even more than search engines, RSS feeds, a part of the XML family, enable knowledge sharing

and foster community building in real time, for instance through include pingbacks and trackbacks. 'Pingback' is a method for Web authors to request notification when somebody links to one of their documents. This enables authors to keep track of who is linking to, or referring to their articles. Some weblog software, like WordPress, support automatic pingbacks where all the links in a published article can be pinged when the article is published (source: en.wikipedia.org/wiki/Pingback). Trackback is essentially the opposite, allowing a blogger to see who has seen the original post and has written another entry concerning it. The system works by sending a 'ping' between the blogs, and therefore providing the alert. (source: en.wikipedia.org/wiki/TrackBack). While these methods contain implicit technological linking, pingbacking and trackbacking require an explicit conceptual linkage in terms of the body of knowledge which researchers share interest in or are contributing to.

'Sometimes it feels as though the discussion concerns two different nodes. The 'eportfolio' used for final assessment / job seeking where the emphasis is on the product(s) and then the 'e-portfolio' used for reflection, deep learning, knowledge growth and social interaction where the emphasis lies on the process' (Tosh 2004). It is the latter that is the most interesting for research purposes: citation on a PRP using social software encourages social interaction, albeit driven by technology. Social networking can further be reinforced by comments on others' PRPs or the creation of 'Friend of a friend' (FOAF) files and blogrolls: 'FOAF' is an XML standard that allows website owners to define who they are as well as their relationships with other website owners – effectively creating a wide area social network' (Tosh 2004). Inclusion of such tools contribute to shaping a virtual research network around the PRP and in fact around its creator.

In terms of development impact, the PRP can potentially 'seamlessly link individuals to larger communities, thereby facilitating interpersonal connectivity versus fostering social isolation' (Cohn 2001). By reinforcing this behavior among scholars the presence of 'invisible' researchers can be improved.

Web pages are a form of asynchronous communication, but social software makes it possible that 'my web page... mediatively interacts with other people in my absence' (Chandler 1998). Indeed, collaboration can occur, 'reducing contact time while also increasing the quality of contact time' (Roberts 2005). From this perspective, PRPs 'can help people to define their own success through reflection with evidence often *enhanced with peer or mentor commentary*' (Roberts 2005, emphasis added), through the exchanges and linkages which can be initiated through such virtual exchanges. Although these are of quite a different nature than the habitual double-blind review that most journals follow, open peer exchange boosts networking and collaboration to an effect reaching far beyond that of anonymous readers. Moreover, the immediacy of finding posted on PRPs allows

> *hypotheses [to be] more easily tested, thus reducing the cost associated with research ventures and increasing productivity. Similarly new researchers can quickly be integrated into ongoing projects and make contributions to the research […]. In the long term, the external visibility of the web-based research engine will promote a shift in organizational culture toward a more open and cooperative environment where knowledge augmentation and sharing are instrumental to individual learning and organizational*

> *development. In such a culture research engine participants will benefit from increased collaboration with qualified colleagues both within and outside the institution*. (Piccoli 2000)

Overall, to take part in a conversation one must speak – and blogs (individual or collective, supplemented by feedreaders), wikis or online office suites are tools by which to make one's voice heard. Contributing, commenting and linking (directly or through pingbacks and trackbacks) are the way to let others know their work is acknowledged.

Self-archiving, self-publishing

'Whilst the fundamental technical difference between the medium of speech and that of writing is that writing is automatically recorded, web pages introduce another key feature: what is written on a web page (and stored on a web-server) is automatically published' (Chandler 1998). As mentioned above, researchers in developing countries often face tough barriers to do such publishing. A tool like the PRP can help address this problem in different ways.

First of all, self-archiving of preprints and published works in a personal repository is an evident purpose for the PRPs to fulfill. This is only a complementary track to journal publishing, but is a way to provide access to published works which would otherwise remain more obscure, at the same time acting as a repository of the owner's (academic) output. 'This complete openness may be an anathema to archivists and cataloguers as it abandons all attempts to control the system, but it was suggested that such an approach could greatly facilitate short term uptake' [of knowledge] (Roberts 2005).

'Anathemic' or not, self-publishing goes one step further still in terms of challenging the faculty establishment, because it avoids peer review. Even so, self-publishing has its value, providing an opportunity for publication of interesting work that might otherwise remain unpublished. Moreover, works that need no review such as newsletters, bulletins, opinion columns, working papers, datasets, or works that have already been reviewed such as working papers, theses and other kind of dissertations can obtain formal identifiers (ISSN or ISBN) and be published on a PRP without violating academic standards or other publishing norms. Under an open license, such publishing contributes to increasing the visibility of the author, shaping a digital identity, enriching the content of the site, making it more appealing to users and search engines and, all in all, helping research to have its rightful place in the academic arena.

In the long run, an increased legitimacy of open access science can be expected. The benefits such as higher exposure and easier dissemination make it easier for work to be accessed and reviewed but more difficult to plagiarize, while generally enhancing the advancement of knowledge to researchers in developing and developed countries alike.

Conclusions

There is a place for individual initiatives, complementary to institutional efforts, to bridging the research biases and imbalances in the international arena. These initiatives find a perfect companion in social software tools.

Some of these tools, such as wikis, social bookmarking, social networking, file sharing, RSS feeds, discussion forums and blogs, are already used for diverse research purposes either directly; of these tools, the blog is the most important (White 2007). Despite the digital divide which still restrains researchers in developing countries from capitalizing fully on the possibilities provided by these tools, virtual communities have demonstrated their potential for bridging capacity divides, whereby technology stewardship take place naturally, nonhierarchically yet nonchaotically.

More than just a matter of being published, or participating in knowledge communities, collaborative or 'discourse' technologies (Roberts 2006) can play a role in empowering the individual with (digital) means to master a learning and research process within a cultural framework relevant to his or her needs. The creation of a digital identity is a means of empowerment, contributing to gaining control over one's life, but also participating equally in a globalized knowledge society. As such, the PRP is, overall, an e-inclusion device, contributing the creation of a vast and public body of knowledge for progress.

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Abstract
Researchers and research interests in developing countries are underrepresented in mainstream academic publishing systems. Reasons are many but publishing costs, research infrastructure financing and researcher invisibility are among the most apparent. Efforts have been made to mitigate this situation; an increasingly common and successful approach is open access to scholarly literature such as open access journals, self-archiving in institutional repositories and self-publishing.

While this discussion has focused predominantly on institutional initiatives, the concept and tools around the web 2.0 harness clear opportunities for researchers, acting as individuals, to contribute and build a broader personal presence on the Internet, at the same time benefiting from a better diffusion for their work, interests and publications.

By using a mesh of social software applications, this paper introduces the concept of the Personal Research Portal (PRP) as a means to create a digital identity for the researcher and to build a virtual network of colleagues working in the same field. Complementary to formal academic research dissemination and validation trajectories, the Personal Research Portal is presented as a knowledge management system that can enhance reading, storing and creating knowledge at both the private and public levels, helping to bridge the academic digital divide.

About the author

Ismael Peña-López is lecturer of Public Policies for Development and ICT4D at the Open University of Catalonia, Spain. His main research interests are the Digital Divide, e-Readiness, ICT4D and Digital Inclusion. As a side effect of his teaching in virtual learning environments, he has also developed a deep interest in Open Access and its relationship with e-learning and development. Prior to this he set up and directed during five years the cooperation for development program of the University, focused on e-learning for development. His Personal Research Portal can be accessed at http://ictlogy.net

Ismael Peña-López, School of Law and Political Science, Universitat Oberta de Catalunya, Av. Tibidabo 39-43, 08035, Barcelona, Spain. E-mail: ipena@uoc.edu