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A PBL Response to the Digital Native Dilemma

Timo Portimojärvi and Roisin Donnelly

Introduction

The purpose of the chapter is to delve into the growing imbalance between the educational technology widely supported by higher education institutions and today's digitally cognisant student body. The authors argue that technology, such as Learning Management Systems (LMS), are not meeting the needs of the current students, commonly referred to as "digital natives", and that a disparity exists between how the students choose to communicate, in general, and how they are encouraged or required to communicate in accredited courses.

This chapter draws on the writers' experiences and research together with studies on PBL supported and enhanced with technology. The key issues discussed include resolving the dichotomy between the technology needs of higher education students and the systems that institutions are providing to support their learning environments. The main thrust of the chapter is to highlight the strongest points where PBL and modern technology meet which will be illustrated using current examples from Ireland, Finland and other countries.

As stated by John Dewey (1938) , `If we teach today as we taught yesterday, we rob our students of tomorrow.' In writing about digital natives and digital immigrants specifically, Prensky (2001a, p. 1), one of the leading proponents of this theme, argues that:

our students have changed radically. Today's students are no longer the people our education system was designed to teach

and that

[o]ur digital immigrant instructors who speak an outdated language (of the pre-digital age) are struggling to teach a population that speaks an entirely new language (Prensky, 2001a, p. 2).

Bayne and Ross (2007) warn that serious critique of this discourse is long overdue as there is comparatively little published literature that examines Prensky's assumptions in a sustained way.

While Dewey (1938) and Prensky (2001a) are not writing about problem-based learning or simply technology, both are looking to the future and are seeing education of continuing preparation for that future. The views of Dewey and Prensky create a grounding for this chapter, in which we discuss the tensions and possibilities in using information and communication technology (ICT) with problem-based learning (PBL), and present a framework for future development.

Traditionally, PBL has usually been conducted in a face-to-face setting. Recently, there has been a growing interest in PBL and technology among educational researchers (Dennis, 2003; Donnelly, 2007; Portimojärvi, 2006; Savin-Baden, 2003; Savin-Baden & Wilkie, 2006; Uden & Beaumont, 2006). There have been several attempts to define terms for the combination of e-learning and PBL. However, these attempts are seen as problematic since they offer little indication about the ways in which technology is being used, the areas of student interaction, the quality of the learning materials or the extent to which any of these factors are integrate with PBL. In this chapter, we adhere to the idea of enriching the essential components of PBL with media and integrating technology, as a natural part of PBL. The context and the need set the limits as to whether technology is used just to enrich classroom practices or to create fully virtual applications. We already know that even a full implementation of online PBL with a dispersed group is possible when needed, but it cannot be an objective, just a choice.

Chapter Overview

In this chapter, we return to pragmatic, basic views: the tools and practices used in learning should be selected and developed further to achieve the learning goals needed in life and work.

This chapter:

- discusses key emerging issues,
- explores reflection and digital tools,

- outlines a framework for the future, and
- provides a list of useful further resources for integrating technology and PBL.

Context

This section of the chapter details the context of a triad of perspectives of teacher education at tertiary level and outlines the authors' argument on the lack of alignment therein. Three issues are explored:

- 1) the culture and tools of digital natives
- 2) the current use of ICTs in educational contexts, and
- 3) work culture.

Digital natives and immigrants

The generation born from the beginning of the 1980's has been characterised as 'digital natives' (Prensky, 2001a) or the 'net generation' (Tapscott, 1998) and are also referred to in the literature as the 'Net Gen' or 'digital learners' (Oblinger, 2006) because of their familiarity with and reliance on ICT. The digital natives are seen as having grown up in mediated environments surrounded by and using computers, videogames, digital music players, video cameras, cell phones, and all the other toys and tools of the digital age (Prensky, 2001a).

Manathunga and Donnelly (2008), echoing the sentiments of many educationalists, have argued that the learning preferences and styles of the so-called digital natives are extremely important to take into account when designing any course involving learning technologies. The aptitudes, attitudes, expectations, and learning styles of these NetGen students reflect the environment in which they were raised - one that is decidedly different from that which existed when the academic staff were growing up (Oblinger & Oblinger, 2005). As Oblinger (2006) continues to argue, today's younger student learners are digital, connected, experiential, immediate and social, with preferences for learning, which include peer-to-peer interaction and engagement, and for learning resources that are visual and relevant.

This technological immersion is described as so complete that young people either do not consider computers as technology anymore or are not able to distinguish the real world from the digital one. These young people are the native speakers of the digital language of computers, video games and the Internet. Those individuals who were not born into the digital world, but have later adopted many aspects of the new technology, are compared to them and called 'digital immigrants' (Prensky, 2001a).

Prensky (2001b) grounds his idea in neurobiology, social psychology, and in studies conducted with children using games for learning. Neurobiologists and social psychologists agree that the brain can and does change with new input. Teachers of students with disabilities and the military are already using custom designed computer and video games as a way of reaching digital natives.

However, the majority of today's educational establishment remains bound to more traditional means of delivering instruction.

The divide between digital natives and digital immigrants over-simplifies the differences between the users. Students have the skills to use new kinds of applications and new forms of technology, and their ICT skills are wide but their working habits might be ineffective and even wrong (Ilomäki, 2008). Age, ICT skills and the availability of digital media are not interdependent, and Prensky's argumentation does have weaknesses. Therefore, the divide is strongly debated (see Bennett, Maton, & Kervin, 2008).

The findings of Margaryan and Littlejohn (2008), from their study of students' use of technology in two British universities, tend to contradict the prevailing view of the "digital native" as a sophisticated user of technology who has a fundamentally different approach to learning. In more detail, they report:

Students use a limited range of technologies for both learning and socialisation. For learning, mainly established ICTs are used - institutional VLE, Google and Wikipedia and mobile phones. Students make limited, recreational use of social technologies such as media sharing tools and social networking sites...the findings point to a low level of use of and familiarity with collaborative knowledge creation tools, virtual worlds, personal web publishing, and other emergent social technologies (Margaryan & Littlejohn, 2008, p. ??).

A recent study (Joint Information Systems Committee [JISC], 2007) notes that, while use of internet technology, particularly for social networking, is almost ubiquitous among 16-18 year olds, this does not translate into a desire among this age group for more technologically-focused approaches to teaching and learning at university.

Whilst the existence of this debate is recognised here, it illustrates the bigger picture that can be seen in the practice of many academic staff today.

ICT in Educational Contexts

What is the role of technology in our classrooms? - Is it to support the teaching paradigm? Is it the means for developing media literacy skills in action? Is it the leading force in educational development? Inherent in a discussion of the function of ICTs in education is the position of LMS, institutional views, and centralised systems.

The use of technology in education is a series of huge expectations, with many success stories, but also, at least as many failures and frustrations. It has two major roots, computer-aided instruction and distance education, both of which still have a remarkable impact on education. From the history of media, we know that new forms do not replace the old, but become mixed and, as a result, create new forms. Media and technology change rapidly, as we have seen, but the dominant paradigms seem to remain active, even if the old paradigms and new media collide with each other.

In opposition to the discourse of digital natives, other researchers (van Braak, 2004; Rajab & Baqain, 2005) report that the main use of computers among students is still word processing, as it used to be 15 years ago. We have to keep in mind that the research of educational technology does not often converge with the research of the new media cultures of the youth. However, the notion of word processing being the main activity reveals that educational settings are still based on some traditional instructional practices.

During the last ten years, the dominant educational technologies are virtual learning environments (VLEs) or, more exactly, learning management systems (LMSs) such as WebCT, Blackboard, Moodle, Sakai, etc. These systems are typically centralised maintained within an organisation's IT sector and are based specifically on educational purposes, supporting the systematical hierarchies and structures of courses. In other words, LMSs are institution and teacher centred systems for managing courses, students, materials, discussions, assignments and examinations. And here we have the central paradox between the system and the objectives.

Learning management systems, such as Moodle and Blackboard, do not meet the new natural ways of communicating, saving, sharing and editing. When students or teachers are asked which media they use for education and which media they use in their informal daily life, the difference is clear. Tønnessen (2008) in a longitudinal study looking at recent media development in a generational perspective with school children, reports that they seem to relate

differently to formal and informal paths of learning. The findings indicate that knowledge of ICT and its use is developed mainly outside school in informal learning communities.

Learning management systems do not seem to have any use outside of the educational context; this gap is particularly evident when "digital natives" are supposed to use these LMSs. In the literature, many small-scale studies are available which describe the use of an LMS to support student learning; only for courses, because they are supposed to do so. There is little indication of the LMSs being used for informal activities, even if this option is available. Students are increasingly digital natives, who are familiar with social media such as Facebook, Wikipedia, Twitter, Ning, blogs, wikis, Jaiku, Skype, etc.

There seems to be a difference, not only in practice, but also in paradigms of learning. While LMSs are still based on cognitive approaches, the pedagogical thinking behind the social software and the free and open content can be located within the theory of social constructionism and cultural-historical psychology.

Even if the divide between digital natives and digital immigrants were sustainable, the need for teaching ICT skills, media literacy, or ethical issues does not disappear. Calling students digital natives is not an excuse for not actually teaching them about technology. While the variety and fragmentation on mediated culture increases, it becomes more complex to organise teaching and learning to use media, if taught in traditional way. Instead, a teacher is

forced to admit he/she cannot be an expert of all media practices. Here, we face the conception of the teacher's or tutor's role, which is supposed to turn more and more towards "meddler in the middle" which will be discussed in the next section.

Students need to be given opportunities to use technology in school. This issue of technology use in school is less about teachers mastering specific tools or techniques than their being willing to allow students to use these tools to find information and create products. Many teachers resist being taught to use technology:

because it is not they who should be using the technology to teach students, but rather their students who should be using it, as tools to teach themselves. The teacher's role should not be a technological one, but an intellectual one – to provide the students with context, quality assurance, and individualized help (Prensky, 2008a, p. 2).

Work cultures

We have been discussing the discontinuity in using ICT between the digital natives' informal life and formal education; however, this is not the only possible gap. Another critical point is the shift from education to working life and the induction phase at work. One of the main strengths of PBL has been often said to be the relevant transferable skills (such as time management,

teamwork, independent learning, decision-making, problem solving, and communicating ideas and results needed in work.

However, even if we can provide the students with a range of transferable skills and a more full disciplinary knowledge, we have also the question whether the technology-bound communicative processes and tools meet the real standards used in work. Especially there are new challenges of working across traditional time, geographic, and organisational boundaries, while information and communication technologies are transforming traditional workplaces into virtual workspaces.

Globalisation and virtuality are common trends in work and education. Information and communication technology has a central role in the post-modern society (Castells, 1996). Over the last ten years, the change in education and working practice and tools has been truly remarkable. In today's so-called "knowledge society", where there now exists new technologies and new structures for knowledge construction, new challenges emerge. Working in groups with geographical distance needs effective computer-mediated communication tools to enable the group action in spite of the distance (Hildreth, Kimble, & Wright, 2000; Portimojärvi & Vuoskoski, 2009; Vartiainen, Kokko, & Hakonen, 2003).

Yet, we can recognise the difference between different fields. In many branches of business, technology or medicine the continuum in using ICT is clear, when the same technologies are used in both education and work. Here,

we come back to the educational contexts and teacher education. The professional development of teachers in information and communication technology (ICT) is a central educational imperative that presents financial and strategic challenges. While many teachers are now integrating ICT in innovative and pedagogically appropriate ways, there are still a significant number of teachers who are resistant to using technology in their teaching.

Schools, as communities, are slow in implementing changes, even in well-organised projects. There is evidence that special pedagogical ICT projects have led to true changes in learning practices and to student-centred, collaborative, inquiry-oriented and authentic teaching practices (Ilomäki, 2008, p. 4).

Main Issues

Then, what is the role of problem-based learning with this critical view of educational technologies and the paradox between students as digital natives and teachers as digital immigrants? Online PBL, as a practice-driven theory-informed learning, has many similar points with everyday informal learning. What is being proposed here is that a way forward with online PBL is an easy, affordable and sustainable solution that is already in use outside of formal education.

Prensky's view that we need a totally new pedagogical approach may be quite confusing. We would argue that it depends on the current approach to learning

and teaching. As McWilliam (2008) states, there are three popular metaphors in use in the literature: 'Sage on the stage', a metaphor for a substance expert teacher, who relies on a transmission model of teaching; 'Guide on the side' is a metaphor which has a transactional perspective. However, she states that this is not enough, and presents a third metaphor, 'meddler in the middle' which positions the teacher and student as mutually involved in assembling and re-assembling cultural products. This metaphor of meddler in the middle is bound to socio-cultural approaches, which emphasise participation and transformation in the same way that it has been identified in using social media.

It is well recognised that there are many approaches to online problem-based learning (Savin-Baden & Wilkie, 2004). The main approach is establishing the role of a tutor, as well as, the role of technology. If PBL is to be understood as truly student-centred and a group-intensive way of learning, arguably the best metaphor for a tutor would be 'a meddler in the middle'.

Earlier, we described learning management systems as artificial "out-of-the-real-world" systems. In the same way, traditional teacher and subject centred teaching is unaligned with current information society. We have learned that PBL is something else. Problem-based learning works because it is practice-driven, theory-informed learning which has many similar points of reference with everyday informal learning. It begins with a real or authentic problem, goes through natural processes of enquiry such as questioning, sourcing information, communicating, analysing – with the group as the active element

initiating rich discussion, meaning negotiation and information practices. And those processes are under constant assessment and development.

This description, again, has the same characteristics with social media practices of the 'digital natives'. Here, we see the focal point, which leads us to develop the use of technology with PBL further and towards the use of "natural", easy, affordable and sustainable media choices and practices.

Reflection and Digital Tools

Reflection enables us to generalise mental models from our experience; it is the process of learning from experience. Chapter Eleven explored how PBL can be used to develop student reflection. The digital world is described as fast, hectic and having less and less time and opportunity for reflection. This development concerns many people. In teaching digital natives, it seems important to figure out and invent ways to include reflection and critical thinking in the learning process, either built into the instruction or through a process of instructor-led debriefing (Prensky, 2001b).

The learning groups in PBL can benefit from "blending" virtual and physical resources, examples of which include combinations of technology-based materials and traditional print materials. The fact that the Internet is a complex repository, containing an enormous maze of information from a variety of sources, has impacted on the PBL landscape, in that, it has become a prominent source of information for multidisciplinary groups. The use of online

communication technologies also provides many ways in which distance educators can facilitate flexible tutorial support to groups of students (Fox, 2005).

Prensky (2008b) gives us four simple practices which help teachers make education relevant to students' lives and truly prepare children for the future. Firstly, it is vital to give students the opportunity to use technology in school. Secondly, this opportunity to use technology needs to be followed by finding out how students want to be taught and connecting students to the world. Finally, we need to understand where children are going and help them to get there. Prensky (2008b) also tells us to 'Work with both students and teachers to implement the new "kids teaching themselves with guidance" model.' Inherent, in this, is the elimination of lectures and busywork from schools and asking teachers, who use active learning, to share their practices with their colleagues. Whilst Prensky does not refer to PBL, this is submitting to Dewey and seems to have the same basic ideas and principles that are present in PBL.

In terms of exploring the crossover and boundaries of informal and formal education events and technology tools to support them, there has been much of debate in the literature as to the nature of formal, informal and non-formal learning. The locus of this debate is centred on arguments for 'the inherent superiority of one or the other' (Colley, Hodkinson & Malcolm, 2002, p. 2) and '[i]t is difficult to make a clear distinction between formal and informal learning as there is often a crossover between the two' (McGivney, 1999, p.1).

One tool that is making great progress in bridging this crossover is the use of a blog with group access. Bull et al. (2008) reports on the effectiveness of the dynamic dialogue generated by blogs, but in order to translate informal use of communication technologies outside school into applied activities inside school, educators must consider content and the pedagogies best suited for bridging these in- and out-of-school uses of technology.

Other social media tools which reflect new opportunities and outlets for creativity are wikis, instant messaging, and texting in the realm of writing, podcasting in audio, countless sites such as Flickr for distribution and sharing of images, and video shared via YouTube.

Whilst constraints remain in schools in today's challenging global economic climate, more than ever, Sterling (2008) suggests that the energy and creativity emerging outside schools should be harnessed and linked to the academic enterprise within schools. The fact exists that the ubiquitous spread of social media outside school has yet to be employed with equal effectiveness inside schools.

Personal Development Planning (PDP) is a key component of today's lifelong learner's continuous professional development. Jackson (2001) argues that through this process there is an emphasis on learners making sense of what they are learning and how they are learning it and, ultimately, taking responsibility for what they learn. Increasingly, in higher education, e-portfolios

are being used to help students realise the many skills that they have developed during their time in formal education and to provide them with a vehicle to help them plan ahead for their personal and continuing professional development. Within formal education, the e-portfolio is a collection of computer-based files organised into a personal web-site that is representative of coursework that the participants produce in their courses. It can be based on assignments and activities completed in and out of class to demonstrate the participant skills and knowledge related to the subject discipline. There are a variety of e-portfolio system tools available today, such as PebblePad and Mahara.

The development of an e-portfolio can help students synthesize much of what they have learned on their course, as well as, creating one cohesive package that demonstrates the skills and knowledge that they bring back to their professional practice and working context. In essence, the e-portfolio can serve as a record of what each student has learned during his/her course. Undergoing an e-portfolio development process can provide students with distinct benefits; it captures the complexities of their learning in a discipline and, from the teacher's perspective, it matches assessment to the teaching style of each course.

From a networking perspective, e-portfolios can promote new conversation about e-learning practice around higher education institutions. It has the potential to create a culture in which "*thoughtful discourse*" about e-learning becomes the norm. Over time, e-portfolios can create a concrete evidence of

learning by documenting the development or "*unfolding of expertise*" in a subject discipline. It also gives a profile of student abilities by enabling them to show quality work that is done with the help of resources, reference material and collaboration with others. A wide range of skills can be demonstrated and it shows efforts to improve and develop and demonstrates progress over time.

The e-portfolio is a tool for assessing a variety of skills; written as well as oral and graphic products being easily included. In addition, it develops an awareness of the students' own learning as they have to reflect on their own progress and the quality of work in relation to known goals. The e-portfolio also caters to individuals in the heterogeneous class; since it is open-ended, students can show work on their own level. Since there is a choice, the e-portfolio caters to different learning styles and allows expression of different strengths. Finally, it develops independent and active learners: students must select and justify e-portfolio choices, monitor their own progress and set learning goals. However, from the authors' experience, as teacher educators, encouraging reflective writing amongst students can be challenging, alongside ensuring that adequate support is provided in the area of academic writing.

Framework for the Future and Conclusion

Problem-based learning offers online learning a structure and pedagogical grounding and a motivating and effective way of learning. Over time, we anticipate that our understanding of Online PBL and its outcomes will mature and that measures of effectiveness will continue to develop and improve.

Donnelly and Portimojärvi (2006) have argued that technology offers PBL more flexible environments, limited on some aspects, but enriched on others. The workload that active participation in online problem-based learning places on students should not be underestimated when the decision is being made to pursue this style of education.

The advanced combinations of problem-based learning and online learning provide effective tools for virtual teams and virtual communities of practice. However, the development of higher levels of skills in the use of online communications is an important consideration in the design of PBL online. Figure 18.1 illustrates a number of key factors for effectively implementing PBL in a virtual environment, including the function of the PBL group online and how ultimately and successfully this can lead to an online community of practice (CoP); within this is the division of labour for the individual roles, the size of the group and the level of co-operation and collaboration between members. The nature of the blend of technologies is also an important consideration; Graham (2006) has coined asynchronous interaction as *low-fidelity*, and it is argued here that the blend of high and low technologies needs to be explored in relation to how they affect the problem-based learning experience. A range of psychological variables need to be balanced in an implementation of online PBL including cognitive, constructivist and community learning alongside motivation, rigour and deep learning strategies. Finally, the role of the different, relevant technologies needs to be considered including the role of social media and group reflection tools.

Figure 18.1 Proposed factors for aligning the digital native dilemma

{INSERT FIGURE 18.1 HERE}

References

- Bayne, S. & Ross, J. (2007, December). *The 'digital native' and 'digital immigrant': A dangerous opposition*. Paper presented at the Annual Conference of the Society for Research into Higher Education (SRHE), Edinburgh, Scotland.
- Bennett, S., Maton, K., & Kervin, L. (2008). The 'digital natives' debate: A critical review of the evidence. *British Journal of Educational Technology, 39*(5), 775–786.
- Bull, G., Thompson, A., Searson, M., Garofalo, J., Park, J., Young, C., & Lee, J. (2008). Connecting informal and formal learning: Experiences in the age of participatory media. *Contemporary Issues in Technology and Teacher Education, 8*(2). Available from: <http://www.citejournal.org/vol8/iss2/editorial/article1.cfm>
- Castells, M. (1996). *The rise of the network society*. Oxford: Blackwell.
- Colley, H., Hodkinson, P., & Malcolm J. (2002). *Non-formal learning: Mapping the conceptual terrain. A consultation report* [Internet] Available from: http://www.infed.org/archives/e-texts/colley_informal_learning.htm
- Dennis, J.K. (2003). Problem-based learning in online vs. face-to-face environments. *Education for Health, 16*(2), 198–209.
- Dewey, J. (1938). *Experience and Education*. New York: Collier Books.
- Donnelly, R. (2007). Virtual problem-based learning communities of practice for teachers and teacher educators: An Irish higher education perspective. In C. Kimble & P. Hildreth (Eds.), *Communities of*

practice: Creating learning environments for educators. Charlotte, NC: Information Age Publishing.

- Donnelly, R. & Portimojärvi, T. (2006). Shifting perceptions within online problem-based learning. *Encyclopedia of Distance Learning*.
- Fox, S. (2005, September). Reflections of the benefits of the use of the new learning technologies in higher distance education through the prism of a case study. Paper presented at the 11th Cambridge International Conference on Open and Distance Learning,
- Graham, C. (2006). Blended learning systems: Definition, current trends, and future directions. In C.J. Bonk & C.R. Graham (Eds.), *The handbook of blended learning: Global perspectives, local designs* (pp. 3-21). San Francisco, CA: Pfeiffer.
- Hildreth, P., Kimble, C., & Wright, P. (2000). Communities of practice in the distributed international environment. *Journal of Knowledge Management*, 4(1), 27–37.
- Ilomäki, L. (2008). *The effects of ICT on school: Teachers' and students' perspectives*. Academic Dissertation, University of Turku, Turku, Finland). Available from:
<https://oa.doria.fi/bitstream/handle/10024/42311/B314.pdf?sequence=3>
- Jackson, N. (2001). Personal development planning: What does it mean? Available from:
http://www.heacademy.ac.uk/resources/detail/id465_pdp_what_does_it_mean

- Joint Information Systems Committee (JISC) (2007) Student expectations study. Available from:
<http://www.jisc.ac.uk/media/documents/publications/studentexpectations.pdf>
- Manathunga, C. & Donnelly, R. (2008). Opening online academic development programmes to international perspectives and dialogue. In R. Donnelly & F. McSweeney (Eds.), *Applied eLearning and eTeaching in higher education*. Hershey, PA: Information Science Reference.
- Margaryan, A. & Littlejohn, A. (2008). *Are digital natives a myth or reality? Students' use of technologies for learning*. Brighton: Higher Education Academy.
- McGivney, V. (1999). *Informal learning in the community: A trigger for change and development*. Leicester: National Institute of Adult Continuing Education.
- McWilliam, E. (2008). Unlearning how to teach. *Innovations in Education and Teaching international*, 45(3), 263-269.
- Oblinger, D. (2006, September). *Listening to what we're seeing*. Keynote presentation at ALT-C, Edinburgh, Scotland
- Oblinger, D. & Oblinger, J. (2005). (Eds.) *Educating the net generation*. EDUCAUSE.
- Portimojärvi, T. (2006). Synchronous and asynchronous communication in online problem-based learning. In *Verkkovirityksiä – ongelmaperustainen oppiminen ja projektioppiminen verkossa*.

- Portimojärvi, T. & Vuoskoski, P. (2008). The alliance of problem-based learning, technology and leadership. In R. Donnelly & F. McSweeney (Eds.), *Applied eLearning and eTeaching in higher education*. Hershey, PA: Idea Group.
- Prensky, M. (2001a, October). Digital natives, digital immigrants. On the Horizon MCB University Press, 9(5). Available from: <http://www.marcprensky.com/writing/Prensky%20-%20Digital%20Natives,%20Digital%20Immigrants%20-%20Part1.pdf> [Accessed 4th May 2009].
- Prensky, M. (2001b, December). Digital natives, digital immigrants, Part II: Do they really think differently? *On the Horizon* MCB University Press, 9(6).
- Prensky, M. (2008a). The role of technology in teaching and the classroom. *Educational Technology*, Nov-Dec 2008. Available from: http://www.marcprensky.com/writing/Prensky-The_Role_of_Technology-ET-11-12-08.pdf
- Prensky, M. (2008b). Turning on the lights: Reaching the reluctant learner. *Educational Leadership*, 65(6), 40-45. Available from: http://www.ascd.org/publications/educational_leadership/mar08/vol65/num06/Turning_On_the_Lights.aspx
- Rajab, L. & Baqain, Z. (2005). Use of information and communication technology among dental students at the University of Jordan. *International Perspectives on Dental Education*, 69(3), 387-398.

- Savin-Baden, M. (2003). *Facilitating problem-based learning: Illuminating perspectives*. Buckingham, England: The Society for Research into Higher Education & Open University Press.
- Savin-Baden, M. & Wilkie, K. (Eds.). (2004). *Challenging research in problem-based learning*. Maidenhead: Open University Press.
- Savin-Baden, M. & Wilkie, K. (Eds.). (2006). *Problem-based learning online*. Maidenhead: Open University Press.
- Sterling, R. (2008). Writing, technology, and teenagers. Available from: <http://wamu.org/programs/kn/08/04/29.php>
- Tapscott, D. (1998). *Growing up digital: The rise of the net generation*. New York: McGraw-Hill.
- Tønnessen, E. (2008, June). *ICT(s) and socialization: The role of the school and teachers*. Contribution to OECD Expert Meeting, Oslo, Norway.
- Uden, L. & Beaumont, C. (2006). *Technology and problem-based learning*. Hershey, PA: Information Science Publishing.
- van Braak, J.P. (2004). Domains and determinants of university students' self-perceived computer competence. *Computers & Education*, 43(3), 299-312.
- Vartiainen, M., Kokko, N., & Hakonen, M. (2003). Competences in virtual organizations. In *Proceedings of the 3rd Inter-national Conference on Researching Work and Learning*, Book I (pp. 209-219). Tampere, Finland.

Further Resources

In this final section, we provide an annotated list of web based resources that are relevant for the practitioner wishing to integrate technology with problem-based learning.

- An annotated list of online PBL resources from Central Queensland University
http://pbl.cqu.edu.au/content/online_resources.htm
- Online Problem-Based Learning: Models, Processes and Tools for Creating Collaborative Learning Environments
<http://www.elearningguild.com/olf/olfarchives/index.cfm?id=452&action=viewonly>
- An annotated list of online PBL resources from the University of British Columbia
http://web.ubc.ca/okanagan/ctl/support/practice/pbl/PBL_Resources.html
- Tools for delivering scenario-based e-learning: PBL Interactive is a newly developed suite of tools designed to enable teachers, lecturers and others working in training or education, to create and deliver interactive problem-based scenarios as an aid to the problem based learning (PBL) instructional method.
<http://pbl.massey.ac.nz/pbl-interactive.htm>
- Special Interest Group in PBL: The context and problem based learning (C/PBL) SIG is a forum for people with an interest in the use of C/PBL to support teaching and learning.
<http://www.heacademy.ac.uk/physsci/home/networking/sig/CPBL>
- Eduforge Learning Resources

<http://eduforge.org/wiki/wiki/eduforge/?pagename=LearningResources>

- PBL online

<http://pbl-online.org/LearnOnline/elearn.htm>

- E-learning scenarios including PBL

<http://www.eduhub.ch/info/elearningscenarios/>