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Pre-service teacher education enriched by technology-supported learning environments: a learning technology by design approach

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Abstract

Many teacher educators are now concerned about how to scaffold student teachers in the development of the literacy demands of the digital age. The present paper presents a descriptive account of a learning technology by design approach to teacher education, which basically addresses this problem. It draws on a technological pedagogical content knowledge framework to conceptualize what it means learning to teach in the digital age and presents an educational experience, the subject New Technologies Applied to Education, taught in a pre-service teacher education program. The results of this subject approach show that the students' semiotic production is an evidence that when learners are motivated, their capacity to learn is not limited by teachers' capacity to teach. It is suggested pre-service teacher education should prepare future teachers not only to consume, but also to produce and distribute semiotic resources, taking a more active and critical role in their learning process.

Introduction

The widespread use of Information Communication Technologies (ICT) in all areas has a direct effect upon the way in which the world is perceived. The way knowledge is represented, the modes and media chosen, is a crucial aspect of knowledge construction, which makes the form of representation integral to meaning and learning more generally (Jewitt, 2008). As Kress (2003: 9) puts it, "the former constellation of *medium of book* and *mode of writing* is giving way, and in many domains has already given way, to the new constellation of *medium of screen* and *mode of image*". That bears profound consequences to communication and education, forcing

Volume 11, Number 1: April 2010
ISSN: 1535-0975

researchers and educators to rethink social relations and knowledge construction processes under the new conditions of the digital age (Jewitt & Kress, 2003; Jewitt, 2006; Balagué & Zayas, 2007; Cases & Torrescana, 2007; Pérez & Redondo, 2006). Actually, a great problem of children at schools nowadays is that those who teach them live in a world differently experienced to the world which the young take as their normal world (Kress, 2007).

The discussion is of particular relevance for those who prepare people who will soon act as teachers. As Katic points out, "preparing these pre-service teachers to use technology in ways that could transform learning practices is no easy task and one that falls on the shoulders of current teacher educators everywhere, regardless of content area discipline and technological proficiency (Kati, 2008, p.158). Living in a society in which telematic networks rapidly become the most outstanding means of communication, one of the greatest challenges to be overcome by educational systems is enabling teachers and students to achieve competency and mastery on the use of technology instead of letting them be enslaved by it (Moya & Cervera, 2003, p.252).

In this context, what can teacher educators do to scaffold student teachers in the development of the literacy demands of the digital age? The present paper presents a descriptive account of a learning technology by design approach (Mishra & Koehler, 2006) to teacher education, which basically addresses this problem. The paper draws on a technological pedagogical content knowledge framework to conceptualize what it means learning to teach in the digital age. The present paper thus presents an educational experience, the subject New Technologies Applied to Education, taught in a pre-service teacher education program. While the subject is taught in a traditional fully on-campus program, the teacher explores different spaces of (inter)action, apart from the classroom. This teaching experience explored four domains of student's (inter)action: Moodle activities (forum and wikepedia), traditional theoretical seminars,

workshops (laboratory activities to produce an educational web, a blog and a webquest) and the class' blog (http://tintafrescavlog.blogspot.com/), the latter a non evaluative activity. The effects of the use of Moodle in the construction of a student-centered environment of learning is discussed. Deep learning, as opposed to surface learning, helps integrate new data with existing knowledge structures in a meaningful way. It can only occur if the learner is able to identify the personal relevance in a learning object (Biggs, 1979).

With the advent of social software tools, numerous advantages for computer-mediated communication have been made available both for students and teachers. These tools enhance social networking and knowledge sharing on a global scale, providing opportunities to access, use and produce authentic content in real-world contexts. In fact, as Coiro et al (2008) highlight, before internet, no previous technology of literacy had been adopted by so many, in so many different places, in such a short period and with such profound consequences. Ensslin (2007), who reported high levels of student motivation and deep learning in a project involving literature and hypertext, calls our attention to the fact that hypertext, as a pedagogical tool, as well as any technology of communication, has to be organically incorporated in a carefully planned syllabus, which integrates conventional teaching approaches with a constructive use of technology.

Teacher Knowledge and Education

Mishra and Koehler (2006) and Koehler and Mishra (2008) build on Shulman's (1996) work to elaborate the conceptual framework called Technological Pedagogical Content Knowledge. Shulman advanced thinking about teacher knowledge by claiming pedagogy and content had been treated in the literature as two separate bodies of knowledge and advocated for their

Volume 11, Number 1: April 2010
ISSN: 1535-0975

integration. Pedagogical Content Knowledge, Shulman thought, was at the intersection of pedagogy and content and was crucial for good teaching.

Although Shulman did not mention the role of technology in his framework, his defense of a type of teachers' education which took into account both pedagogy and content remains valid nowadays, as long as it is extended to reflect the new conditions of learning and teaching in the digital age. As Mishra and Koehler (2006, p.1023) point out, "what has changed since the 1980s is that technologies have come to the fore front of educational discourse primarily because of the availability of a range of new, primarily digital, technologies and requirements for learning how to apply them to teaching".

For Mishra y Koehler, though not all teachers use technology in their teaching practices, it is now undeniable that technology is an essential part of the educational landscape. According to the authors, it is now not possible to conceptualize teacher education based exclusively on the relatively stable technologies used until a few years ago, like books, chalk and chalkboard. In the past, technology did not change as fast as it does nowadays and teachers and their educators could concentrate on the search of most appropriate pedagogical strategies for specific aspects of the content. In the context of the educational landscape of the XXI century, nevertheless, a new element must be added to that search: technology.

The Technological Pedagogical Content Knowledge framework (Mishra & Koehler, 2006; Koehler & Mishra 2008) offers a theoretical model for the use of technology in education. The authors add technology to Shulman's model and emphasize the connections, interrelations, affordances and constraints between knowledge of content, technology and pedagogy. It is in the interrelations established among those different types of knowledge necessary for good teaching that the Technological Pedagogical Content Knowledge framework makes its most relevant

contribution. Though other authors had pointed out the importance of articulating content, pedagogy and technology, Mishra and Koehler are sensitive to the different types of knowledge established in the interrelation of these three fundamental areas. Figure 1, elaborated by the authors, presents the three areas of teacher knowledge, Content (C), Pedagogy (P), and Technology (T), and the areas created in the interrelation among them: Technological Content Knowledge, Pedagogical Content Knowledge, Technological Pedagogical Knowledge and, finally, the area that organically integrates all areas of teacher knowledge, Technological Pedagogical Content Knowledge.

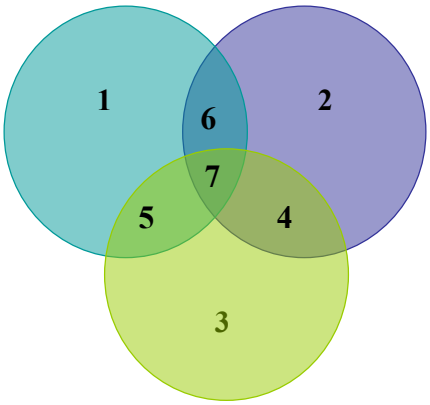

Figure 1: Mishra and Koehler's (2006) Technological Pedagogical Content Knowledge framework. The three circles, Content (1), Pedagogy (2) and Technology (3), overlap to create four other types of teacher knowledge: (4) Technological Pedagogical Knowledge, (5) Technological Content Knowledge, (6) Pedagogical Content Knowledge, (7) Technological Pedagogical Content Knowledge.

Volume 11, Number 1: April 2010
ISSN: 1535-0975

Technological Pedagogical Content Knowledge is thus a nuclear area of knowledge which integrates all types of knowledge considered above. The professional who can organically integrate them is able to see both learning and semiosis in different ways content, pedagogy and technology experts usually do. Similarly, the pedagogical designs he or she is able to elaborate, including pedagogical objectives, content, materials, techniques, etc, will be transformative of reality and will allow their student's learning to be transformative as well. This professional will be able to 1) create and or/use technologies having into account specific pedagogical designs; 2) identify and select most appropriate technologies a specific pedagogical design, taking into account their affordances and constraints as conditioned by the semiotic modes technologies integrate, produce and allow students to produce; 3) use and/or modify in creative ways in the educational context technological tools generally designed for the contexts of business or entertainment; and, last but not least, 4) understand what is it that changes in education when we use new technologies.

Following Rittel and Webber (1973), Koehler and Mishra (2008, p.3) propose to view teaching with technology as a "wicked problem", a view in which teaching is taken as "a highly complicated form of problem-seeking and problem-solving that derives from flexible and integrated bases of knowledge". Preparing teachers is by no means an easy task. The present paper expects that by offering an example in which pre-service students were asked to integrate content, pedagogy and technology and solve problems independently will contribute to the elaboration of pedagogical designs that favour teacher education in agreement with the demands of the digital age.

Volume 11, Number 1: April 2010
ISSN: 1535-0975

Student teachers should develop a holistic understanding of the new contexts for learning and teaching in the digital age. They must then be offered the opportunities to produce multiple and varied types of text which instantiate the type of knowledge they have constructed. Their own learning must be driven by their interests so as to allow them to organically integrate content, pedagogy and technology knowledge. Student teachers must be active, creative and transformative actors in their own process of learning. Teacher educators must constantly assess their own pedagogical designs and exercise problem-solving flexibly integrating different bases of knowledge.

Pedagogical designs for teacher education must offer models in which their students can experience learning and representation. When the students are future teachers all formative actions must be reflexive. That implies, as Russell et al. (2003) point out, that as important as it is teaching student teachers the mechanisms of technology, it is exposing them to examples of uses of technologies with pedagogical objectives in their own educational process. Professional development to incorporate ICTs into teaching and learning is a continuous process and should not be thought of as one 'injection' of training. So as pre-service teachers develop the understanding that using technology meaningfully for their students is an intrinsic part of their future job, they should have the opportunity of experiencing technology in their teacher education program, technology should be introduced to them in context and pre-service teachers should experience innovative technology-supported learning environments in their teacher education program. The UNESCO corroborates that view: "unless teacher educators model effective use of technology in their own classes, it will not be possible to prepare a new generation of teachers who effectively use the new tools for learning." (UNESCO, 2002, p. 34).

Volume 11, Number 1: April 2010
ISSN: 1535-0975

Example of a learning-technology-by-design Approach

This paper aims at presenting a descriptive account of a teaching experience which uses a learning technology by design approach. It focuses on the construction of artifacts and puts emphasis on learning by doing. In this approach, as Misha and Koehler (2006, p.1035) note, "design is learned by becoming a practitioner, albeit for the duration of the course, not merely by learning about practice". This section will offer an account of the context in which the experience was performed (setting and participants) and a general description of the subject organization.

Setting and participants

The present paper presents the experience of a subject, New Technologies Applied to Education, taught in the curriculum of a teacher initial training program developed in the Pedagogy Department at the University X. The program comprises 180 credits (10 classroom hours/credit) distributed in three years. Students who successfully complete the program are allowed to teach students up to 12 years old in the Spanish educational system, but would have to take two more years in an undergraduate course to apply to a PhD program. The *Strategic Teaching Plan* (2006) adopted by the University X aims at, among other things, promoting a student-centered educational model which will help students develop special competencies within a specific academic area, multidisciplinary competencies, practical skills, and ethically and environmentally driven competencies.

Volume 11, Number 1: April 2010
ISSN: 1535-0975

The subject New Technologies Applied to Education focuses on the skills related to the selection, evaluation and production of multimedia pedagogical materials. Such skills should make students able to promote learning as "agentive selection from, engagement with and transformation of the world" (Kress, 2007, p.37). The experience reported here had an enrollment of 210 students, who received theoretical classes in two separate groups and were split into 8 groups for the workshops during 15 weeks. In the following section, we make a general description of the subject and of the domains of (inter)action students had available.

The subject design: New Technologies Applied to Education

The major objective of the subject was raising technology awareness by providing students the opportunity to design, develop and evaluate multimedia materials.

There were four domains of interaction for the subject:

1. Moodle - Moodle is a free open source software (FOSS) which allows the production and development of web-based courses (Rice IV, 2006; 2007). In the case of the subject experience reported here, it had an important role: it was used to maintain links to the bibliography students should read, to make available web links where students could find extra online information, to keep constant communication both between teacher-students and students-students, to manage organizational aspects in general (task delivery, examination calendar, etc), to centralize information (on evaluation performance indicators, for example), to continue discussions initiated in class (forums), to do cooperative work (Wikipedia) and to organize online databases fed by the students (online educational videogames, WebPages and blogs of interest).

2. Theoretical on-site seminars – Every week, two hours were dedicated to discussion of a text or paper available to students on Moodle. In general, the teacher also made available a power point presentation which guided interactive debate about the challenges of literacy in the digital age, the use of information and communication technology in Spanish schools, pedagogical uses of online environments, games, Voip, etc., pedagogical multimedia evaluation criteria, etc.
3. The workshops in the Faculty's laboratory, where students organized themselves in groups. Each group was supposed to create:
    - An educational webpage with a minimum of 3 html documents all linked to one another– the software used in classroom was Dreamweaver, but students were free to choose any other web page design software they knew of;
    - An education oriented blog – the blog hosting service students received instruction on was www.blogger.com, but, again, they were free to choose any other host service they knew of; and
    - A WebQuest – students could choose between using Dreamweaver to create their WebQuests or using services like PH WebQuest (http://phpwebquest.org/?page_id=14), which was actually found in the Web by one of the students.

Aspects related to the materials' content were dealt with in the theoretical seminars. Students had the freedom to choose which topic they wanted to develop, the only condition being it must be of an educational nature.

4. *Tinta Fresca* – Fresh Paint (http://tintafrescavlog.blogspot.com/) was a non evaluative cooperative space created about a week before classes began. Students were invited to become authors of *Tinta Fresca* and to use it as a space to share and express their feelings and ideas. 23 students volunteered as authors. By the end of the subject, *Tinta Fresca* had had more than 2 thousand visits (http://www.histats.com/es/); 34 posts, 13 of them published by the teacher; and an average of 5.5 comments/post.

All three materials produced by the groups (web page, blog and WebQuest) must have links to one another and also to the subject's web page, EDUCANET (http://pedagogia.fcep.urv.es/educanet/) and to the class' blog, Tinta Fresca. Since the very beginning students knew that their outcomes did not have their teacher as their only audience, but were supposed to be shared in the subject's webpage. They were encouraged to think as teachers and to prepare their materials with one of their possible audiences in mind: students, parents or colleagues. Their workshop outcomes are now available in the Resources section of EDUCANET (http://pedagogia.fcep.urv.es/educanet/recursos/recursos.html/).

In the workshops, students worked in groups. The groups received some instruction from the teacher responsible for the subject on how to perform the activities, but were highly encouraged to research on the Web for information on how to solve specific problems and incorporate multimedia materials into their work. Besides, students were asked to share any new information they found of relevance for their colleagues and to ask each other questions on how to perform specific tasks in the appropriate Moodle spaces: 2 forums were created for that, *How have you done it?* and *Doubts*.

Volume 11, Number 1: April 2010
ISSN: 1535-0975

The workshop of the subject experience reported here generated 75 WebPages, each of them with at least one blog (some groups decided to make blogs individually) and a WebQuest. With varying levels of technical and content quality, it is fair to say that, when compared to the subject demands and to the instruction students formally received in class, students' semiotic production, their Webpages, blogs and WebQuests, in general is an evidence that when learners are motivated, their capacity to learn is not limited by teachers' capacity to teach.

Workshop classes focused on the design mode of Dreamweaver, which does not require programming knowledge. However, once students learned to make simple code manipulations, such as including You Tube videos in their web pages, they soon began to search for all kinds of stretches of code in Internet, and learned how to include music (http://ivoon.com/), power point presentations (http://www.slideshare.net/), counters (http://www.histats.com), calendars (http://www.free-blog-content.com/), vokis (http://www.voki.com) animated titles (http://www.hotlink-bumfiles.com/), etc. Two things are important to highlight: first, manipulations like these were meant to increase their materials' interactivity, to make them more attractive and to help visitors who could not yet read (many of the WebPages aim at very young audiences) to understand content and/or perform activities; second, as the students webpage design was a real exercise and their work was actually uploaded to the subject webpage, a group's advance in the incorporation of a particular multimedia material immediately became public knowledge and was soon incorporated by the other groups too.

Out of the subject 15 weeks, a week theoretical session was dedicated to the discussion of the design and evaluation of multimedia materials and another one to the discussion of what teachers can learn from videogames in general and how to evaluate and choose educational videogames. At this point of the course, most students were busy with their evaluated material

improvements, so they received no instruction at all on how to produce interactive activities with Zona Click (http://clic.xtec.net/es/clic3/index.htm), Hot Potatoes (http://hotpot.uvic.ca/) or Game Maker (http://www.yoyogames.com/make). They did, though, have the links for manuals and further information in the Moodle environment and, during the theoretical sessions, were highly encouraged to research these tools independently. A few of them did indeed investigate autonomously these tools and report that in the Moodle forum (for two examples: http://pedagogia.fcep.urv.es/educanet/recursos/musica/canconsiinstruments/crucigrama.htm,http://pedagogia.fcep.urv.es/educanet/recursos/infantil/menjabemenjasa/webquest/memori.html. One student looked for the teacher so as to present her work with Game Maker. In the game, players drive a train through 12 levels or months. In the Catalan culture there are sayings for each month, like, *en febre, abriga't be* (in January, get a good coat) and part of the difficulty in the student's game is guessing them.

The use of Moodle allowed the teacher and the students to maintain a close relationship. During the 15 weeks the subject lasted, the teacher sent out 116 messages in the different forums open to all students, some of them solving doubts, moderating debates or of real participation in the discussions. These messages do not include individual messages sent out to students who privately asked for information or help, neither the numerous messages students sent to their colleaguesvv in the discussion and doubts forum available in Moodle. Though it is not possible to provide data for comparison – how many emails the teacher would have sent out using a different approach, for example – these numbers can be considered high if the on-campus, face to face nature of the subject is considered. This online interaction is actually expanding the spaces of interaction traditional instruction uses.

Volume 11, Number 1: April 2010
ISSN: 1535-0975

Students were encouraged to think of themselves as teachers and researchers and, in many situations, both in the Moodle forums, in the workshops and in the theoretical classes, students and teachers reversed roles. Students became peer tutors or reciprocal mentors, debating theoretical themes and teaching their colleagues and their teacher how to solve problems or improve the design of their multimedia materials.

A direct result of this type of subject organization is the establishment of new relationships between the teacher, the students and knowledge. At the very moment students and teachers reverse roles, students enter a new type of relationship with knowledge: they understand their teacher's limitations are natural and do not accept them as their own limitations. Students then learn things which were not actually taught in classroom and, most importantly, become teachers themselves, transforming what they have learned in public knowledge. It is possible to move ahead of an instruction of minimums and to empower students to set their learning objectives as high as they will.

Discussion

I would like to highlight here I do not imply the simple presence of technology will allow any change in classroom. I am strongly aware it is the teachers' responsibility to choose a pedagogical design which will either present a world that can be ordered for the student or designed by the student. When technology is good enough, and by that I mean it allows enhanced interactivity, students' agentive design and management of their learning, and access to extensive relevant supporting materials, it is up to teachers to engage with a theory of learning which attends to the meanings of those who have power or a theory of learning which attends to the meanings which result from principled engagement with the world. In other words, technological

Volume 11, Number 1: April 2010
ISSN: 1535-0975

developments alone do not and will not promote student-centered learning, but they will more than ever make evident whether teachers will stick to their central and powerful position in a instructional paradigm or if they will become managers and facilitators who build scaffolding for learning.

When learning takes place in a variety of interactional environments, teachers and students have more opportunities to reverse roles. When that happens, teachers become guides and encourage further investigation, while students become agentive in the selection from and engagement with the transformation of the world. That process opens space for fundamental changes in the social relations established among students, teachers and knowledge. Students can become teachers, what should be considered an essential part of pre-service teachers' instruction. They can teach themselves, their peers and their own teacher. There is no shame for teachers to be taught by their students and that should be clear both for teachers and their students. A teacher is no longer someone who knows more things, but someone who knows different things. He or she must pursue the acquisition of knowledge as a lifelong objective, as well as students.

In a richer variety of learning interactional environments, the pride for autonomous discovery can be fostered, and the passiveness many of us find familiar in students in different learning contexts is challenged by motivation. Motivation arises when the outcomes of students' activities are not only a means of getting a grade, but become public semiotic resources. In the subject experience reported here, having their WebPages open to their peers view and any other Internet visitor was a much stronger driving force than the grades themselves.

Concluding remarks

Volume 11, Number 1: April 2010
ISSN: 1535-0975

It is of extreme importance teacher educators rethink their practice so as to allow future teachers not only to consume, but also to produce and distribute semiotic resources, taking a more active and critical role in their learning process. Redesigning pre-service teachers and their instructors' authority relations in the development of teaching skills is a key factor for the accomplishment of educational systems in which learning becomes individual's agentive selection from, engagement with and transformation of the world. As in the experience reported by Ashton and Newman (2006), we need to "reconceptualize ourselves as academics". The authors rightfully say that "today's teacher educators must develop students' capabilities, not just their skills and knowledge, and in so doing they must relinquish some power. In the 21st century knowledge sharing is needed, not knowledge hoarding" (Ashton and Newman, 2006: 829).

During the 15 weeks the subject lasted and during the elaboration of the present report, many important questions arose, which can only be addressed in future research. How does the teaching received by these future teachers actually impact in their teaching, if it does at all? How do teacher educators assess their teacher students' multimedia outcomes when, as Unsworth (2008) pointed out, despite social semiotic research on the interaction of writing, speech, gesture, sound, still and moving images, theoretical descriptions of digital rhetorical systems and a working pedagogical metalanguage remain still in their infancy. How do teacher educators address specific literacy needs of student teachers who specialize in different areas of knowledge, such as science, language and history. The present experience report, nevertheless, demonstrates a learning technology by design approach allows student teachers not only to consume, but also to produce semiotic resources which may help them improve their classes. Future work should explore the development of a more critical attitude towards technology, semiotic resources and literacy itself.

Volume 11, Number 1: April 2010
ISSN: 1535-0975

As a final remark to be made about the experience of the subject reported in the present paper, I would like to say the reading of the bibliography and attendance to the theoretical sessions were far from ideal. That, however, reinforces what has been said before in that theoretical seminars were, among the four domains of interaction of the subject, the only one which kept traditional roles among students and the teacher. It is only when students are motivated and produce actual semiotic resources when their capacity to learn goes beyond ours to teach. It still remains a challenge making theoretical content a learning adventure for students.

Volume 11, Number 1: April 2010
ISSN: 1535-0975

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