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Promoting digital competence in secondary education: are schools there? Insights from a case study

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ABSTRACT

In recent years, a large number of educational systems, following the recommendations of international organisations, have introduced a competence-based emphasis into their traditionally subject-based curriculum. This move, beyond what any document can deal with, does not seem to find its way into everyday school practice easily or with instant results. This paper explores encounters and clashes between policy and practice regarding a competence-based curriculum framework. We refer firstly to the notions about information processing and digital competence held by international organisations and the Spanish and Catalan Ministry of Education, and the implications of said notions for teaching. Then, from evidence collected through class observations, interviews with students and teachers, and documents analysis in a case study, we draw on four teaching and learning scenarios where ICT is regularly used. Promoting students' digital competence is one of the key competences prescribed in the curriculum; however, our study showed that the backgrounds and educational views of teachers, as well as the teaching culture and organisation of schools, should be deeply challenged to foster this competence.

KEYWORDS: INFORMATION PROCESSING, TECHNOLOGY USES IN EDUCATION, SECONDARY SCHOOL, TEACHING METHODS, EDUCATIONAL POLICY, DIGITAL COMPETENCE, TRANSVERSAL COMPETENCE

1 INTRODUCTION

This paper shows part of the processes and results of a research project which examined the continuities and discontinuities between the requirements of education policy and teaching practices. The focus of this part of the study was to analyse how secondary schools dealt with the imposed need to move from a traditionally discipline-based curriculum to a competence-based one. In line with different studies about curriculum and educational reform (Fullan, 1999; Sarason, 1990; Thomson, 2014; Wentland, 2015, among others), this paper shows that schools do not implement policy regulations in a direct and immediate way. On the contrary, between the enactments of a policy and its implementation there is a long and winding path; a path marked by teachers' backgrounds, educational views and access to professional development, and by the schools' teaching culture and organisation**.** The main claim of our paper is not that *schools are failing* when implementing education policy, but that policymakers do not take into account the minimum requirements for a change of such considerable magnitude.

1.1 Competence-based education and digital competence

In recent years, a large number of educational systems, following the recommendations of international organisations such as the OECD and the European Commission, have introduced a competence-based emphasis into their traditionally subject-based curriculum (Krumsvik, 2011). This move, beyond what any document can deal with, does not find its way into everyday school practice easily or with instant results.

For the OECD's DeCeSo project (2002), it is clear that competence implies several dimensions, starting from the ability to (1) use a wide variety of tools; (2) interact with others in heterogeneous groups; and (3) take responsibility for one's life and act autonomously. The European Commission (EC, 2006[i]) defined the eight key competences – understood as a combination of knowledge, skills and attitudes – necessary for personal fulfilment, active citizenship, social cohesion and employability in a knowledge-based society. One of them was digital competence.

The EC recommendation suggests that

> Digital competence involves the confident and critical use of Information Society Technology (IST) for work, leisure and communication. It is underpinned by basic skills in ICT: the use of computers to retrieve, assess, store, produce, present and exchange information, and to communicate and participate in collaborative networks via the Internet (EC, 2007, p. 7).

As many studies (Calvani, Fini, Ranieri, & Picci, 2012; Somyürek & Coskun, 2013) question the assumption that the younger generations would be "innately" digitally competent, schools are supposed to secure basic digital competence for all

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(Gansmo, 2009). However, different authors (Janssen, Stoyanov, Ferrari, Punie & Pannekeet, 2013; Krumsvik, 2011) agree that, although digital competence may be quite concisely defined, it is less evident in practical terms and difficult to be transferred to the context of schools. In fact, Ferrari, Punie & Redecker (2012) have identified up to fifteen frameworks for approaching digital competence. Hatlevik & Christophersen (2013) mention the existence of different concepts around the use of digital tools, such as digital competence, digital literacy, media literacy, digital skill, Internet skills and others. However, according to the authors, digital competence and digital literacy reflect a gradual shift in the concepts, one that has evolved from the simple use of digital tools to the understandings and critical reflections of students. Likewise, Mills (2010) refers to the "increased attention to new literacy practices in digital environments across a variety of social contexts" (p.246) as the digital turn. In any case, to be consistent with the context of our study, the perspective taken in our case has been that established by the Spanish Ministry of Education in Royal Decree 1631/2006.

For the legislators, information processing and digital competence consists of having the ability to search, obtain, handle and communicate information, and to transform it into knowledge. It incorporates different skills, ranging from access to information to its transmission through various media once it has been processed, including the use of ICT as essential for informing oneself, learning and communicating. It is associated with the search, selection, recording and processing or analysis of information, using a variety of techniques and strategies to access it according to the source and support used (oral, print, visual, digital or multimedia). It requires a basic command of specific languages (textual, numerical, iconic, visual, graphic and audio) and guidelines for decoding, transferring and applying knowledge in different situations and contexts. Digital competence involves making regular use of the technological resources available to solve real problems efficiently. At the same time, it enables the evaluation and selection of new information sources and technological innovations as they appear, in terms of their usefulness for undertaking specific tasks or objectives.

In other words, data processing and digital competence involves being autonomous, efficient, responsible, critical and reflective in selecting, processing and using information and its sources, as well as using different technological tools. It also implies having a critical attitude and a reflective assessment of the information available, contrasting if necessary, and respecting the socially agreed rules of conduct to regulate the use of the information and its sources in the different media.

For the Catalan Ministry of Education, implementing this cross-curricular competence involves:

> developing working methodologies that help students to become autonomous, efficient, responsible, critical and reflexive people in the selection, treatment and use of information and its sources, across different supports and technologies. Critical and reflexive attitudes must also be strengthened in the evaluation of the information available, checking it when necessary, and respecting the rules of socially agreed behaviour in order to regulate the use of the information. (Departament d'Educació, 2010, p. 26)

For this purpose, the guidelines issued at the beginning of each scholastic year for the organisation and functioning of Catalan schools states that ICT should: (1) Be used to organise, apply and display different kinds of information. (2) Become a relevant tool for teaching and learning. (3) Facilitate students' interaction with mathematical objects. (4) Be used to produce music and combine sounds and images.

Being coherent with the contextual objective of our research, we used this framework to analyse the implementation of information processing and digital competence at school level.

2 MATERIAL AND METHODS

This paper is based on a case study carried out in a secondary school as part of the research project Policies and Practices for the Use of ICT in Compulsory Education: Implications for Innovation and Improvement. The main aim of this project was to describe, analyse, interpret and assess the technological and educational visions underpinning educational policy on the use of ICT in the school; the degree of implementation of said policy; and its capacity to foster the transformation and improvement of education. As stated above, this paper examines the possibilities and limits a given secondary school faces when developing one of the eight compulsory competences, namely information processing and digital competence, in a traditionally subject-based curriculum. This particular secondary school has a tradition in the use of ICT and was chosen precisely because it would clearly be one of the public schools in the project's target region that would be better equipped to implement ICT-related policies.

The case study was developed over a school year. The fieldwork consisted of repeated visits to the school by three researchers and a technical assistant who carried out different research tasks simultaneously. The required information was collected through the following methods:

- Document analyses: external evaluation of *Projecte_ad@*; school website; teaching materials; 3rd grade CSE synthesis project; 4th grade research projects.
- Observation. Several observations of the following subjects: Physics, second A-level grade. Mathematics, 4th grade. English, first grade. Basic Maths Skills, second grade. Basic Catalan Skills, second grade. Classical Culture, 4th grade. Biology, first grade. Science for the Contemporary World, first A-level grade. Technology, second grade. Computing (web design), 4th grade, optional subject. Art History, second A-level grade, optional subject. Geography, second A-level grade, optional subject. Computing (digital video editing), 4th grade, optional subject.
- Interviews: head teacher and ICT coordinator (four in total); all observed teachers (13 in total); focus groups with students (four, with 24 students in total).

The criterion for selecting these subjects was the recognition by the head teacher and the ICT coordinator of being taught by teachers who used ICT in their daily teaching practice. The other teachers used ICT for preparing lessons, but hardly ever with students.

From this field study we were able to draw up an overall view of the conditions that the school we studied encountered in implementing a competence-based curriculum (de Bruijn & Leeman, 2011). The data was analysed using the grounded theory approach (Charmaz, 2008; Glaser, 1992, 2001; Glaser & Strauss, 1967; Saldaña, 2013; Strauss & Corbin, 1990), which means that the analysis began without a previous definition of categories of analysis. We built categories of analysis from the

coding of documents, interviews and observations and the construction of these categories gave us different foci of analysis. One of these was teaching and learning scenarios. Our notion of scenario is closer to a theatrical metaphor. We conceived the scenario to be a synoptical collage of a pre-planned event or series of actions and events.

This metaphor has allowed us to identify four distinctive scenarios, understood as consistent events, and a series of actions planned by teachers according to their:

Ideas about what teaching and learning mean.

Notions of school knowledge, of how classrooms should be managed and how students' work should be assessed.

Views on the role of ICT in the teaching and learning process.

Ways of interpreting educational policy.

The four scenarios listed below contain teaching practices ranging from a more restrictive notion of information processing and digital competence to a more complex one.

The pre-eminence of the tool: teaching and learning ICT

Teaching and learning with ICT: emphasis on exercising

Teaching (or showing) with ICT: the teacher is the main actor

Learning with and through ICT: the students are the main actors

Our methodological decision to generate synoptic scenarios allowed the integration of documents, interviews and observations to form bigger pictures. However, we are aware that such integration may cause the loss of details or lead to overgeneralisations. We do not see the four scenarios as the only possibility of analysis, nor do we think of them as closed categories in which every class may be labelled. Nevertheless, we do see them as a way of presenting the classroom realities found and the teachers' points of view.

3 RESULTS AND DISCUSSION

We have conducted this case study in a secondary school recognised as an early adopter of ICT by the educational community and the educational authorities. It caters for about 350 lower-middle and middle class students with a low immigration rate and is located in a town bordering Barcelona.

The technological infrastructure of the school reflects the difficulties of the educational policy of recent years. However, both teachers and students alike are of the opinion that they have good equipment that is adapted to their needs. In this context, the majority of the teachers do not match the interest and enthusiasm of the headmaster and the ICT coordinator in promoting the educational use of ICT in all areas of the curriculum. Despite the fact that information processing and digital competence form part of the *compulsory* curriculum and must be taught as a transversal activity, only fifteen out of thirty-eight teachers used ICT in their classes.

From the analyses of the data collected, we can affirm that the school curriculum and timetable follow the Department of Education indications practically to the letter. The curriculum clearly reflects the aforementioned theoretical discussion. However, the lack of a contextual definition of what the teaching and learning of the eight enacted competences in a traditionally subject-based official curriculum involves results in a structure in which subjects and competences are being superimposed rather than interacting.

The school's head teacher and the ICT coordinator recognise that one of the institutional limits to developing competences, especially the information process and digital competences, is the one-hour lesson (in reality, 55 minutes). The subject-based curriculum and the fragmented school time promote a vision of knowledge among both students and teachers that Bernstein (1971) coined as *collection (or disciplinary) type.* This way of conceiving the curriculum only seems to offer the students two moments at which they are able to approach a vision of knowledge that is less factual, declarative and tending towards repetition and the application of formulas. We refer here to the synthesis project that is undertaken at the end of the 3rd CSE year and the research project undertaken in the 4th year.

3.1 Implementing information processing and digital competence: four scenarios

The first three of the above-mentioned scenarios consistently share the same traditional spatial disposition, whether both teacher and students have a computer or whether only the teacher has access to one. Individually or in groups (of two or three), students are seated in front of a computer or a desk. The computers and desks are arranged in rows and columns in front of the board or screen and the teacher's table or computer. In only one of the subjects, where students had to analyse the technical uses of different video editing freeware, did students sit in a semicircle. Underlying these three scenarios, we also identified similar ideas about teaching and learning, school knowledge, student assessment, the role of ICT, and the way educational policy is dealt with.

3.1.1. The pre-eminence of the tool: teaching and learning ICT

In this scenario, composed of subjects such as Technology, Computing (web design), Computing (digital video editing) and Biology, the main goal seemed to be mastering the computer and Internet tools. All lessons focused on the use of given software and the main activity was learning to use it. OpenOffice.org Impress (OOI) to produce multimedia presentations, freeware video editing software, a web editor, a browser, etc. The following paragraphs show instantaneous samples of the most recurrent activity performed in different lessons.

In the Technology class, the students – in groups of two or three – made an OOI presentation with the contents of the first unit of the syllabus (a wiki for other units and so on). All presentations had the same information taken from the same sources (the textbook and the teacher), the only difference among them being the background colour, the font, and the presentation's effects.

In one of the computing subjects focused on web design, a typical task consisted of teaching students the functions of a web editor: how to format the text, change the colours, etc. The assignments were not connected to any curriculum content. The other optional computing subject (digital video editing) was more student-centred. Students had to analyse the characteristics of freeware video editing software found on the Internet. Even though the activity was focused on the study of a tool, students were asked to argue their statements and critically assess the technological pros and cons of the software selected.

The biology teacher focused the lessons taught with computers on teaching students how to use a browser. She stressed the importance of contrasting information, being critical and never

resorting to automatic cut and paste. As mentioned, acquiring this mastery is one of the purposes of information processing and digital competence. However, she did not teach them how to achieve this goal. In addition, students did not find these activities particularly interesting.

> In the usual classroom, the teacher gives us more information so we learn more about natural sciences. Going to the computer room is more fun and entertaining but we do not learn as much (Student F).

Teaching practices in this scenario seem consistent with the views held by many of the teachers interviewed who are convinced that ICT can only be used if they and the students have a good technical command. The narrow focus on the technical aspects of ICT seems to neglect the information-processing potential of these technologies to improve students' understanding and interest in the topics they study. The use of ICT here made little difference in the traditional teaching and learning process, in the representation of knowledge and in the assessment system. Instead, it confronted students with rather low-demanding tasks such as recalling and applying given information. Although two of the subjects placed in this scenario were related to the curriculum content (Technology and Biology), the use of ICT did not appear to represent any specific contribution to improving their learning. The underlying pedagogical notions of this scenario made it difficult to integrate different kinds of learning or promote the transversality of knowledge recommended in the competence-oriented curriculum.

Only in one of the subjects considered in this scenario were students asked to show understanding, express ideas and seek alternative solutions. The teacher fostered a more global reconstruction and a more intuitive comprehension of the subject of study, which implied, on the one hand, a more prolonged activity and control of the process by the student, making it possible to "experience" an idea and develop a sense of applicability to solve problems (Kemmis, Atkin & Wright, 1977). On the other hand, it enabled students to apply their knowledge and skills more effectively.

3.1.2. Teaching and learning with ICT: emphasis on exercising

In this scenario we placed the subjects that used ICT to teach content: Basic Catalan Skills and Mathematics. In each of them the teaching was:

- teacher-centred;
- based on a declarative and factual notion of knowledge;
- rather de-contextualised, de-problematical and uncritical;
- oriented towards what is known, rather than encouraging going beyond the given information (Bruner, 1973; Vuolevi & Van Lange, 2010).

In both subjects, ICT was used to do exercises that involved recognising, recalling and applying disciplinary knowledge. However, the Catalan teacher used ICT to connect students' learning in and outside school. For instance, they used the *Google Apps* editor to write a summary of the stories they had read (sometimes the students also developed their own stories) to be shared with the teacher. Once the tasks were finished, they had to write back a set of single-answer questions.

The maths teacher used computers for students to do exercises prepared by him and placed in an online space called *Toomates*[ii] or exercises provided by the *GeoGebra*[iii] geometry package. The teacher stated that the lists of exercises contained in his repository were *drill and practice* tasks, but were very good for helping students *capture* what he explained in the classroom. He was convinced that students learn more in this way because they *can do things* and it is better for them than listening all the time. However, many of the students interviewed did not share this view and were rather critical of this way of using computers.

Basic Catalan Skills was supposed to enhance the "Linguistic and Audiovisual Competence", which would require learning "to communicate orally (talking, listening and expressing oneself), through written work and audiovisual language, using one's own body and communication technologies (digital competence)" (Departament d'Educació, 2010, p. 20). However, the learning activities proposed generally led the students to tasks of recognition and memory. Only when they were asked to invent their own stories and share them with the teacher through *Google Apps* was it possible to discern a more sophisticated level of competence development.

In Mathematics, the computer as a *machine for doing exercises* didn't seem to contribute much to the development of the students' digital competence either. However, in both cases, teachers were the ones who seemed to improve their information processing and digital competence as, in their own words, they had spent hours preparing the exercises to be completed by students. We should be aware that the knowledge and skills needed for producing teaching material or virtual learning management systems are not the same as the knowledge and skills necessary for their use; and likewise the learning processes for those who develop materials are not the same as for those who use them (Sancho, 2010).

3.1.3. Teaching (or showing) with ICT: the teacher is the main actor

The audiovisual capabilities of computers enable their use for essentially exhibitive purposes. A section of the teachers we observed used the computer and a video projector in the same way as many others use the blackboard. Obviously, replacing the blackboard with a computer connected to the Internet offers many more possibilities: the teacher can easily show texts, images, videos and other available items on the Internet. The students may also show their creations and projects to the class. However, the use of ICT as an electronic blackboard was focused on the teacher[iv]. Each use was in tune with the interests and objectives of the teacher. We can say that in all the cases the interaction with the students was similar to that of a class in which the teacher uses the blackboard to explain and transmit information. Only in two of the subjects studied (Basic Math Skills and Physics) was the use of ICT as a blackboard complemented with the students using the computer to undertake exercises or solve problems.

In subjects such as Art History, Physics and Science for the Contemporary World, the use of a video projector with Internet access constituted a window onto the world, an opening that enabled students to visit a museum, access multimedia resources created or selected by the teacher about different topics (Asian flu, the theory of evolution etc.) and also explore abstract concepts, such as potential gravitational energy, by way of a YouTube video.

In Geography and Classical Culture, ICT provided a way of comparing information, while the teachers continually warned

students – without providing any criteria to do so – of the need to verify the content offered by sites such as Wikipedia. In English, the video projector was used to correct homework and familiarise students with web resources for helping them improve their pronunciation.

The ICT use that characterises this scenario considerably strengthens the organisational and symbolic culture of the school, based on the belief that "teaching is telling, learning is listening, and knowledge is what is in books" (Cuban 1993, p. 27) or, in today's world, what can be found on the Internet. In fact, it seems to have the same limitations for the students as conventional lectures.

> What I don't agree with is when they turn on the video projector and begin explaining everything […] and we have to copy it. That is not learning. It is copying from a video projector that he has put there because he says that when he writes it on the blackboard we don't listen to him (Student E).

In the context of this paper, this scenario does not foster the development of information processing and digital competence. The acquisition and development of this competence requires involving students in genuine learning experiences, in which the use of ICT plays a fundamental role in promoting understanding and problem solving.

3.1.4. Learning with and through ICT: students are the main actors

During our time at the school, we were unable to observe any class sessions with students doing the 3rd grade CSE synthesis project or the 4th grade research projects – activities in which the use of ICT played a substantial role in the learning process. However, as these projects were available on the school website, we did have the opportunity to analyse them. We also interviewed some students and teachers about them.

These two activities represented two distinctive, prescribed curriculum slots for students in which they are able to approach a vision of knowledge that is less factual, declarative and tending towards repetition and the application of formulas. Instead, by doing such activities they are able to advance towards a more multidisciplinary and meaning-oriented notion of knowledge and student performance. These are also two privileged settings for the development of different competences and, in particular, information processing and digital competence.

The 3rd grade CSE synthesis project was named "Discovering Barcelona". This involved groups of students undertaking an activity aimed at:

> developing complex competences and checking that they have been achieved; verifying to what extent students have integrated the basic competences acquired from the contents of each subject for the application and solving of questions and problems relating to practical life (Departament d'Educació, 2010, p. 251)

To fulfil these objectives, students were asked to devise a route around Barcelona to discover the cultural, social and artistic aspects of the city, while simultaneously learning to move around in it. Teachers provided them with basic guidelines, from which they had to develop their group project. Once data was collected and analysed, each group had to design and implement a weblog to show their processes and results[v]. Developing the projects involved students searching for diversified information to illustrate the routes covered around the city, the use of different strategies, modes and languages for collecting information (photos; interviews in different languages: Catalan, Spanish, English; videos; drawings, etc.) and the diversified representation of the results of their work. The obligation of students to present their work on a weblog forced them to face a series of unknown situations, related to processing and presenting digital information, which they had to solve while developing the project. In interviews, students said that this task led them to master digital tools which had previously been unfamiliar to them. Although they were initially troubled by how little control they had of these media, as a whole their evaluation of their learning in this activity was highly positive.

Another example of this scenario is the research project developed during the last CSE year (4th grade). This must be done in a group and should be a "set of discovery activities developed by students around a chosen theme and delimited, in part, by them, under a teacher's guidance" (Departament d'Educació 2010, p. 251). Twelve groups of between two to five students undertook research projects on topics such as: urban gangs, bullying, gender in the cultural world, the world stock exchanges, animals in danger of extinction, web publishing, alternative energies, tobacco, etc.

Topics usually came from the students' own interests, with the pros and cons that this involves. The positive aspect was the students' motivation to get involved in the task and, with teacher guidance, to move from the known to the unknown to obtain a deeper understanding. The negative aspect was that by approaching issues they *already knew about*, they found it hard to take a more in-depth look and seemed unable to question their previous beliefs and convictions, something that was reflected in the interview we had with a group of students.

Thinking about research projects as a process of gathering information about a topic without any problem-solving framework may end up being as meaningless for students as the de-contextualised contents of the different curriculum subjects. The students were aware that they were not doing an *authentic* piece of research. Nevertheless, the projects required searching for information on the Internet and other resources and then sorting it, carrying out chemical analyses, drawing-up and analysing surveys, etc. They also had to show a command of specific computing tools in order to be able to present their results through a weblog that included different types of information (text, image, audio, etc.)[vi].

Students' interaction with ICT in this scenario helped them to undertake a comprehensive reconstruction of the topic under study that did not depend on the recognition and application of a specific text. At best, and since it involved prolonged activity, the students could achieve a global reconstruction or intuitive comprehension of the issue, to the extent that control of the process focused more on the student than on the text. On the other hand, students could explore an idea and develop a sense of applicability to solve the problems (Kemmis et al., 1977).

This scenario facilitated the use of distinct sources of a multidisciplinary character. Students did not have to stick to a given subject matter, but had to surf through relevant trans-disciplinary knowledge. It also allowed for a greater in-depth analysis; a more critical attitude; the possibility of not only *manipulating* but also generating knowledge; a diversified use of

devices by students and a greater commitment and dedication to the task.

Finally, this scenario seemed the most suitable for the development of transversal and methodological information processing and digital competence (Departament d'Educació (2010). All the projects analysed had a table of contents that segmented the work into different areas of information. Nevertheless, the major problem seemed to be how to help the students move on from *copy and paste* to *search, record, analyse, compare and interpret*. In a world increasingly surrounded by, and made up of, digital technologies, this is a key question, not only for the development of information processing and digital competence, but for practically all learning experience. Without a doubt, this is a new and highly demanding challenge for the contemporary school.

4 CONCLUSIONS AND LIMITATIONS

The processes and results shown in this paper have the strengths and weaknesses of case studies. They are able to offer a rich, in-depth view of the real challenges met by schools, but cannot pretend to generalise their findings to all educational systems. However, we believe that the reflections emerging from our research and the conclusions reached provide an important contribution to the field of education and can foster a dialogue among interested parties.

A constant feature in the recent history of education has been the tendency to legislate what should happen in the school, without taking into account what is happening and how cultural inertia can make the imposed changes difficult to implement (Sancho & Alonso, 2012). The competence-based curriculum superimposed over the traditional disciplinary approach constitutes the penultimate episode of this situation. Democratic societies and the business world demand that people know more *hows, wheres, whys* and *what fors* than *whats.* In addition, people are expected to have a greater predisposition to face new contexts, rather than simply repeating definitions and concepts. The problem is that school culture has been built on the imagery of *having to transmit* disciplinary knowledge. In this context, introducing a series of transversal activities that involve: (1) the recognition of students' agency, (2) the ability to face not very well-defined situations, (3) the ability to position oneself critically before information, and (4) recognising the possibility of reaching different conclusions, into a disciplinary, non-problem solving, loose and spatially fragmented curriculum is by no means an easy task. From the four scenarios emerging in our research, only the fourth provided situations that actually enabled and promoted information processing and digital competence, and as we pointed out, this activity had its limitations too.

This research has revealed how a secondary school with a recognised tradition in the educational use of ICT is dealing with the imposed need to move from a teaching system focused on transmission and repetition to a system based on action, compromise, critical awareness and the capacity to take risks. Although our research was not aimed at explaining what it takes to make this move, as pointed out by the head teacher, the ICT coordinator and some of the teachers interviewed, the curriculum, timetable and spatial structures of the school have to be taken into account when promoting a curriculum oriented towards developing competences. However, the beliefs sustaining the teaching models put into practice by many teachers are also very important.

The acquisition and development of information processing and digital competence seem to occur more effectively, as we have seen in this research, when the disciplinary curriculum *is broken* and subjects and research problems are tackled; when students can manifest agency and their authorship is recognised; when digital technologies are not simply used to apply and repeat, but to search for, think about, elaborate, create and recreate.

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NOTES

[i] http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:394:0010:0018:en:PDF

[ii] http://www.toomates.net/info/info_cast.htm

[iii] http://www.geogebra.org/cms/en

[iv] Although we had evidence that the students use this resource to present the projects undertaken in situations considered in the fourth scenario.

[v] See: http://3esomallola.blogspot.com/

[vi] See:http://spreadsheets.google.com/pub?key=prkrB9XkkI3qy4MZ9ed4aWg&output=html

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