



Received: 30-09-2010  
Revised: 14-12-2010  
Accepted: 28-03-2011  
DOI: 10.3916/C37-2011-03-09

**María Domingo and Pere Marquès**  
Barcelona (Spain)

## **Classroom 2.0 Experiences and Building on the Use of ICT in Teaching** **Aulas 2.0 y uso de las TIC en la práctica docente**

*Recognising the importance of new technology in the classroom, our aim is to promote the integration of information and communication technology (ICT) in teaching practice based on a collaborative research in which action research-style methods are applied in 21 primary and secondary schools in Spain. In these research seminars, the participating teachers receive a progressive educational and technological training orientated towards the experiment, and reflect on the possibilities of using one computer per student in the classroom and a digital whiteboard or interactive whiteboard (IWB). After the first period of research, we present some significant ideas that guided the training and the findings on the testing of teachers in their classrooms, which we call Classrooms 2.0 as they are equipped with an IWB and computers with Internet access. Specifically, this experiment provides relevant results on the intensity of IWB and computer usage, the usual activities conducted with these technological resources, the advantages and disadvantages of their use and their impact on student learning. The conclusion provides an analysis and evaluation of the results, noting possible criteria for taking action in order to move 21<sup>st</sup> century teaching practices forward and promote the inclusion of ICT in classrooms.*

*Asumiendo la importancia de las nuevas tecnologías en las aulas, pretendemos impulsar la integración de las tecnologías de la información y de la comunicación (TIC) en la práctica docente desde una investigación colaborativa donde se aplican metodologías cercanas a la investigación-acción y participan 21 centros de educación primaria y secundaria de España. En los seminarios de esta investigación, el profesorado participante recibe progresivamente una formación didáctica y tecnológica orientada hacia la experimentación y la reflexión de las posibilidades de uso de un ordenador por alumno, en el aula, y de la pizarra digital o pizarra digital interactiva (PDI). Después del primer periodo de la investigación, aportamos ideas significativas que han guiado la formación impartida y avanzamos información de la experimentación del profesorado en sus aulas denominadas aulas 2.0 por estar dotadas de una PDI y de ordenadores con acceso a Internet. Concretamente, de esta experimentación, aportamos resultados relevantes sobre la intensidad de uso de la PDI y de los ordenadores, las actividades habituales realizadas con estos recursos tecnológicos, sus ventajas e inconvenientes destacables al utilizarlos y sus incidencias de uso en los aprendizajes de los estudiantes. En las conclusiones, se analizan y se valoran los resultados, apuntando posibles criterios de actuación para ir avanzando en la práctica docente del siglo XXI y en la inclusión de las TIC en las aulas.*

*ICT, education, technology, training, teachers, students, IWB, computers, interactive whiteboard.  
TIC, educación, tecnología, formación, profesorado, alumnado, PDI ordenadores, pizarra digital.*

**Dr. Maria Domingo Coscollola is Associate Professor at the Faculty of Education of the University Internacional de Catalunya and of the Department of Didactics and Educational Organization of the University of Barcelona (Spain) (domingo.maria@gmail.com).**

**Dr. Pere Marques Graells is Full Professor at the Department of Applied Education of the University Autònoma de Barcelona (Spain) (pere.marques@uab.cat).**

## 1. Introduction

Throughout history, new technology has always changed those societies where it has been implemented (Cabero, Lorente & Román, 2007: 1). Information and communication technology (ICT) is now one of the most effective agents of social change due to its impact on society. Faced with the emergence of ICT in our society, it goes without saying that the educational world cannot be immune to these changes.

In the field of education, ICT can provide a teaching and learning environment for both students and teachers. According to Cabero (2006), ICT offers new environments and settings for training with significant features, such as, expanding the range of information, training and tutoring opportunities, eliminating time-space barriers, facilitating collaborative work and self-learning, as well as enhancing interactivity and flexibility in learning. At the same time, Marquès (2008) highlights that ICT adds to the resources we are already using; ICT is a readily available resource for teachers, and, as emphasised by Gairín (2010), ICT facilitates the collective creation of knowledge.

In line with these approaches, our research experiment is designed around the use of a whiteboard or interactive whiteboard (IWB) in the classroom, along with a study of the notion of one computer per student. This research analysed ICT integration at 21 primary and secondary schools in Spain. The teaching staff carried out experiments in their classrooms, which we call Classrooms 2.0 as they are equipped with an IWB and computers with Internet access, with the aim of considering the current demands of 21st century society on schools that use ICT.

Teachers and/or managers of these participating institutions have a positive stance towards intervention in research and/or the use of ICT in the classroom. Therefore, the results and conclusions of this research are somewhat limited because they are interpreted within a positively biased teacher and/or management context. Evidently, what the teacher thinks about the educational potential of ICT conditions its use in teaching practice (Tejedor, García-Valcárcel & Prada, 2009: 117). Our research also examines the stumbling blocks that hamper teachers' use of technology, such as those highlighted by Calderón and Piñero (2007), resistance to change, lack of technical training, the effect on self-esteem and the frustration felt by teachers.

Then, we present a brief bibliographic review of the technological resources under study in our research (IWB and computers):

- Plenty of research into IWBs confirms that they are a good resource for use in teaching. The research generally highlights the advantages of IWB use for teachers and students. In Anglo-Saxon countries, there are significant research contributions on IWBs from Bell (2002), Glover and Miller (2001), Levy (2002) and Walker (2003), and we can also mention three IWB research centres: the UK government agency BECTA, the US government agency NCEF and the Canadian company SMART. In Spain, there have been several investigations with promising results that point to the benefits of this resource, notably the Iberian Research Project (Gallego & Dulac, 2005) and investigations by the research group DIM (Marquès & Domingo, 2010; 2011).
- There is also considerable research into the use of computers in the classroom, but the findings on the contribution of computer use in the classroom and improving student performance are contradictory. Despite these discrepancies, the computer makes for an effective tool at school, a valuable information resource and an interesting teaching support (Tondeur, Van Braak & Valcke, 2007).
- Research into the benefits of using the computer at home and improving academic performance is on the increase. Hence, the household computer and Internet access not only contribute to the acquisition of digital skills which prove useful when using this medium at school, but also favour the development of valuable cognitive strategies for school performance (Kuhlemeier & Henkel, 2007).
- We highlight a recent comparison on computer usage and performance (at home or in the classroom): The frequency of computer use at home generates greater performance in the PISA test than the frequency of computer use in the classroom (OECD, 2010).

## 2. Materials and methods

We present a collaborative research in which procedures are applied to action research to investigate teaching practice following classroom training, reflection and experimentation on the educational applications of IWBs and students' computer use. The research is conducted in two periods: from December 2009 to July 2010 (first period) and September 2010 to July 2011 (second period).

This research involves 120 teachers from 21 Spanish public and private schools at all levels of primary and secondary education with a total of approximately 3,000 students. The 21 participating schools are from different parts of Spain. Each area has a local research moderator who organises 5 seminars at the centres.

In each of these seminars, the moderator acts as a supervisor of the action research process while giving basic technical training on the use of IWBs and computers in the classroom and progressive didactical training on teaching and learning activities. Some significant ideas that guide the training are:

- The teacher loses his monopoly regarding the transmission of information in the face of a new form of student and society. Their work aims to make students find their own cognitive and relational belongings in the pluralistic world that we live in (Tello & Aguaded, 2009: 45).
- Today's media and entertainment (Internet, television and other standard screens) affect children more directly and universally than traditional media (Camps, 2009: 140).

- The introduction of social software extends the capabilities of communication, interaction and information exchange among participants. It also facilitates collaborative work generated within a virtual space (Del Moral & Villalustre, 2008: 74).

- It is fundamental to train people to be up-to-date with both existing and emerging technology... appropriately using the technology at each instance (Sancho, 2009a). It is fundamental to reflect on where these actions may lead, look at what is left to do and foresee what might be achieved (Sancho, 2009b: 30).

In these seminars, teachers comment on the activities, highlighting strengths and weaknesses and bringing up questions or problems. Also, we discuss recommendations and guidelines on the actions and use of technology in classroom practices (Area, 2007: 5). Finally, after each workshop, teachers will experiment with the activities that seem most appropriate and they also have access to online information in the research portal (DIM UAB, 2010).

The assessment questionnaire is the data collection tool that complements the minutes of each seminar. There will be 130 completed assessment questionnaires by the end of the first period of the investigation. The format of the questionnaire has already been used in other DIM research.

In summary, during the first period, the most significant activities of the investigative work plan were:

Prominent dates	Activity	Description
December 2009	START OF INVESTIGATION	Preparatory actions: selection of moderators, centres and technological resources to use in the coordinating centres.
January 2010	SEMINAR 1_1 (First period: Seminar_1)	The moderators present the research and provide initial training. Activities to be carried out are planned. We give out the initial questionnaire to be returned completed in June.
February / April 2010	EXPERIMENTATION	The teacher experiments in the classroom, following the planning laid out in seminar1_1 and the training received.
May 2010	SEMINAR 1_2 (First period: Seminar_2)	The teacher explains what was done with the IWB and computers. Reflecting on teaching practice and further training (with emphasis on the educational use of the IWB and computers). Lastly, the course of action is laid out.
May / June 2010	EXPERIMENTATION	The teacher experiments in the classroom, following the planning laid out in seminar1_2 and the training received.
July 2010	REPORT_1 (End of first period)	The report of the first period of research is elaborated mainly from the completed questionnaires.

During the second period, the most significant activities of the investigative work plan will be:

Prominent dates	Activity	Description
September 2010	SEMINAR 2_1 (Second period: Seminar_1)	Upgrading the technical and educational training. Performance review and planning of activities to be carried out. The questionnaire to be given back completed in May is handed out.
October / January 2011	EXPERIMENTATION	The teacher experiments in the classroom, following the planning laid out in seminar 2_1 and the training received.
February 2011	SEMINAR 2_2 (Second period: Seminar_2)	The teacher explains what was done with the IWB and computers. The moderator imparts further training and the activities to be carried out are planned.
February / May 2011	EXPERIMENTATION	The teacher experiments in the classroom, following the planning laid out in seminar 2_2 and the training received.
May 2011	SEMINAR 2_3 (Second period: Seminar_3)	The teacher explains what was done with the IWB and computers and puts forward the end assessments from the final questionnaire.
June and July 2011	FINAL REPORT (Final investigation)	Final report of the investigation obtained from the experiments carried out.

### 3. Results

This section presents the results from the first period of investigation (December 2009 to July 2010).

#### 3.1. Depth of IWB and computer use in classrooms 2.0

During this first period of research, many of the teachers and students carried out a fairly intensive use of the IWB and computers, although somewhat less in the latter case. We emphasize that 50% of teachers use the IWB in almost 50% of their teaching and instead only use computers in about 25% of their teaching.

These results are partly logical because of the short experimental period and the fact that teachers only attended 2 seminars. In addition, most teachers had little experience in the use of IWBs and very little in the integration of computers into classroom activities. Probably in the second period of research, with the completion of the 3 remaining seminars, the usage rates of these technological resources would increase in teaching and learning processes.

### **3.2. Types of activities most used in classrooms 2.0**

During this first period of research, we gather in the more frequent uses of IWBs and computers along with their ratings. Initially, the most common types of activities are those that are focused on the teacher's activity and those that are developed with the IWB:

- Keynote addresses (95%).
- The carrying-out of group exercises (82%).
- Collective comments on information from the Internet, mainly videos or newspapers (80%).
- Class correction of exercises (68%).

Later, and progressively to a lesser extent, other types of activities are also carried out by students with the IWB:

- Presentation of papers and materials used in the work (68%).
- Presentation of information from Internet (62%).
- Explanation of items to classmates on the role of the teacher (62%).

In some cases, students have also previously used computers for work or for looking for resources, the most frequent activities requiring a more active student role being:

- Doing self-correcting exercises and exercises for further correction (52%).
- Development projects (41%).

Less common actions and with lower assessments are for the use of simulators and learning platforms (Moodle or similar), creating blogs and wikis, the use of WebQuests and videoconferencing.

### **3.3. Advantages of classrooms 2.0**

During this first period of research, the teaching staff appreciates many advantages in using technological resources in teaching. The most important advantages that affect teaching and learning processes are:

- Increased attention and motivation (100%).
- Facilitating understanding (98%).
- Increased access to resources for debate and sharing among students and/or teachers (92%).
- Facilitating the teaching, learning and achievement of objectives (90%).
- Increased student participation and involvement (88%).
- Facilitating the contextualisation of activities and diversity management (82%).

Also, positive feedback is collected on activities carried out with a more active student role. The most important activities are:

- Research (93%).
- Developing creativity (86%).
- Making group corrections (85%).
- Conducting collaborative activities (82%).

Additionally, the teaching staff values certain benefits that directly affect the teachers:

- Enables a refreshing of methodology (88%).
- Increasing satisfaction, motivation and self-esteem (87%).

To a lesser extent and with lower assessment rates, the teaching staff mentioned that continuous assessment and presentations are facilitated. In contrast, there is a neutral stance on whether time is better used in class or as to whether reflection and reasoning are nurtured.

### **3.4. Notable classroom 2.0 disadvantages**

During this first period of the investigation, the routine use of technological resources (in teaching and learning processes) also has drawbacks for teachers, few but significant. The outstanding issues are:

- Needing more time to prepare their teaching (75%).
- Internet connection problems (65%).
- Software failures and problems with students' computers (37%).

### **3.5. Impact of classrooms 2.0 on student learning**

During this first period of research, virtually all teachers (91%) and a majority of students (75%) believe learning is better with new ICT activities and they like to perform them. The majority of teachers insist that this represents a significant increase in work, but it is worth it for the learning improvements gained. However, students do not always improve their academic qualifications, as emphasized by almost half of teachers (46%).

The impact on learning improvement from ICT activities is analysed in various student profiles. In this case, it is stated that the greatest impact in improvement (84%) is seen in the students who progress normally, well or

very well during the process of teaching and learning. In contrast, the impact is lower (68%) on students who cannot keep up or who are not motivated.

Additionally, teachers notice an improvement in the acquisition of competence in processing information, digital competence and competence in learning to learn. To a lesser extent, they also identify improvements in linguistic communication skills, autonomy and personal initiative. Throughout the second period of research, how performing certain activities with ICT can make way for skills development was studied in depth.

#### **4. Conclusions and discussion**

At the end of the experiment, the use of IWBs in teaching was greater than that of computers, almost double. The most frequent and highly-rated activities were those made with the IWB and those that focused on the work of teaching (keynote addresses, carrying-out of exercises, conceptualisation of Internet information and corrections). Next, also with good results, came other activities in which students make extensive use of the IWB (project presentations, explanations...). The fact that teachers start out using the IWB for teacher-centred activities and that they are initially the most common activities is considered in other research on IWBs (Marquès & Domingo, 2010; 2011).

At the end of the first period of research, there are several types of activities that students performed with computers, but to a lesser extent. The most common were self corrective exercises and exercises to correct, project development, consultations and works.

The classroom use of other resources of great educational potential such as simulators, educational platforms, blogs, wikis, WebQuests and videoconferencing was low. Probably, they will be used more and with better results as the skills and abilities of teachers increase in the teaching and technical use of these resources.

Obviously, the use of ICT in teaching still has significant drawbacks (devoting more time to prepare teaching and problems with Internet connection and computers), but there are significant advantages that teachers expressed almost unanimously. The most significant advantages being:

- Increased attention, motivation and student participation.
- Facilitating the understanding of issues, teaching, learning and the achievement of objectives.
- A refreshing of methodology.
- Increases in teacher satisfaction, motivation and self-esteem.

In addition, teaching staff appreciate that they now have more resources to use and share in class, more contextualized activities, can better manage diversity and provide more opportunities for research, collaborative efforts and corrections. They also underline the impact on the acquisition of certain skills such as digital literacy, processing information and learning to learn. Together with these advantages, we note that the use of IWBs and / or computers (in teaching and learning) is a wise choice for use in today's classrooms. We further assert that perhaps these resources could be helpful in contributing to reducing academic failure.

Virtually all teachers and a majority of students believe that learning improved with the use of IWBs and / or computers in teaching and learning processes. However, students do not always improve their academic qualifications, as emphasized by almost half of teachers. Therefore, there is an inconsistency because the improvement in student learning is not reflected in their final assessment. Perhaps, the cause of this contradiction resides in that memorising still prevails in the assessment. In fact, the activities supported by IWBs and / or computers only benefit memorising contents long-term when specific programs are used for this purpose. Probably, if the assessment provided more learning competence, student grades would also be higher. Therefore, a significant challenge lies ahead to design reliable strategies for identifying and validating learning outcomes in the assessment.

We found that the use or incorporation of ICT in the classroom can provide a good opportunity to raise necessary issues about teaching and learning in 21st century schools (Adell, 2010a, 2010b; Domingo & Fuentes, 2010). In this investigation, the progressive considerations and experimentation have been complemented by an increase in new realities such as learning through teaching practice and active ICT experimentation.

We round up by underlining significant activities carried out since the seminars, which have eased the incorporation of ICT in the classroom:

- Contextualising teacher training that attends to their practical needs.
- Teachers exchanging experiences and sound practices.
- Providing opportunities for teachers to work together and with experts.
- Supporting and encouraging the testing of new strategies and skills.

#### **Acknowledgement**

The Classrooms 2.0 research project was carried out as part of a collaboration agreement between Microsoft and the Teaching and Multimedia Research Group of the Autonomous University of Barcelona (UAB). The agreement code between the UAB and MICROSOFT is 11,566 (starting 18/03/2010). It goes without saying that we thank everyone who has made this research possible.

#### **References**

Area, M. (2007). Algunos principios para el desarrollo de buenas prácticas pedagógicas con las TICs en el aula. *Comunicación y pedagogía: Nuevas tecnologías y recursos didácticos*, 222; 42-47.

- Adell, J. (2010a). Jordi Adell: Web 2.0 y escuela 2.0. Revista DIM-UAB, 16 (<http://dim.pangea.org/revistaDIM16/revistanew.htm>) (04-09-2010).
- Adell, J. (2010b). Educació 2.0, en Barba, C. & Capella, S. (Eds.). Ordenadors a les aules. La clau és la metodologia. Barcelona: Graó; 19-32.
- Bell, M.A. (2002). Why Use an Interactive Whiteboard? A Baker's Dozen Reasons! (<http://teachers.net/gazette/JAN02/mabell.html>) (20-10-2010).
- Cabero, J. (2006). Bases pedagógicas para la integración de las TICs en primaria y secundaria. Biblioteca virtual del Grupo de Tecnología Educativa de la Universidad de Sevilla (<http://tecnologiaedu.us.es/bibliovir/pdf/Bases456.pdf>) (04-09-2009).
- Cabero, J.; Lorente, C. & Román, P. (2007). La tecnología cambió los escenarios: el efecto pigmalión se hizo realidad. Comunicar, 28; 167-175.
- Calderón, P. & Piñero, N. (2007). Actitudes de los docentes ante el uso de las tecnologías educativas. Implicaciones afectivas. Monografias.com. ([www.monografias.com/trabajos14/tecnologiaeducativa/tecnologiaeducativa.shtml](http://www.monografias.com/trabajos14/tecnologiaeducativa/tecnologiaeducativa.shtml)) (09-09-09).
- Camps, V. (2009). La educación en medios, más allá de la escuela. Comunicar, 32; 139-145.
- Del Moral, M.E. & Villalustre, L. (2008). Las wikis vertebradoras del trabajo colaborativo universitario a través de WebQuest. Relatec, 7 (1); 73-83.
- DIM UAB (2010). Investigación Aulas 2.0. Barcelona. UAB. Departamento de Pedagogía Aplicada (<http://peremarques.pangea.org/aulas20/>) (04-09-2010).
- Domingo, M. & Fuentes, M. (2010). Innovación educativa: Experimentar con las TIC y reflexionar sobre su uso. Pixel-Bit, 36; 171-180.
- Gairín, J. (2010). Joaquín Gairín: Gestión del conocimiento y escuela 2.0. Revista DIM-UAB, 16 (<http://dim.pangea.org/revistaDIM16/revistanew.htm>) (04-09-2010).
- Gallego, D. & Dulac, J. (2005). Informe final Iberian Research Project ([www.dulac.es/Iberian%20research/Informe%20final.doc](http://www.dulac.es/Iberian%20research/Informe%20final.doc)) (04-09-09).
- Glover, D. & Miller, D. (2001). Running with technology: The pedagogic impact of the large scale introduction of interactive whiteboards in one secondary school. Journal of Information Technology for Teacher Education, 10; 257-276.
- Kuhlemeier, D. & Henkel, J (2007). The impact of computer use at home on students' internet skills. Computers and Education, 49 (2); 460-480.
- Levy, P. (2002). Interactive Whiteboards in learning and teaching in two Sheffield schools: a developmental study. Department of Information Studies, University of Sheffield (<http://dis.shef.ac.uk/eirg/projects/wboards.htm>) (20-10-2010).
- Marquès, P. (2008). Pizarra digital: las razones del éxito. Funcionalidades, ventajas, problemáticas... Barcelona. UAB. Departamento de Pedagogía Aplicada ([www.pangea.org/peremarques/exito.htm](http://www.pangea.org/peremarques/exito.htm)) (04-06-2010).
- Marquès, P. & Domingo, M. (2010). Aplicaciones de las pizarras digitales, en Roig, R. & Fiorucci, M. (Eds.). Claves para la investigación en innovación y calidad educativas. La integración de las Tecnologías de la Información y la Comunicación en las aulas. Alcoy: Marfil & Roma TRE Università Degli Studi; 273-284.
- Marquès, P. & Domingo, M. (2011). Presente y futuro de las pizarras interactivas según resultados de últimas investigaciones, en Roig R. & Laneve C. (Eds.) (2011). La práctica educativa en la sociedad de la información. Innovación a través de la investigación. Alcoy: Marfil & Scuola Editrice (in press).
- OECD (2010). Are the New Millennium Learners Making the Grade? Technology use and educational performance in Pisa (<http://browse.oecdbookshop.org/oecd/pdfs/browseit/9609101E.PDF>) (04-10-2010).
- Sancho, J.M. (2009a). DIM interview Juana M. Sancho: Escuela 2.0. Revista DIM-UAB, 15 (<http://dim.pangea.org/revistaDIM15/revistanew.htm>) (04-09-2010).
- Sancho, J.M. (2009b). ¿Qué educación, qué escuela para el futuro próximo? Educatio Siglo XXI, 27(2); 13-32.
- Tello, J. & Aguaded, J.I. (2009). Desarrollo profesional docente ante los nuevos retos de las tecnologías de la información y la comunicación en los centros educativos. Pixel Bit, 34; 31-47.
- Tejedor, F.J.; García-Valcárcel, A. & Prada, S. (2009). Medida de actitudes del profesorado universitario hacia la integración de las TIC. Comunicar, 33; 115-124.
- Tondeur, J.; Van Braak, J. & Valcke, M. (2007). Towards a Typology of Computer Use in Primary Education. Journal of Computer Assisted Learning, 23 (3); 197-206.
- Walker, D. (2003). Quality at the Dockside. TES Online, 3; 66-67.