Special features of Interactive Whiteboard software for motivating students

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Abstract—**The introduction of the Interactive White Board (IWB) in the educative system embodies new methodological approaches that require prior research and training in teachers. To meet the educational opportunities offered by the new digital classrooms, the integration of Information and Communication Technologies (ICT) has to be considered from a new interactive learning horizon. In Spain IWBs have early been adopted in classrooms, since 2005, but thanks to the 2.0 School National Program (2009), the implementation of ICT has been fostered by the central government. However, even though teachers may have an IWB in their classrooms, it does not mean that they use it for interactive teaching and advanced learning purposes. New software for digital boards has to be specifically created in order to benefit from this innovative learning tool. This paper presents practical examples of the IWB application in classroom teaching. It also shows the need to implement software to develop students' goals when using the IWB. The lack of specific software in IWB tools is an important barrier. The main interest lies in the learning opportunities it offers to children as a writing device, as a resource to correct exercises, as a means of interactions, etc. IWB current programs are rather linear in the sense that only a few of them allow students' interaction with their peers. Similarly, multimedia software has to be developed to get the most of the latest ICT, like the IWB. This only can be reached if authoring tools develop as far as to achieve programming instructions to run the possibilities of the IWB, such as handwriting recognition, strokes and shapes recognition, finger dragging or multi-student collaboration.**

Index Terms—**Interactive whiteboard, IWB, ICT, digital classrooms, authoring tools.**

I. Introduction

Technological innovations emerge so fast that new educational innovation processes are constantly being introduced. This has advantages and disadvantages. The advantages relate to the endless possibilities of expansion, consolidation and training a student can receive, once the teaching staff has been trained. The disadvantages refer to the necessary assessment process that each innovation program requires. As a result of this handicap teachers need to identify new methodologies or modify the ones currently used.

Traditional devices such as slide projectors, videotapes, and audio cassettes have almost vanished under the deployment of possibilities showed by computers. The traditional blackboard seems to be the next victim. The Interactive WhiteBoard (IWB) has consolidated itself as one of the main devices to last long time in classrooms, living together with or even contributing to the disappearance of the foregoing technology. Many teachers consider the IWB as an invaluable classroom tool. Though IWBs begin to be used ten years ago it is now when they are expanding. The massive incorporation of IWBs into teaching in some countries is expanding so fast that teachers suddenly encounter they have to use a completely different technology. Even more they are forced to quickly modify quickly a great part of their teaching strategies to adapt them to this "new guest" that determines the kind of contents and the didactic methodology. In Spain IWBs have been recently implemented in classrooms (about 2005), but thanks to the 2.0 School National Program (2009) fostered by the central government, they have been massively distributed.

However, if we consider the investment that the implementation of IWBs implies in each classroom, it would be desirable to clarify what advantages they have and the didactic methodologies that emerge with them. There is controversy on the need of having IWBs in classrooms because many common programs are often conceived as IWB specific software though they can be used in any computer. Even considering the IWB as an extraordinary technology it is important to identify accurately which are its contributions to the teaching-learning processes. Several authors agree on its didactic uses: "Effective use of an interactive whiteboard encompasses and extends a range of teaching styles. It also supports and extends a wider range of learning styles – but, as with any ICT tool, its success depends on effective use" [1]; "Current evidence at both primary and secondary levels points to a reluctance on the part of many teachers to do other than use the IWB as a visual textbook in the same way lesson by lesson. As a result, pupil boredom once again inhibits understanding and achievement and the potential for changed approaches is lost" [2]; "A number of respondents raised concerns that IWB use was 'just another presentational tool' " [3].

In last years some projects have been carried out in order to identify the best didactic models to be applied in "2.0 classrooms". One of this, the "2.0 Classroom Research" project has involved 21 centers and 3000 students [4]. This report highlights that one of the IWB achievements is to increase attention and motivation in a 100% of the cases they analyzed (96% of students declared their preference for developing their classroom activities using ICT). Teachers consider ICT are a valuable resource in classrooms (more than 90%) but they acknowledge the time it takes when preparing the lectures. The project remarks the need to develop teacher training programs based on digital didactics in 2.0 classrooms.

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Increased student engagement is a common factor detected when using IWBs. The visual aspects seem to be the main reason. This opinion is reflected in several studies [5] that argue the positive effects of supporting the lessons with visual elements and the influence in metacognition. Another reason is that IWBs have the potential of maintaining students' attention and improving their results. "The more students are motivated to learn, the more likely it is that they will be successful in their efforts" [6]. But the motivational effects heavily rely on teachers' attitudes and technological skills. Adopting the best practices in the use of IWBs are critical for assuring success and quality in the lectures, therefore, it is very important a detailed planning of activities in the syllabus design [7]. The question is: what methodologies and kind of activities are the most effective with IWBs and how to integrate them into the learning process?

II. Advantages and Disadvantages of using an IWB

Bautista has gathered some of the advantages of the IWB [8]. Among them, he emphasizes the possibility of writing and drawing with colors over the surface, underlining, stating the benefits for pupils with psychomotor problems, storing screens drawn in previous days, the big size of the screen, the triple interaction teacher – student at the whiteboard – students on their seats, or the wide possibilities of the software supplied with IWBs. The great motivation and interest that IWB produces in students is also highlighted.

Indeed, one the main reasons of the IWBs success in contrast with the existing computer and projector duo lies in higher motivation roused in students. In relation with the traditional chalkboard this motivation is fundamentally caused by the graphical capabilities of the IWB (use of color, images, videos…), already available since the computer video projection system invention. Above all, the key is the sort of "magic" produced by having the possibility to use regular tools directly over it (stylus pen, hand or fingers): "Multimedia and interactive content on interactive whiteboards is engaging and motivating, particularly for primary pupils, and students pay more attention during lessons" [9]. Nevertheless, the optimism derived from the current research has to be considered within the "novelty effect" that any new ICT can generate when incorporated to the teaching. It is important to remember that the perception of teachers in relation with the improvement of their students' skills when using IWBs and the assessment that the students have themselves about their performance is not always objective. It has to be checked and contrasted in research for determining if there is an effectively positive correlation.

"Therefore, a question that remained unclear was as to whether improvements in pupil attainment during the first year after the introduction of whiteboards were due to good teaching as some teachers have claimed rather than technology alone" [10]. In this sense, "it is interesting to observe that teachers appreciate the IWB because they think it increases their pupils' concentration; an aspect that students share although they point out to be more concentrated when working with their own laptop" [11].

BECTA's recommendations [1] establish four main advantages about using IWBs:

- Enhance demonstration and modeling.
- Improve the quality of interactions and teacher assessment through the promotion of effective questioning.
- Redress the balance of making resources and planning for teaching.
- Increase the pace and depth of learning.

Another research [12] gets the point hat IWBs have the potential for enhancing interactivity in learning contexts, connecting students with other students, resources and ideas. IWB is a positive reinforcement for a triangular interaction model in whose vertices are the teacher, the students and the contents.

Between 2004-06 the "Iberian Research Project" [13] was carried out. This project tried to identify and study the processes and results derived of the use of IWBs in different learning stages and different pedagogical models to integrate IWBs in classrooms. The conclusions of this study reveal that:

- IWBs considerably improve the teaching-learning processes.
- IWBs are very well accepted by teachers.
- The use of IWBs generates a higher motivation in teachers and students.
- There is a need for technical, pedagogical and methodological training and to leverage creativity while using properly IWBs. (This point is nearly to these paper objectives).
- IWB software is perfectly integrated with usual classroom activities.
- IWBs foster teacher's creativity.

But, are these the real IWB advantages? What's the difference between the IWB and the previous system based on a computer and a projector? Which are really its specific traits?

On the other hand disadvantages laid on illumination (and shadows produced over the projection area), technical problems (as calibration, receptor orientation, best angle for using stylus pen, accuracy…) and software problems (use and learning of IWBs control software features mainly).

III. Methodological Contributions to the Teaching-Learning Process

In order to get the most of IWBs, teachers have to be conscious of their contributions. They will have to think about the best activities for their students with the IWB and search for the proper resources (documents, images, multimedia applications…). On the contrary, the IWB will not be very useful and probably the students would get more profit using their own netbooks.

The didactic models most used and with more excellent evaluations are those centered on the teachers' activity and control using the IWB [4]: lecture presentations (95%), resolution of exercises all together and group comments based on video visualize[tin or digital news (80%), public correction of exercises (70%)…

Considering the actions done with IWBs, Horng-Ji [7] distinguishes between basic and advanced functions and features of software. Among basic functions the following are identified: installation, board orientation, digital ink layer and floating toolbar, working with objects, gallery collections, writing and saving notes; and among the advanced ones: handwriting recognition, use of tables, using and managing Gallery collections, linking objects to other content, advanced text options, recording interactions, saving still images, using rich media and incorporating interactive content, advanced control panel set up, experience sharing.

Some of these uses are similar to their equivalent without IWBs but now they can be done in a different way. Recovering the declaration of an interviewed teacher, the difference seems to be clear: "for the majority of secondary school teachers, [the] IWB is a brand new tool, and its operations are not like keyboard typing or mouse clicking. Teachers must get training in order to maximise the potentials of its flexibility and versatility features." [7].

Getting the most of the IWBs is achieved when thinking about what is the real contribution of this technology opposed to the previous system (computer–projector), because we can make the mistake of reproducing exactly the same uses. Here are some examples of methodological uses for the IWB:

A. Use 1

Using the IWB as a blank blackboard renews and amplifies the possibilities of the traditional chalkboard. These sink into obscurity when using the computer-projector system over a non-interactive surface. There are many software applications able to create a new full screen blank document, but IWBs always count with a presentation software optimum for this aim (e-Beam models include Interact with Scrapbook, Hitachi models have StarBoard, SmartBoard comes with Notebook, Mimio with Studio, etc.)

B. Use 2

To write over Webpages or PDF documents (underlining or labeling with markers, framing with shapes, pointing with arrows…). This possibility turns any static content into an interactive one. IWB allows the development of any activity on a layer above existing content –higher level-, for example completing a proposed exercise in a PDF document as it was a paper sheet. There are some applications like the PDF Annotator that allow making and saving annotations into conventional PDF documents.

C. Use 3

To write/draw into Presentations. The new versions of some computer programs, for example Microsoft PowerPoint, include the capability of making annotations with different kind of felt-tip pens. They also allow saving the annotations as part of the presentation. This possibility can be used to achieve a unique presentation on the IWB in each lecture: "As the lecture becomes 'canned' using tools such as Microsoft PowerPoint, the ability to change direction, annotate or illustrate on the fly becomes difficult if not impossible" [14].

D. Use 4

To write/draw over images. The IWBs control software allows importing images or making screen captures to be labeled later. The image then becomes an interactive content too and it is usual to point to parts, color zones or write names on it.

Apart from working on top of more or less static media, it is also possible to take advantage of IWBs when working with activities in educational interactive multimedia applications:

E. Use 5

Activities based on handwriting recognition (number, letters, symbols or even mathematical formulas). This capability does not mean converting handwriting into a typewritten text that is copied into a text field; it consists of the ability of multimedia applications to recognize handwritten text and trigger an action. An example would be the digital version of Sudoku (called Inkdoku for IWB or Tablet PC).

F. Use 6

Activities based on drawing recognition (objects, structures, strokes/gestures, shapes…). Some good examples of multimedia applications with these characteristics are Algodoo (to create freehand drawn physics systems), Ms Composition Tool (a musical score editor able to recognize strokes turning them into notes) or the geometric shapes recognizer that some IWBs control software have. The user can freely draw symbols and shapes that the interactive multimedia software will recognize and use.

G. Use 7

Activities based on dragging with fingers (to place, insert, order, discriminate, classify, rotate objects, and follow paths...); in short, drill and practice activities where the IWB potential can be maximized. These activities could be performed with a simple mouse device but IWBs give an added value allowing the use of your own finger. Recent years have led to an explosion of touch-screen devices because people prefer not to depend on any tool. Dragging better than clicking. Finger better than stylus.

H. Use 8

Interactive WhiteBoard Sharing (simultaneous participation or collaboration on exercises resolution or correction). Modern IWBs can be shared through Internet in conference mode. This possibility allows students, with Tablet PC laptops and from their seats, to collaborate on activities and exercises solving them with the same or higher precision than in the IWB itself. Collaboration can be implemented with the IWB control software, installed on the laptop of the students, but there are also different possibilities as Microsoft Mischief or remote control programs able to share the screen like Real VNC.

I. Use 9

Lecture recordings and storing of previous whiteboard screens. This function allows audio to be recorded at the same time the activity is developed in the IWB. Teachers then can publish the recordings on the Internet, so that students will be able to review lectures and their parents to know exactly the contents of the lecture.

Therefore any software that does not run these specific advantages of the IWB and Tablet PC belong to the conventional software that can be used equally, or even better, with a normal computer. In such case IWBs would not contribute with any substantial advantage. Furthermore IWBs do not lack problems either: in some trademarks the stylus still works with low precision; it is hard to get used to do common actions that can be easily done with the mouse (right button or double click); and generally it is not possible to obtain a perfect stroke as in paper handwriting. The need of periodic calibration of IWBs is another inconvenient.

The following charts show a sketch of each one of the uses cited before (all of them are examples; the numbers of the figures correspond to the abovementioned use numbers):

Fig. 1. Using it as a blank space, IWB can substitute the traditional chalkboard for any exercise. This option is incorporated by the software supplied with the IWB but it is possible to use any other software that allows preparing a blank screen as PowerPoint.

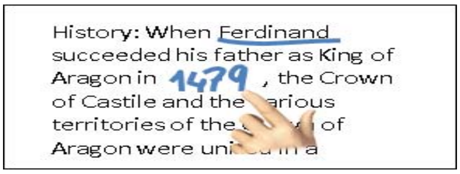

Fig. 2. Writing or drawing over Web or PDF to do simple but effective actions like fill in the blank, underline, highlight, etc. This option is incorporated by the IWB software. Some programs have their particular set of tools for drawing over PDFs.

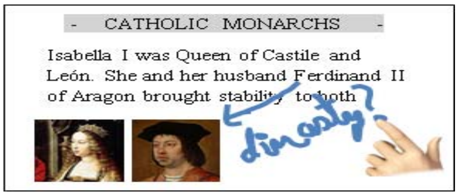

Fig. 3. Writing or drawing over presentations to point, underline, highlight, etc. This option is incorporated by the IWBs and also by programs for making presentations that use to have a drawing tools set.

Fig. 4. Writing or drawing over any image to point, mark, color, etc. This option is incorporated by the software supplied with the IWB. The image can be inserted into a new document or remain in its original context.

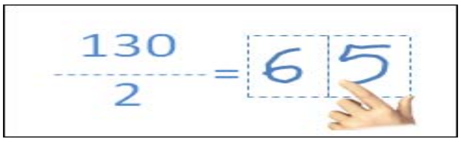

Fig. 5a. Writing or drawing on multimedia software with handwritten number recognition capabilities. Author tools do not include programming instructions to do that. There are only standalone solutions (of course not standard) able to do that.

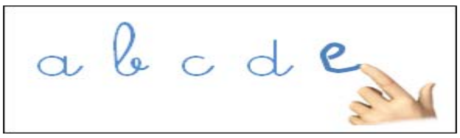

Fig. 5b. Writing or drawing on multimedia software with handwritten text recognition capabilities. Author tools do not include programming instructions to do that. The case is similar to the previous one but now language dependent. May be non-majoritarian languages could be not implemented.

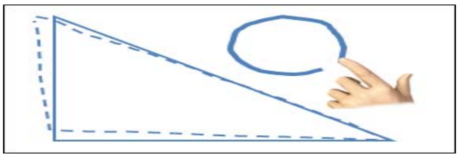

Fig. 6. Drawing shapes or objects that multimedia software can recognize. Author tools do not include programming instructions to do that. It is possible only to find standalone solutions or this function incorporated into IWBs software.

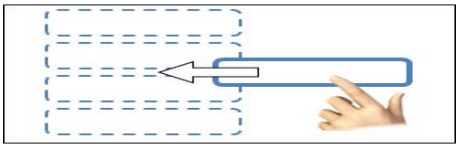

Fig. 7a. Dragging objects with your finger to place them in puzzles, schemes, diagrams...This can be programmed with any common multimedia authoring tool. It takes advantage of finger-dragging capabilities.

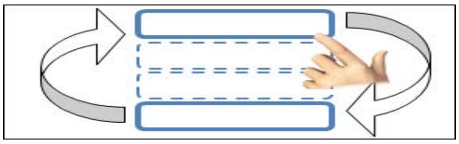

Fig. 7b. Dragging with your finger to insert an item into ordered sequences. Similarly to the previous this can be programmed with any common multimedia authoring tool.

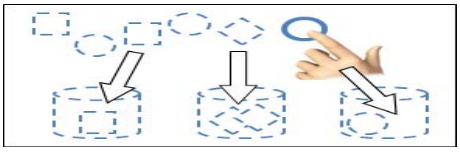

Fig. 7c. Dragging with your finger to classify or discriminate items. Similarly to the previous this can be programmed with any author tool.

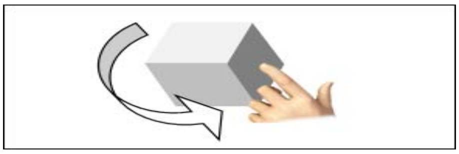

Fig. 7d. Dragging with your finger to rotate 3D objects. This can be programmed with author tools that support 3D objects or applications like the Google 3D warehouse.

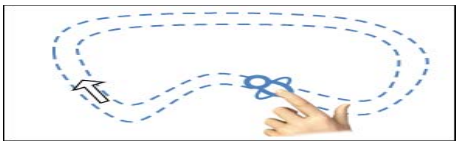

Fig. 7e. Dragging an object with your finger to follow up the path. This can be programmed with any multimedia author tool. It takes advantage of finger-dragging capabilities.

Fig. 8. Several students can participate in activities simultaneously. Some IWBs allow this multi touch possibility. Also IWBs can be shared through Internet and the students can collaborate from their seats.

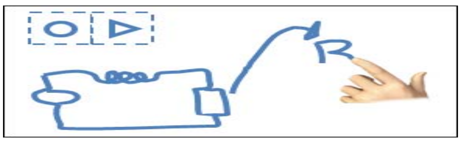

Fig. 9. IWBs allow recording the lecture in real time. This option is incorporated by the IWB software or third party applications (like Camtasia). There is also the possibility of saving previous screens with the IWB software.

IV. The Need of Authoring Tools with Specific Programming Interfaces for IWB

One of the reasons why there are almost no educational multimedia programs available to get the most of IWBs handwriting and drawing capabilities is the lack of programming instructions in authoring languages to recognize handwritten characters or shapes. The modern software technologies are now able to recognize marks, typed and handwritten characters (Optical Mark Recognition, Optical Character Recognition and Intelligent Character Recognition, respectively). The last feature, ICR, is an advanced and almost unexploited possibility for improving the quality of interactive activities in the classroom. But because common authoring tools like Adobe Flash, Director, Authorware, Toolbook, etc. lack of this capability, the very interesting kind of uses referenced before as number 5 and 6, cannot be programmed.

While authoring tools have been improved to implement support for 3D elements, vector images or new video formats lack any ICR recognition. It happens something similar when talking about voice recognition. The most widely used authoring tools (Adobe Flash, Adobe Director, CourseLab, eXe Learning, Articulate, etc.) lack instructions for managing voice recognition (the existing solutions are OS dependent, for example third party ASR engines).

Some examples to show ICR in Flash have been developed. The examples provided were done only as ICR test with simple characters; then they have not a general application. Future ICR should cover all characters in all languages.

The integration of ICR in Flash would lead to educational contents able to solve interactive questions in a written natural way. For illustrating this it is useful to take look to some simple examples found on the Internet. They use different algorithms of pattern recognition and achieve different levels of accuracy as well.

The first Flash example [15] is a game for training in two digit addition with handwriting recognition. Accurate strokes to get a good result are needed.

The second one [16] uses the Freeman's chain algorithm with ActionScript to recognize a reduced set of characters.

Of course multilanguage full recognition would require a huge database, heavy for being transferred though the Internet. The following example [17] tries to identify Japanese characters using Flex, Zinnia and Ruby on Rails, finally implemented through a Flash solution.

Last Flash example [18] is able to recognize gestures and guess letters and numbers, unfortunately not very accurately.

There are some extensions and third party applications that extend the operative system capabilities; but these are not standardized solutions and do not allow further multiplatform content distribution. There are no Xtras or Extensions in author multimedia development applications to increase their possibilities in the field of handwriting recognition. Externally we can find abundant independent solutions for recognizing handwritten texts (Myscript Stylus, ritePen, PenReader…). The software provided with IWBs usually has a handwriting recognition tool, as for example the ActivStudio software of Promethean, SmartBoard Notebook, Mimio Writing Recognition for Mimio Studio, etc. There is also support to handwriting recognition in some operative systems (for example last versions of Windows with the Input Panel and the Mathematical Input Panel). Certainly since these solutions are installed onto the operative system they can be used in many applications. For example after clicking on a field in any application, an area for handwriting is showed; and after the user draws some characters, they are automatically recognized and the result inserted into the edited field. However, again, these solutions are O.S. dependent.

When author languages would include functions for handwriting recognition, programmers would be able to delimit a drawing area and manage the bitmap created thanks to instructions like these:

Function recognize Text (imageoftext: bitmap): string

Function recognizeNumber (imageofnumber: bitmap): string

Function recognize Shape (imageofshape:bitmap):bitmap

Function recognize Symbol (imageofsymbol: bitmap):string

Therefore a new innovation (perhaps generation) in the evolution of authoring tools for implementing recognition functions for different multimedia items is necessary. In short, this means the real evolution to get the most of IWBs will take place when authoring tools include a handwriting recognition system (ICR, not OCR), as well as with symbols and shapes. This will boost the design of IWBs software for students, thus allowing freehand writing and drawing, allowing in this way the computer to be able to understand their strokes.

V. Conclusion

IWBs offer didactic possibilities for classroom uses that few technologies have. However, sometimes people attribute them innovative qualities that already existed before. The most interesting uses have been explained in this paper, in special, it is important to exploit those IWBs characteristics that are differentiated from other technologies: the advanced issues (handwritten text, numbers, symbol and shapes recognition, recording of screen activity…) and also the simplest ones (clicking, dragging, drawing, underlining, marking, pointing to…). IWBs gather all the advantages of the computer-projector duo and also add new functions that we need to know to get the most of them. Interactivity, motivation/engagement and high visual representation capabilities are their main advantages.

Though IWBs by themselves include very useful didactic functions in their control software, many multimedia programming applications (and their authoring languages) do not get the most of their capabilities due to the lack of instructions. In fact there are no Xtras, Extensions or Components to complement authoring tools for recognizing letters, numbers, shapes or symbols (only a few SDKs for high-level languages programs). Therefore the vast group of programmers (teachers many of them) are unable to implement advanced activities based on recognition. Such evolution of authoring tools would allow the design of exclusive software for IWBs and Tablets.

Acknowledgment

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the project of IWBs implementation of the Faculty of Education at the University of Zaragoza and interviews with Elementary and Secondary teachers of the institutions participating in "2.0 School National Program".

The Faculty of Education counts with mobile and non-mobile IWBs that are used regularly with the students. They have to develop some presentations that will be exposed using the IWB. They must place their emphasis in getting the most of the IWB as a differentiated technology.

The teachers interviewed in this project also have IWBs in their classrooms. They have expressed problems with the use of IWBs, for example recalibration, and have suggested interesting possibilities. They are aware of their need of special training. We want to thank all of them.

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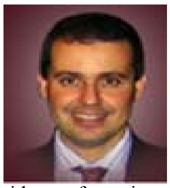
[18] Flash example 4: http://nuigroup.com/log/comments/hand_writing_recognition/



J. Sarsa. is an Electrical Engineer with specialization in Informatics, Electronics and Control by the University of Zaragoza (Spain). He lives in Zaragoza and teaches Educational Technology at this university since 1995. His major fields of research are those related with educational technology, mainly multimedia programming, video and audio editing, videoconferencing, e-Learning and LMS, e-Learning standards…

He has published a substantial number of papers in national and international conferences. He has been participating in some outstanding R&D projects as, in MINERVA: Wireless Content and Language Integrated Learning, in PROFIT-Ministry of Industry program: Multimedia and Multilanguage Platform for e-Learning Contents Contribution; in ALFA program: Teaching Computer Graphics and Multimedia; for the Ministry of Education: Design of Teaching Plans in the EHEA harmonization process based on using e-Learning Tools; for the Autonomous Government of Aragón: Development and Implementation of a Pilot System for Delivering Audiovisual and Multimedia Contents through Internet, etc. His current research is focused on the impact of rich and comprehensive multimedia educational contents including video streaming sequences.

Prof. Sarsa has been collaborating as reviewer in some panels and in Scientific Committees of relevant international conferences and journals such as e-SOCIETY from 2007 to 2011, SPDECE from 2007 to 2011, BJET 2006, etc.

R. Soler holds a degree in Psychopedagogy. She is also Bachelor of Arts in English and likewise has a Diploma in Education (Language, English). PhD from the University of Zaragoza (Spain). Professor in the Department of Educational Sciences, Faculty of Education, University of Zaragoza. Her doctoral thesis deals with the internal stratification of language in the analysis of specialized vocabulary in the language of Educational Sciences. She has published several articles on school organization, general Didactics and Information and Communication Technologies (ICT) in journals of impact. She has participated in national and international research projects focused on the inclusion of ICT in the stages of compulsory education (Primary and Secondary Education) and university level (teaching models in e-learning, interactive, telematic tutoring, etc.).

Dr. Soler has made several postdoctoral research stays at foreign universities and has developed foreign lines of research relevant to the subject area of "Didactics and School Organization" and particularly, in the application of ICT in initial and continuing teacher training in attendance and mixed e-learning modalities.