

# LOW-COST INTERFACES AND THEIR EDUCATIONAL POSSIBILITIES

J. Ferrés Font, M. Estebanell Minguell, P. Cornellà Canals, E. Guiu Puget

Universitat de Girona

Girona (SPAIN)

*josefina.ferres@udg.edu, meritxell.estebanell@udg.edu, pere.cornellacanals@udg.edu, eulalia.guiu@udg.edu*

## Abstract

Projectors in classrooms improved the functionality of computers by allowing groups of people to view simultaneously the same image (from a computer monitor). The image could be used to guide an explanation or a presentation or group interaction on a particular subject. The resources that are currently available to teachers on the Internet (information of all kinds, videos, maps, etc.) can help to make the subject matter more attractive, interesting and, in addition, more participatory.

The interactive whiteboard (IWB) has brought further advantages since users are able to interact directly on the screen. This allows the person doing the presenting and the projection itself to be the focus of attention of the whole class, thus eliminating the communication barrier arising from talking from one part of the classroom while referring to images that are projected in another part of the room. Such communicative improvements can further enhance the teaching-learning process that takes place in the classroom.

Furthermore, the IWB can improve group activities in which the children are directly involved by enabling small groups to interact with each other on the board while the rest of the class can follow their activity.

There is one major obstacle to exploiting these advantages: cost.

In 2006, the Nintendo Wii console came on the market and revolutionized the video game industry through a new concept of interaction between player and console. The key to this transformation is the Wii Remote or Wiimote, the command console, which incorporates optical sensors and accelerometers arranged in three spatial axes. On December 7, 2007 Johnny Chung Lee, a computer engineer, posted on YouTube the result of his tests of new applications using the Wiimote, introducing the possibility of using the Nintendo Wii console to create a low-cost of IWB.

Thanks to this development, the use of IWBs could become widespread in schools, with full advantage taken of their educational potential.

In order to assess the true pedagogical worth of this tool, the University of Girona research group GreTICE (Grup de Recerca en Tecnologies de la Informació i la Comunicació en Educació-Information & communication Technologies in Education), is conducting an empirical study which, through a pattern of detailed observation, is collecting details of various aspects of the performance of schoolchildren and their teachers while using such tools. At the same time, the teachers will be questioned about certain didactic aspects and the children will be asked about their impressions and how they compare with previous experience.

In the final paper, we will provide an advance report of the findings of this research and the prospective work of the research group.

**Keywords** - Innovation, technology, interactive digital board, interactivity, Primary School.

## 1 CONTEXT

This study took place along the lines of research of the Research Group on Information and Communication Technologies in Education (GReTICE) of the UdG and within one of the projects currently under development, the CONTIENE project (Intelligent Content for Virtual Reality Applications, point of view and global illumination techniques, TIN2007-68066-C04-01) financed by EMED – Ministry of Education and Science (MEC) in the TIN - PN of Information Technology programme.

Within the framework of this project and in line with the body of work that explores new communication interfaces which allow the establishment of new working environments in the classroom, we explore here the possibilities on offer and design proposals for classroom action. We are particularly interested in technologies that make it possible for users to interact using peripheral devices capable of activating the different senses, thereby extending traditional communication restricted to sight and hearing. This objective has led us to study the characteristics and potential of low-cost interactive boards.

## 2 WHY LOW-COST DIGITAL BOARDS ARE OF INTEREST TO TEACHING

By definition, an interactive digital board, or IDB, is a system comprising a computer connected to a video projector. The image is projected onto a surface where the computer may be controlled using a specific pointer, the touch of the person interacting with the screen or some other device. In this way it is possible to annotate over the projected images, manipulate them, and use buttons or touch-screen elements for the applications being run.

Due to these features, if the classroom has a digital board and an Internet connection, work can be conducted using presentation resources that have been prepared beforehand (slide presentations, audiovisual documents) as well as resources that can be found on the Internet while interacting with the information. This is one of the relevant aspects included in the report compiled by Redes: *“increased motivation among students, who see in the board a new element that allows for attractive graphic presentations, where it is also possible to interact with the objects”* [3].

Another improvement offered by these boards in comparison with video projectors consists in the person who is leading or in charge of the activity being able to stand next to the screen, interacting with it and not with the computer. Not having to constantly move to interact with the computer allows for richer communication. This helps to focus the attention of those present on a single point, whilst communication with those in attendance is also enriched by non-verbal elements: gesture, facial expression, eye contact with those listening, etc. If the act of teaching is considered an act of communication, any resources that favour or improve this communication are of great interest to educators.

Furthermore, another aspect that we believe adds value to this interface is the possibility of interacting within a small group. This may happen when:

- Two or more people interact on the board at the same time using different peripheral devices (multi-touch).
- A small group stands in front of the board and establishes a discussion or debate regarding the information they all see and analyse simultaneously. This allows participants to be able to work together as a group to solve problems or to create as a group.

Although these arguments allow us to state that the use of interactive digital boards may facilitate the teaching and learning process, this technological resource is not available in most school classrooms. One of the main conditioning factors is its high price.

Various different companies sell interactive digital boards, with few differences in terms of basic features and functionalities. Prices differ according to the model, but, without counting the computer and video-projector (many schools already have these), the purchase and installation of an IDB (projection surface, software, cables, etc.) can easily exceed €1,500.

This forces schools to restrict purchases of the board...or search for more economic alternatives.

Recently, an alternative has appeared which has notably reduced the cost of interactive boards while maintaining many of the advantages: they are what is known as low-cost boards.

As proposed by Johnny Chung Lee [1], the Wii Remote application (or Wiimote, the Nintendo Wii console gamepad), together with other components, allows emulation of a digital board and opens the possibility of using it in schools at a vastly inferior cost to that of an IDB.

The existence of this device, along with the aforementioned characteristics, has led us to study the possibilities and limitations of this interface.

### 3 TECHNICAL ASPECTS OF LOW-COST BOARDS

On 7th December 2007, Johnny Chung Lee, an American IT engineer, posted a video on YouTube [X] explaining how to create a low-cost IDB by taking advantage of the functionalities of a Wiimote (as of today's date, said video has received over 2.7 million views). Using different components, the total cost of which does not exceed €60, it is possible to obtain a system similar to that of an IDB. This discovery led to the creation of a discussion forum, on which followers of this project participated [X].

#### 3.1 System components

In order to obtain a low-cost IDB system, the following components are required:

- A computer with the Windows XP or Windows Vista operating system. Versions of the software do not currently exist for Linux or MacOS. - In our experiment we used both desktop computers and laptops.
- A Bluetooth USB adapter with the necessary software (should the computer not be equipped with Bluetooth). -In our study, we used one manufactured by the company "Intuix", with the software "BlueSoleil" (Fig. 1).



Fig. 1: Intuix Bluetooth USB Adapter.

- A Wiimote. Nintendo Wii console gamepad. One of its main characteristics is its capacity to detect movement thanks to various accelerometers. It also has an optical sensor capable of detecting infrared rays emitted by IR-LEDs (infrared LEDs).
- An infrared light pointer. This can be obtained by substituting the LED with visible light for an IR-LED in some widely available device (pen, keyring, lighter, etc.) or by building one from scratch (this does not require any specific skills). -In our experiment we began with a keyring and later constructed our own pointers (Fig. 2). This was the better option because it was possible to control the position of the IR-LED more precisely and it was easier to use. It is possible to find small companies on the Internet that sell handmade pointers. The material required for constructing such a pointer is as follows:
  - a felt-tip pen casing
  - an IR-LED
  - a small push button
  - a battery
  - electric cable

It is important to note that infrared light is not visible to humans. In order to verify whether the pointer has been constructed correctly, it should be focused on a camera (mobile phone cameras may be used as they do detect infrared light).



Fig. 2: Infrared light pointers for activating the low-cost board.

- A projector. Any projector will do. The higher the quality and brightness of the lens, the better the results obtained, regardless of external light.
- A screen. A flat, white, hard surface. If it is a projection screen, the quality of the image will be better. The use of roll-up screens is not recommended.
- The specific software. – In our case, we experimented with two different applications and different versions. In both cases it was necessary to install the .NET Framework, a development environment for different programming codes. The following applications may be used:
  - The Wiimote Board. Developed by Johnny Chung Lee. This was the first application to appear with these characteristics. The current version is 0.3 and dates to 20th August 2008 [1]. The same author has developed a code for using two pointers simultaneously with one single Wiimote.
  - The Smoothboard [4]. Developed by Goh Boon Jin. The first version we tried was the 1.0, from 1st February 2008 [4]. It has similar characteristics to the above software, but allows two Wiimotes to be connected to a single projector, thereby increasing the area of incidence. The current version, from 19th September 2009, is the 1.6.0.7 [4]. The main characteristic of this latest version is that it has a floating toolbox with which it is possible to implement actions such as drawing with different colours, underlining, deleting, making screenshots and simulating a right click. This application is free to use.

## 3.2 Operation

In order to use the low-cost IDB correctly, the following steps must be followed:

1. Connect the computer and the Wiimote using the Bluetooth connection. The correct way to do this will depend on the software for the Bluetooth device. It should be noted that, for the computer to detect the Wiimote, the A button must be pressed on the Wiimote (the blue lights come on at the bottom).
2. Place the Wiimote in a position where it fills the entire screen (at a distance of 2 to 3 metres should work).
3. Run the specific software (Wiimote Board or Smoothboard). The software will not function correctly if it does not detect the connection to the Wiimote.
4. Calibrate the screen. The specific software has a calibration tool which consists in turning on the IR-LED at four points of the screen which are marked with a cross.
5. Use the screen by pressing the push button on the pointer.

In this environment, as depicted in Fig. 3, when the push button is pressed on the pointer the IR-LED is turned on. The emitted light is captured by the infrared light detector on the Wiimote, which acts as a camera. All of the information regarding the position of the detected light is sent, via Bluetooth, to the computer, where it is processed by the specific software. This software makes the movements of the pointer work on the applications running on the computer. Finally, the projector shows the content of the computer screen on the projection surface and makes it possible for the user to interact with the applications running on the computer.



Fig. 3: Low-cost IDB system

### 3.3 Aspects to take into account

- Ensure the software is installed correctly.
- Position the Wiimote in a place where there is minimum interference with the pointer. A good place tends to be just above or next to the projector. Generally, the user will keep away from the light of the projector and leave a passage free for the Wiimote to capture the IR light.
- The projection surface must be rigid. If it is canvas there is the risk that users will distort the image when pressing on the surface.
- The IR-LED has to be very visible in the pointer (it must stick out, not remain hidden inside the casing). This will make it easier for the Wiimote to capture the IR light.
- The Wiimote and pointer batteries must have enough power to ensure good operation.

## 4 EXPERIMENTS

In order to see how these boards work and study their utility, we prepared experiments at two different schools (Sta. Margarida primary school in Quart and Bordils primary school in Bordils, both situated in the municipal districts of Girona, Catalonia, Spain), where there was previous experience of using ICTs in classroom activities. It was hoped that in both schools the use of these new interfaces might represent a step forward in their integration.

In order to gather data relating to the use to which teachers and pupils put these tools and to detect aspects relevant to our study, a questionnaire was compiled for teachers and pupils, and observation guidelines drawn up for use by researchers during the pupils' lessons.

The questionnaire aimed at teachers had to include data regarding the advantages and/or difficulties noted by teachers when using this technology, as well as the possibilities it offered for teaching in comparison to the use of other resources or methodological alternatives. A further aim was to gather teachers' impressions regarding possible changes in attitude the technology might provoke in pupils, comparing their normal behaviour with their behaviour in sessions in which the low-cost board was used.

The questionnaire compiled for pupils was aimed at gathering their impressions after using the low-cost board for an activity that previously would have been conducted without it. Questions were posed regarding emotional aspects, whereby they could express how the experience had been and what had surprised them most, and other questions were intended to explore the characteristics they had identified as distinctive and different from their experiences without the board.

Finally, the aims of the observation guidelines were to extract concrete data and to be as objective as possible, allowing a comparison of the actions of the children observed while using the low-cost board and their normal behaviour during other school activities. Here we are referring to the level of motivation, attention paid to the teacher's explanations, attention paid to the content, behaviour after giving correct answers and/or making mistakes, behaviour towards their classmates and the resource itself.

#### **4.1 Work with pupils at SCHOOL 1**

At School 1, ICTs are used with all classes for isolated activities.

##### **Description of the activity**

The experiment was conducted with Year Six children (11 and 12-year-olds) over two different sessions.

The proposed activity had been agreed beforehand with the teacher, although on this occasion it was led by a person from the research group. The teacher and another person from the research group observed.

The two sessions focused on studying aspects of the subject matter "The Modern Age". Specifically, pupils studied the distribution of geographical areas on modern maps, comparing this with current resources and the content of the subject matter they were studying in the classroom: cities, artisans, scientists, etc. For this, a slide presentation (PowerPoint) had been prepared with a series of maps from medieval times with links to Google Earth and the JClic package "*Catalunya en l'edat moderna* (Catalonia in the Modern Age)" [5].

##### **Resources used**

Components of the low-cost IDB system, slideshow presentation prepared by the teacher, PowerPoint, Google Earth, JClic.

##### **Organisation of space**

The children were seated in a semicircle facing the board, leaving sufficient space to allow a good view of the projection and for the person or people interacting with the board to be able to move freely.

##### **How the session progressed**

When the children arrived in the classroom they found the space already prepared, with the chairs in place, the board calibrated and the programs running (Google Earth, PowerPoint and JClic). The session began by presenting the project (experimentation with this type of digital board) and the new interface, explaining how it was to be used.

As planned, the children conducted searches using Google Earth (for a town in Nicaragua twinned with their town, and their own town, Quart) observing how the region looked on the screen. One pupil interacted with the board while another went to the computer to enter the name of the towns, while they both commented on what they could see.

The second activity consisted in the teacher showing different maps of the Modern Age representing different depictions of the geographical information and commenting on this with the pupils.

The third activity consisted in working with a JClic package on the Modern Age. The children worked in pairs to complete the activities while the others helped them.

At one stage two children participated with two pointers, which made it easier to work together. This was not multi-touch technology, rather they simply had one peripheral device each so as to avoid wasting time passing the pointer to one another. This meant that they had to agree on which of them would use their pointer at any given time. In this case, good understanding depended on the attitude of the participating pupils: if one of them was more dominant, even though they had a pointer each it was observed that the normal hierarchy was maintained, but in some cases it made it possible for more "reserved" pupils to be able to take more initiative.

## **Observations on the experiment**

Using the Wii Remote stimulated the children's curiosity and they asked all types of questions. It was therefore explained to them how the board worked.

The pupils appeared very motivated and followed explanations closely at all times. Within the group there were some children who monopolised the session and seemed to know everything, wanted to do everything themselves, wanted to take centre stage. Others went more unnoticed due to their being more "reserved", but not because they were unmotivated or passive. The basic reason was that the others did not give them the opportunity to participate. When the teacher suggested they do something, however, they showed interest and demonstrated that they had been following the lesson.

In general, they had no difficulty in using the resource of the digital board; only one child showed underdeveloped motor skills and paid little attention.

The JClic activities were very successful and appeared to achieve their aims: generating interaction between the whole group, both those at the board and those sitting in their places.

There were a couple of children who constantly told the others what to do. They wanted to complete the activity and thought that they had the answer. As this group of pupils was close to the board, on many occasions they even got up and pointed to demonstrate what had to be done.

Most of the children behaved normally after making mistakes, trying to resolve them; at no stage did the technology seem to be an impediment to carrying out the activity.

Evidence was found to back up some of the researchers' prior beliefs: the teacher (or person leading the activity) being in front of the group, before the board, helps to focus attention and allows this person to be able to bring more dynamism to the group.

There were not many problems with regard to blocking the signal to the computer ("shadow" problems) because the children had been warned and they mostly took this into account.

## **Children's assessment**

In answer to questions regarding their degree of satisfaction with the activity, all of the children said that they had enjoyed it very much. And in reference to the type of learning, they said they had learnt "*things related to technology*". One even said "*everyone says that video games are of no use and look what we can do with the Wii gamepad!*" Using this type of resource for studying was clearly associated with a fun aspect of the work they were doing. It could be interpreted that they enjoyed learning.

## **Teacher's assessment**

The teacher demonstrated curiosity and interest in this new interface and the type of activity presented.

## **4.2 Work with pupils at SCHOOL 2**

This school has spent many years doing important work on the integration of ICTs in school. There are computers and video projectors in all of the classrooms.

As stated below, the experiment was conducted with two different age groups.

### **Description of activity A**

The experiment was conducted with Year 4 children (9 and 10-year-olds).

The session was led by the teacher, who participated in the experiment.

The habitual working methodology of this school is what is known as "project work". The class in question was in the final phase of a project, whereby each group has to present and share with the rest of the class the knowledge it has acquired on the subject studied.

During the lesson with the low-cost board, several boys and girls presented their project in front of the class using a slideshow presentation they had prepared with PowerPoint. This activity is usually done in pairs, with one of the participants doing the oral presentation and the other one having to control the computer. On this occasion both children were able to address their classmates by positioning themselves together next to the projection, which they interacted with without having to move to the computer.

### ***Resources used***

Components of the low-cost IDB system, slideshow presentations prepared by the children, PowerPoint.

### ***Organisation of space***

The children were seated in a semicircle facing the board, leaving sufficient space to allow a good view of the projection and for the person or people doing the presentation to be able to move freely.

### ***How the session progressed***

The session began by presenting the new interface and explaining how it was to be used.

The boys and girls took it in turns to come out to the board, look for the file containing their presentation and open it to do the presentation.



Fig.4: Children interacting with the low-cost IDB

In some cases the children who were watching asked questions relating to the subject matter.

The activity progressed in the habitual manner with the only difference being the use of the low-cost digital board.

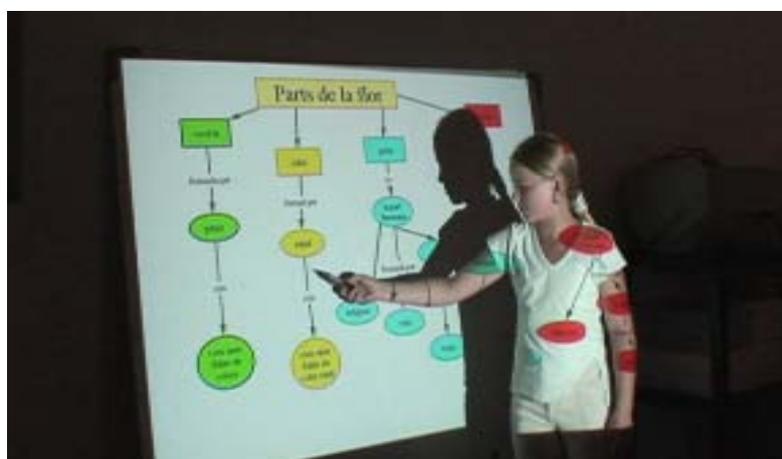


Fig.5: Girl presenting her project

After the project presentations, a graphic editing program was run and some of the children were able to try out the new technology.

### ***Observations on the experiment***

Using the Wii Remote stimulated the children's curiosity and they asked all types of questions. It was therefore explained to them how the board worked.

The confidence of the children was noticeable in the activity they were doing and also in the use of the different programs.

In general, they did not have many difficulties in operating this new technology and in some cases classmates who were not participating directly suggested solutions to problems that arose, telling them how to hold the pointer or reminding them not to stand between the projection and the place they were pointing to with the pointer ("casting a shadow"), otherwise the board would not work.

### ***Children's assessment***

The children who participated directly (those who did the oral presentation) said that it was easier for them to do it like this because it meant they did not have to agree with the person manually operating the computer. They also stated that this allowed them to write directly onto the screen.

### ***Teacher's assessment***

The teacher stated that the children doing the presentation were able to be more independent and it was not necessary to have a person manually operating computer. She also highlighted the ease with which they used the new interface. She did add, however, that this did not surprise her because it is a skill that they often demonstrated with any new IT applications they may be introduced to.

## **Description of activity B**

The experiment was conducted with Year 1 children (6 and 7-year-olds).

The school habitually uses ICTs from a very young age and there is a video projector in each classroom. For this reason, on this occasion we were able to do the activity in the school classroom.

The activity consisted in jointly correcting a text written previously by one child of the group. This is an activity that is habitually done using the video projector.

### ***Resources used***

Components of the low-cost IDB system, the program Inkscape, document with the child's text.

### ***Organisation of space***

The children were seated in a semicircle facing the board, leaving sufficient space to allow a good view of the projection and for the person interacting with the IDB to be able to move freely.

### ***How the session progressed***

The teacher began the session by presenting the new interface and explaining how it was to be used. The activity was conducted in the usual manner with regard to content, but differently in terms of the procedure followed. The most notable aspect was the children being able to interact with the board without having to manually operate the computer.

The activity consisted in correcting a text written by one of the children. They had to read the text that appeared on the board line by line and search for words that were not spelt correctly. When they found one, they raised their hand and came out to underline it, indicating the mistake they had found (Fig.6).

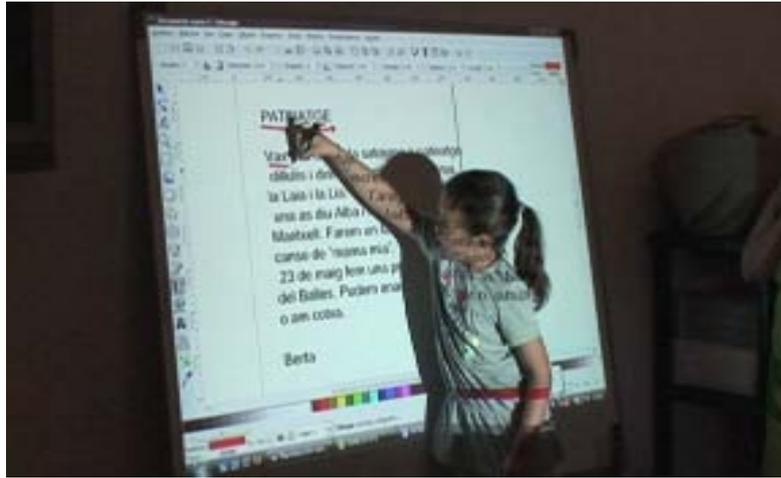


Fig.6: Girl underlining mistakes in the text

When they had finished the correction, the teacher told them to save the document and that she would give them a printed copy.

Before finishing the session, the teacher let those pupils who had not directly interacted with the board come up and have a go.

We were also able to observe how they experimented with the pointer, trying to write on another surface, and one child even checked to see whether it wrote on his hand (Fig. 7).

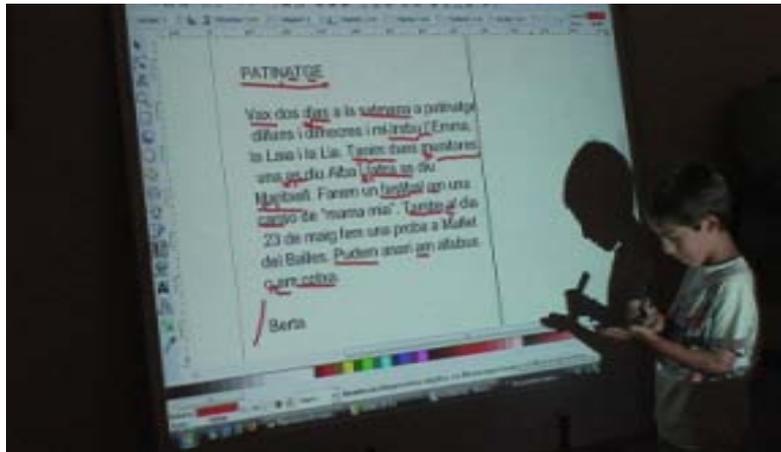


Fig.7: Child experimenting with the pointer to check whether the pen really wrote or not.

### **Observations on the experiment**

Given that in order to do the activity it was necessary to “mark” with the pointer, positioning it over the projected text while pressing the button, some children had some difficulties dominating this new technology. If they did not position the pointer well enough they could not interact with the screen. This also happened at times because they were standing between the computer and the signal sent by the pointer (“they cast a shadow”). This group found it difficult to stay seated, press the button and draw on the board at the same time.

It was found that the procedure required by this activity was too complex to be done adequately in a first lesson using this technology and with such young children.

Nevertheless, these difficulties did not prevent the process of correcting the text from being performed correctly, the activity being followed attentively and the session ending with the objective fulfilled.

When allowed to write freely, they experimented with the program and the pointer to see what they could do with it.

### **Children's assessment**

Due to their age, the children's assessments can only be gathered from their attitude and some questions we were able to ask them as a group. They said that they enjoyed it but it was difficult for them to give a more concrete opinion.

### **Teacher's assessment**

The teacher evaluated the experience of everyone being able to see the same text at the same time as very positive. She did, however, say that they could also do this when they only had the video projector. What was of most interest to her was everyone being able to correct while maintaining attention on the board, so that it was not necessary for the teacher or a child to go to the computer to do the corrections. She also pointed out that the application they had used (Inkscape) had allowed them to underline in the same way that you could on a traditional board, and it was therefore more practical and quicker than the usual process of using a word processor (selecting and using the "underline" command). She also noted that this made controlling the whole group easier.

She stated clearly that it was important to find a classroom use for this resource and that, in addition, it was important to take into account the fact that these new technologies form part of the children's world, and they must therefore be incorporated into school life.

She mentioned the following possible uses:

- Using the program Kidspiration to prepare conceptual maps as a class.
- Preparing artistic creations in small groups (she called this "digital plastic art").
- Working with Google Earth.
- Like the teacher of the other group, she also thought the best thing would be for the children to be able to experiment freely in order to be able to get used to using this new interface and explore all the possibilities it offers. In her experience, she thought that it would take children very little time to adapt to it and that they would do so with little difficulty.

## **5 CONCLUSIONS AND FUTURE OUTLOOK**

Following our experiments and the observations made, we can draw some initial conclusions:

- Children are interested in the technology we experimented with and want to know how it works, without doubt due to using the Wiimote, a gadget they associate with entertainment and for which they know a different function.
- This technology does not distract them from the activity they are doing, however; it is as if they have already assimilated it. We could say that they really are new millennium learners, NML [2]
- Using this resource in some cases leads to the children finding it fun to do the type of activity they are involved in. There is a potential increase in intrinsic motivation for learning.
- The age of the users is an important factor in achieving good control of the pointer. Smaller children find it more difficult to activate the button. Equally, they also find it difficult to position themselves so as to avoid interference with the signal. This is a problem that affects the spontaneity of the children and makes it difficult for work to flow smoothly.
- The type of interaction that users are to have with the board is also important: the activity goes faster when they only have to click on something, as the technology does not interfere with the flow. However, we do believe that this is a skill that can be learnt. It must be taken into account that the experiments we conducted were carried out with children who were using the low-cost digital board for the first time.
- Focusing the attention of the audience on a single point makes it easier for the person leading the session to control the activity, and communication is improved. This is an aspect which reinforces one of our prior beliefs and is also included in the aforementioned Redes report "*the possibility of interacting with the students while facing them means their attention is greater and better controlled*" [3].
- The organisation and characteristics of the space are important in fostering a climate of communication and interaction. It was observed that the children who were following the activity rather than working directly on the board interact with one another to resolve situations

or make suggestions. This would therefore seem to be a good tool for fostering activities requiring collaborative work. However, it should be pointed out that having to darken the room makes it easier for those with the tendency to get distracted to do so.

- Teachers see more or fewer applications for this technology depending on the degree of use of ICT resources at the school. In classrooms where technology has become something “transparent”, teachers find different applications for it that represent a further step in their experience.
- The quality of the teaching when using these interfaces lies not only in its technological possibilities but also in the design of the proposed activity. It is important to attempt to promote interaction between the members of a group regarding the object of study.

These conclusions, together with other new developments that constantly arise, allow us to draw some guidelines for our future progress with this work:

- Experiment with multi-touch applications that allow two or more people to interact with the board in order to foster collaborative work.
- Design applications that can be used in classrooms by primary school children and allow aspects to be worked on that do not require a complex procedural use of this technology, for example, restricting the use of the pointer to a simple click.
- Extend the use of these boards in schools where the availability of resources does not make the purchase of expensive interactive boards possible and continue trying out new teaching applications in order to keep up to date with developments that will allow us to draw new conclusions.

## References

- [1] CHUNG LEE, J. *Johnny Chung Lee > Projects > Wii*. Found on 10 septembre 2009 at <<http://johnnylee.net/projects/wii/>>
- [2] PEDRÓ, F. (2006) *APRENDER EN EL NUEVO MILENIO: Un desafío a nuestra visión de las tecnologías y la enseñanza*. Found on 23rd January 2009 at <<http://idbdocs.iadb.org/wsdocs/getdocument.aspx?docnum=848274>>
- [3] RED.ES (2006) *La pizarra interactiva como recurso en el aula*. Found on 20rd September 2008 des de [http://www.pangea.org/dim/docs/Redes\\_InformePizarrasInteractivas\\_250506.pdf](http://www.pangea.org/dim/docs/Redes_InformePizarrasInteractivas_250506.pdf)
- [4] *Smoothboard.net*. Found on 26rd September de 2009 at <<http://www.boonjin.com/smoothboard/>>
- [5] VERDAGUER I ANDRÉS, J. *L'Edat Moderna*. Found on 13rd May 2009 at <<http://clic.xtec.cat/projects/medisoc6/jclic/moderna6/moderna6.jclic.zip>>
- [6] *Wimote Project Portal*. Found on 22rd September 2009 at <<http://www.wimoteproject.com/>>