"THAT'S THE WAY WE WANT TO LEARN!"

ICT WORKSHOP AT A PRIMARY SCHOOL

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Abstract

Education is a key ingredient of any knowledge-based society, and ICT will be a key enabling factor to cope with the new strains on our education system. Recently TNO, the Dutch Organisation for Applied Scientific Research, experimented with different existing ICT technologies in a real-life primary classroom. Our ICT for education project had four main objectives. First, we wanted to investigate how we can tweak existing technologies to make them useful within an educational context. Second, we wanted to research the willingness of children to embrace ICT tools within their learning process. Third, we wanted to test whether it is feasible to develop ICT tools for education through participative research. And finally, we wanted the input from school management on practical ICT innovations in education. Our workshop consisted of six different educational activities. In this paper we describe these activities, as well as the feedback from the children, teacher and school director and we list the conditions for success for such a workshop. After discussing relevant follow-up activities we put the results of the workshop in a broader context.

Keywords - ICT, games, mathematics, primary school.

1 INTRODUCTION

Education is a key ingredient of any knowledge-based society, and ICT will be a key enabling factor to cope with the new strains on our education system [1]. In fact, it would be hard to imagine a future of education without some sort of ICT, at the forefront or in the background. [2]. Unsurprisingly, policy makers, publishers and schools have been discussing the integration of ICT within an educational context for a long time. Although ICT hardware and infrastructure has been put in place in the Netherlands and other Western countries, usage of hardware and the availability of sufficient digital educational resources have been disappointing [3] [4]. There are many factors that have led to this outcome such as a lack of didactical models and teacher support [5]. What has received less attention is the potential of various existing ICT technologies for education. As TNO is an applied science organization, we decided to experiment with different existing ICT technologies in a real-life primary classroom. The class consisted of 34 children in the age of 9 and 10. Our ICT for education project had four main objectives. First, we wanted to investigate how we can tweak existing technologies to make them useful within an educational context. Second, we wanted to research the willingness of children to embrace ICT tools within their learning process. Third, we wanted to test whether it is feasible to develop ICT tools for education through participative research. In other words, we wanted to have the children participate not only in using different ICT technologies, but also in coming up with alternative educational uses for them. And finally, we wanted the input from school management on practical ICT innovations in education.

2 DESCRIPTION OF THE WORKSHOP

After a short introduction on the purposes of this project to the children and teacher, the workshop started. The workshop consisted of six different educational activities in which existing ICT technologies were used. The following paragraphs describe these activities:

2.1 Magic with numbers I

This first activity simply used a computer, beamer and PowerPoint. The activity was based upon a simple mathematical principle. Children were asked to take any integer that consists of two digits. Next they had to sum these two digits and subtract the resulting number from the original number. The resulting number is always divisible by 9. As an example, consider 43. Now, 43 – (4 + 3) = 36, which obviously is divisible by 9. We did not disclose this principle to the children. Instead, they were challenged to pick any integer of two digits, yet lower than 20, and sum these two digits and subtract the resulting number from the original number. We told the children to memorise the resulting number. Then we offered them a PowerPoint slide (see Figure 1) and instructed them to concentrate on the picture next to their resulting number.
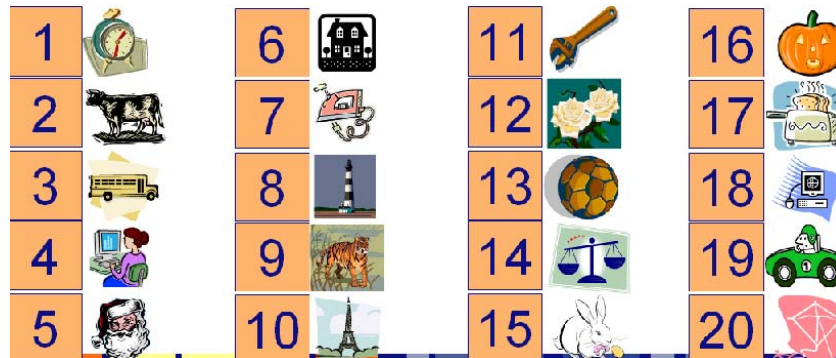

Figure 1: Numbers, with pictures next to it, shown to the children

On the following slide, we showed them a large picture of the tiger next to the number 9. Of course, every child that performed the proper calculation, had the picture of the tiger in his mind. We played this game with the class only once. For further reference, an excellent implementation of this mathematical magic can be found in [6].

2.2 Magic with numbers II

For the second activity we used a simple web interface to do some more magic with numbers. First, the class is asked through the web interface, see Figure 2 (a), to throw an enormous real-life dice.
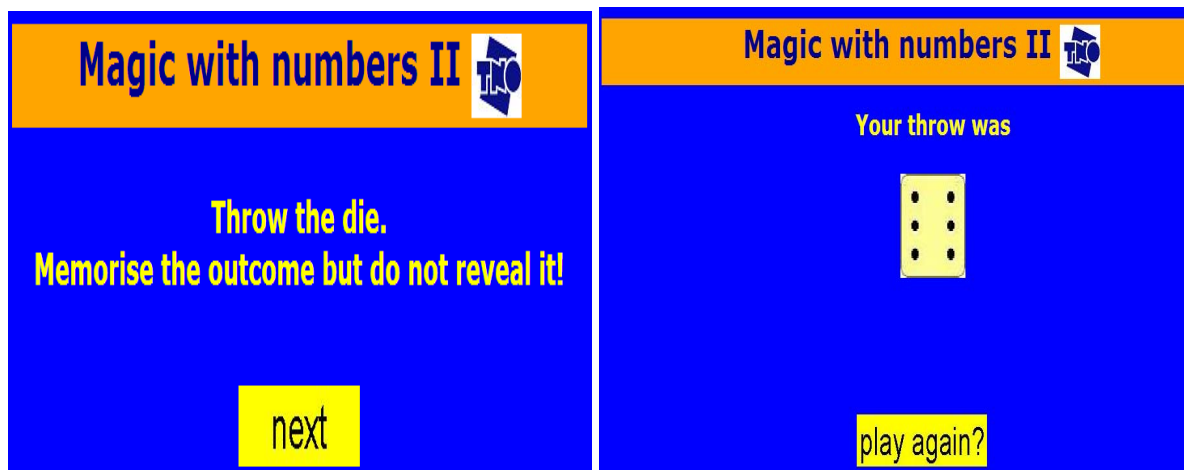
(a)   (b)

Figure 2: Web interface for Magic with numbers II: (a) start up screen; (b) final screen

Next the children were asked to multiply the outcome with 2, then add 5 and finally multiply that result with 5. The children had to tell their results to the group, which were then fed into a text field in the web interface. For example, if the throw was 6, then the computation leads to (2***6** + 5)*5 = **85**. After clicking the calculate button the web page shows the outcome of the dice roll, see Figure 2 (b). The class played this game twice.

2.3 Quiz

The third activity was a quiz. Using a wireless Interactive Response System, the children had to answer multiple-choice questions on subjects that were recently covered by the teacher. The Response System consists of ResponseCard RF keypads and a receiver, see Figure 3.

Figure 3: ResponseCard keypad and receiver

In addition, this activity required a plug-in to PowerPoint. This plug-in came with the ResponseCard hardware. We handed out a keypad to each pupil. Because each keypad has a unique ID, we could match each keypad with a specific pupil. This allowed us to track the score of each pupil, when responding to the questions in the quiz.

The questions were compiled by a group of three pupils from the class. To let the class get used to the system we also added 10 ice-breaker questions such as "How old are you?" and "Do you play an instrument". After this warm-up phase the real quiz started, which contained 18 questions. The questions were displayed in PowerPoint, see Figure 4 (a).
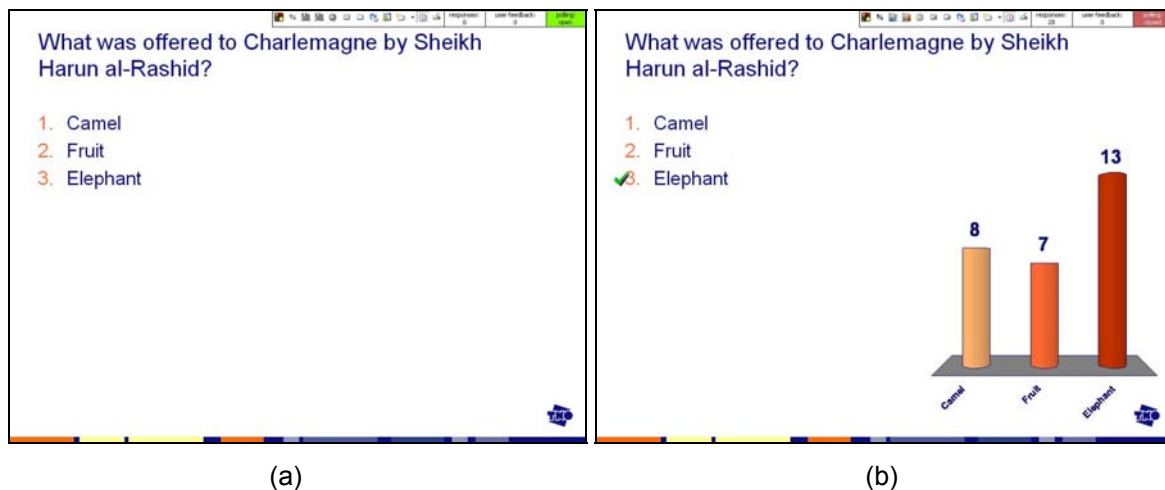

(a)

(b)

Figure 4: Interactive Powerpoint slide: (a) multiple choice question: (b) answer and responses

After all responses were collected, the system showed the correct answer and also the responses to the question, see Figure 4 (b).

After every five questions we showed the best scoring pupils. After all questions were posed we showed the five pupils with the highest scores. In our case the highest performing pupil obtained a score of 17 out of 18. The system also allows for comparisons between groups, for instance "girls" versus "boys".

For the following three activities, we split the class into two groups of approximately 17 pupils each.

2.4 Dance pad

For this activity we used a dance pad (see Figure 5) as an interface to a computer game. Usually the dance pads are used to play dance related games, such as Dance Dance Revolution, see [7]. We believe that dance pads are also suitable as an interface for educational games. In this activity we let the children play the simple game of Arkanoid, that only requires the use of the left-arrow ($\leftarrow$) and right-arrow key ($\rightarrow$). Because these "keys" also appear on the dance pad, it was immediately clear to the children how to play the game.
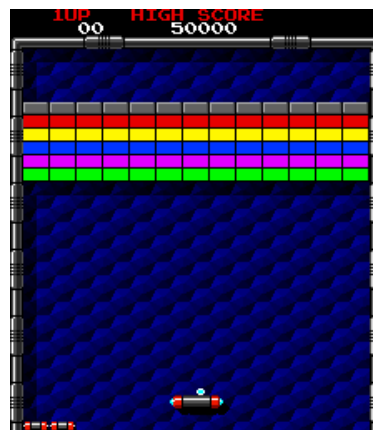

Figure 5: Dance pad

Figure 6: Arkanoid screen shot

In Arkanoid the player controls the "Vaus", a space vessel that acts as the game's "paddle" which prevents a ball from falling from the playing field, attempting to bounce it against a number of bricks. The ball striking a brick causes the brick to disappear. When all the bricks are gone, the player goes to the next level, where another pattern of bricks appear. A screen shot of the game is depicted in Figure 6. Although Arkanoid is not a educational game per se, we did demonstrate that dance pads can serve as an intuitive interface to the computer.

2.5 Labyrinth

This activity is built around the game Labyrinth, see Figure 7, which was developed by 123-game [8].
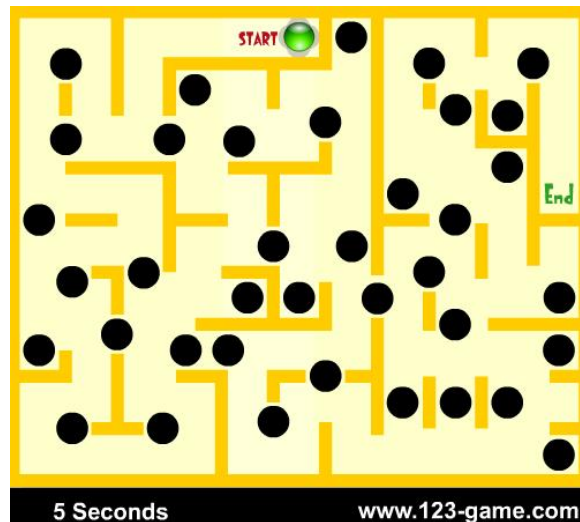
Figure 7: Labyrinth game

The aim of the game is to navigate the ball to the end of the labyrinth, using the arrow keys. The challenge is to prevent the ball from falling in a black hole while manoeuvring the ball through the labyrinth. When the ball falls in a black hole the ball is placed at the starting position again.

We let pairs of children play the game. The game was implemented in Flash. Two SonyEricsson mobile phones that were running the HID protocol [9] were used for controls. This protocol allows the mobile phones to function as a keyboard, through a wireless Bluetooth connection to the computer. We made one phone responsible for the movement of the ball to the left and to the right, see Figure 8.

Figure 8: Left- and right-arrow keys on mobile phone

Pushing the key on the phone that corresponds to the left arrow (←) makes the ball move to the left. We prepared the other phone to make the ball move either in the upward or downward direction. So in addition to completing the task of manoeuvring the ball through the labyrinth, the children had to collaborate in pairs. Each pair of children was allowed three runs of the game. The most succesful pair omanaged to navigate the ball to the 11th black hole.

2.6   Interactive Whiteboard Game

The last activity of the workshop was a game of Touch-In-Time that was developed for an interactive whiteboard. We developed the game ourselves for this workshop. The gameplay of Touch-In-Time is as follows. First the player enters his/her name and then, after the player has hit the start button, a

square (of random colour) of 100x100 pixels appears at a random location on the screen. The player has to touch the square within 2 seconds. If the player succeeds then he/she scores a point and a new square appears at another random spot on the interactive whiteboard. Now the player has 2*0.9 seconds to click the square. Whenever the player hits the square in time, a point is added to the score and another square appears but the allowed reaction time is reduced by multiplying the previous reaction time by 0.9. The game stops if a player fails to hit a square in time. After this, the acquired points are displayed, together with the 10 highest scores of other players. Figure 9 shows a typical screenshot after single games by three players.

Figure 9: Score list of Touch-in-Time after three single games

The game was implemented in HTML. The game can also be played on a PC, using the mouse to touch the squares. In this instance, we used an interactive whiteboard to play Touch-in-Time. Thus the player stands in front of the interactive whiteboard and taps on the square with his/her fingers. Every child got the opportunity to play the game twice. Figure 10 shows an impression of a pupil playing Touch-in-Time.
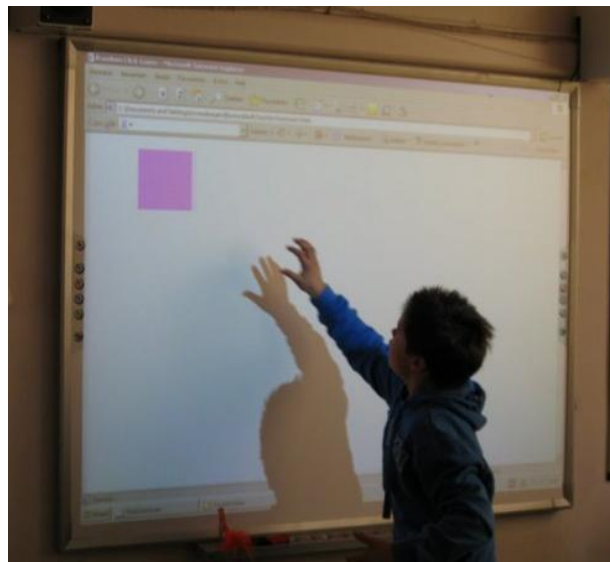

Figure 10: A pupil, in full concentration, playing Touch-in-Time

3 FEEDBACK

3.1 Children

Before the workshop started we asked the children what their expectations were. Words that were used were "dull" and "complicated". Afterwards the children expressed that they really enjoyed the workshop. Interestingly enough, children spontaneously gave feedback during the different activities of the workshop. Especially during the interactive whiteboard game, children started to come up with concepts for the Touch-in-Time application. Children almost 'co-created' further applications / uses of the game, and gave suggestions for what and how features of the game could be adapted.

On the whole, the children indicated that they learned a lot during the workshop. For instance, that you can learn using a computer and move at the same time. We also asked the children to rank the six applications that were used during the workshop. The Interactive Response System received the highest ranking because of the numerous potential applications (arithmetic, geography, insight in words structure, and in general every exercise with questions/answers). Pupils also noted the ease of usage of the system and the immediate outcomes. And for the teacher, the benefit in the eyes of the children was less work in grading tests.

The dance pad was the least interesting activity: it was deemed as too limited for developing further applications.

As far as ICT literacy is concerned, we saw sometimes great differences between pupils. This was especially apparent with the dance pad: children who play regularly with the Wii Fit Balance Board were immediately comfortable using the dance pad, whereas children that lacked this experience needed more time to get acquainted to the dance pad. It did not seem to stop them however, or cause embarrassment.

In the week following the workshop, the teacher organised an evaluation session during which the feedback was discussed. As one child said: 'Maybe I have seen how my grand-children will be taught!'

3.2 Teacher

The teacher was very enthusiastic about the workshop. She perceived benefits both for the children as for herself in the role of teacher.. The teacher stated that the children were engaged and challenged throughout the entire morning. The contact between the workshop organisers and the children was deemded very important, especially in the level of language used (not too complicated). Also addressing the children by their first names in the activitities were beneficial for the process.

The teacher does not regard herself as technology savvy, but does what she can and tries to learn more incrementally. Before the first smartboard was installed at het school, she was very sceptical about its benefits for her classroom practice. After the first morning of using it, she was already much more enthousiastic. Now that she has more experience with the interactive whiteboard, she discovered the its advantage, especially interactivity and the volume of available content. She cannot do everything with it, but she believes (and she hopes!) that she is not too old yet to learn. As her technological knowledge is limited, she finds it difficult to come up with potential uses.

The teacher had worked already with the Interactive Response System during a training. If such systems become cheaper in the future, she sees great potential for such tools for education. Similar to the assessment of the children, the teacher indicated that the dance pad was the activity with the least potential. During the dance pad game, as well as the interactive whiteboard game, the teacher made the observation that almost all children were much stronger with the right side of their bodies than with the left side. Some children made even the remark that the left side of the pad did not work. This opens up great possibilities for using these tools for Motoric Remedial Teaching purposes.

The workshop made the teacher very enthusiastic about the usage of ICT usage within education. Before the workshop, she had not realised that ICT could be such stimulating and powerful educational means. According to her, education and the educational process can improve using ICT.

3.3 School director

The school director made a more strategic assessment of the workshop. According to him, the workshop demonstrated that children are very much capable in determining their own learning needs. Also the way to address these learning needs – the so-called learning routes – were something pupils could determine for themselves. He further stressed that the workshop revealed that children love to learn in activities that do not have the label 'learning' attached to them. In other words, kids like to learn naturally. As an example, one of the students understood the math strategy of the computer and used that strategy to come up with answers to tasks herself.

Another observation was that children have become very able multi-taskers, whereas schools still believe that pupils have to work at one task at a time. Learning methodologies stress focus on structure and concentration. The school director pointed to the difference between an average school book and an average website that is designed for children. Apparently kids are most capable at using websites that seem very 'busy' for older generations. The educational sector should change to facilitate this new generation that has grown up with ICT. Going forward, the problem is how to use ICT experience in the classroom practice of everyday. It is clear to the school director that they need to do something with ICT, but how and what is still unclear. He indicated that this is not something that a primary school can do on its own.

4   CONDITIONS FOR SUCCESS

The success of implementing ICT technologies in the classroom depends on a variety of factors:

- The presence of hardware present at school (computers, interactive whiteboards),
- Openness/enthusiasm of teachers and school management for ICT usage,
- Availability of innovative, engaging and pedagogically sound content
- Willingness by teachers and school management to work with third parties
- Providing a fail free environment for pupils to work with ICT technologies.

5   NEXT STEPS

Next to repeating a similar workshop at other primary schools, we want to conduct a longitudinal study in which we test various educational tools over prolonged periods of time, preferably in multiple classrooms. Furthermore, we will place our efforts in this field in a broader context by cooperating with third parties such as the Kennisnet Foundation (a public organization in the Netherlands that facilitates and supports ICT in education).

This research fits into a TNO programme on future ICT use in the field of new learning environments (so-called learning spaces). Within this program, the design and practical use of future ICT technologies for education are researched, as well as the implications of ICT on future learning processes. Besides other domains, and also in education, ICT is considered to be a driver and an enabler of major change. The focus of the 2009 programme is life-long learning through collaborative and collective interaction in virtual worlds (including 3D learning environments). The perspective is not the technology itself, but rather the individual learner and the learning processes in which he or she engages.. One of the central research questions in this programme is how ICT will initiate and change learning through new ways of interaction, in particular in virtual environments (such as Second Life). The outcome of the research draws on practical experiments in which teachers and students "participate".

6   DISCUSSION

When we look at this workshop in a broader context, some observations can be made:

- The relatively small scale makes it difficult to draw conclusions based on a representative data set. Therefore, as listed in the next steps section, we want to repeat this workshop, preferably in a longitudinal study.

- More insight into didactical aspects of the usage of ICT in an educational context is required. Although the pupils, teacher and school director are all enthusiastic about the technologies that we used, we do not know if there were educational benefits. Didactical insights could help us in the development of new technologies and uses for them, but also can help to assess whether interventions based on ICT lead to results in terms of attaining educational goals.

- It was quite clear from this workshop that informal learning is something that children enjoy. Rather than having formal 'learning moments', informal learning takes place within a larger context. The learning itself is less apparent [10]. For instance, all children learn language long before they go to school. The observation of the school director that children love to learn in activities that do not have the label 'learning' attached to them further demonstrates this point. More research into informal learning is required, as it raises lots of questions regarding assessment of learners, integration within a classroom setting etc.

- Education is moving towards more personalized, learner centric processes [11]. In our project we mostly focused on communal cooperative applications. The balance between collective and individual activities, and how to deal with these within a classroom setting, require further thinking.

- Policy makers will have to find new ways to help smaller educational institutions to adopt ICT technologies. For instance, technological developments are moving forward rapidly that investing in one technology runs the risks of the technology becoming obsolete. Also, technical and didactical support is often not available, and small schools do not have the resources to pay for these themselves.

- The availability of high quality, affordable digital educational resources is still a bottleneck [12]. We have demonstrated that with relatively simple tools, interesting new initiatives can be developed. We hope that this inspires the educational community, publishers and public organizations to do the same.

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