New Educational Environments: TechnoMuseum, Discovering the Use of the Technology

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Abstract. Experimentation is at the core of the educational process. Learners must actively construct knowledge by drawing it out of meaningful experiences. In this sense, we present the TechnoMuseum project, an interactive educational initiative with a double purpose: to help create a technological culture and to show the important role that technology can play helping disabled people in their daily lives. These objectives will be achieved thought the interaction with technological devices in a museum context. The project is aimed at the general public, but with particular attention to school students. Two interactive prototypes have been developed so far: a device to support the teaching-learning process of the Braille alphabet and an assistive device for dependent people. They are available to be used by the visitors of the museum. The preliminary results are promising since visitors feel that they can experience firsthand how the technology may contribute to facilitate the lives of disabled people.

1 Introduction

Interactive activities have been shown as an effective method for supporting the learning process. In fact, due to their practical experience with interactivity, schools and museums can assert that understanding is gradually built up, step-by-step, through active involvement [1]. This reinforces the constructivist learning approach, which argues that learners must actively "construct" knowledge by drawing it out of experiences that have meaning and importance to them [1, 2].

Most authors have attempted to define the concept of interactive learning. In the context of the sciences of learning, this concept can be defined as a process involving some form of digitally enabled reciprocal action between a teacher or designer and a learner [3]. *Sessoms* [4] asserts that interactive learning means that students are active participants in the learning process.

But interactive learning is closely related to learning from experimentation. In this sense, learning from experimentation can be seen as a cycle rather than a sequence of events with a beginning and an end. Generally speaking, a cycle of experimentation might involve testing an idea, gathering data, distilling results into key lessons, and

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then adapting as needed for the next iteration, thus beginning a new cycle of experimentation [5].

This approach puts experimentation at the heart of the educational process. In this context, we present the *TechnoMuseum* project; an interactive experience with two main educational objectives:

1. To help create a technological culture among the general public, but with particular attention to the younger students.
2. To show the important role that technology can play helping disabled people in their daily lives.

These two objectives will be achieved thought the interaction with technological devices in a museum context.

The rest of this paper is organized as follows: section 2 presents the *TechnoMuseum* project, section 3 shows the interactive prototypes developed so far, and finally section 4 draws some initial conclusions.

2 TechnoMuseum Project

The *TechnoMuseum* project brings together Spanish schools (*Colexio Karbo* [6]), universities (*The National Distance Education University* – UNED [7], *University of Zaragoza* [8]), and institutions (*National Museum of Science and Technology* – MUNCYT [9]) to show how the technology can be applied to many different assistive fields. This project is based at the MUNCYT, La Coruña, Spain. This museum was opened in May 2012 with the objective of promoting the scientific and technological education. This scenario allows experiments to be accessible to the general public [10], supporting the dissemination of this initiative.

Within the *TechnoMuseum* project, several technological prototypes are being developed. The following principles have been applied in the design of these devices:

1. *The Prototypes should be Interactive:* Visitors should be able to not only observe them, but also have a physical interaction.
2. *The Prototypes should have a Social Purpose*: They should be aimed at people with special needs, older people, etc.
3. *The Prototypes should be Adapted to be Exhibited in a Museum*: This requisite has accessibility, usability and understandability implications.

Additionally, this project also involves conducting practical demonstrations that simulate the real-world operation of the prototypes. The rationale behind the selection of these guidelines is that visitors can have fun while learning about science and technology. They may try to find out what is the secret behind [11, 12], sowing the seeds of future professional in this field. In this sense, the next section presents the first prototypes that have been exhibited in the MUNCYT.

3 First Prototypes

As a first stage of the *TechnoMuseum* project, we have developed two preliminary prototypes:

1. Device to support the teaching-learning process of the Braille alphabet
2. Assistive device for dependent people

Both prototypes have been designed with the same objective: to show the potential of the technology to assist disabled people.

3.1 Device to Support the Teaching-learning Process of the Braille Alphabet

This prototype aims to show how the technology can help blind people to learn the Braille alphabet.

The idea of designing a device to support the teaching-learning process of the Braille alphabet came from some teachers working with blind children. They contacted the *EduQTech group* [13] to obtain technological support for this specific point. Although the initial idea was to develop a device intended only for blind children, we thought that it may also be useful for adults who had lost vision due to illness or an accident.

But it was possible to go even further. It would be a good exercise to face children without vision problems to learn the Braille alphabet, so that they could experience firsthand the barriers that blind users encounter. In this sense, this prototype meets perfectly the main objective of the *TechnoMuseum* project.

Its inclusion in the project has a double purpose: on the one hand, the potential of the technology to help disabled people is shown; on the other hand, we contribute to raise awareness of the specific needs of blind people. In fact, we enable visitors to have a first contact with the learning process of the Braille alphabet (most of them do not even know of its existence). This is made using a technological device with an attractive way of operating, with the objective of catching the attention of the younger audience. Figure 1 shows a photograph of the prototype.

An information panel is placed next to the prototype, showing the correspondence between the Braille and alphanumeric alphabets. It also includes a graphical description of the operation of the prototype. Since it has been designed to be intuitive, visitors can use it without any external supervision.

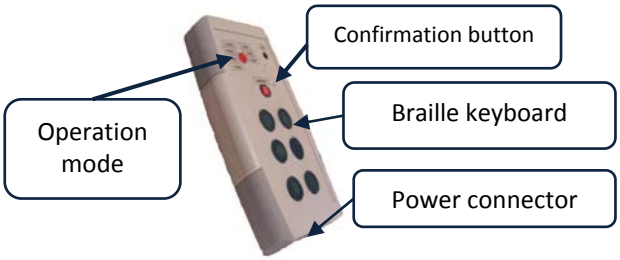

Fig. 1. Device to support the teaching-learning process of the Braille alphabet.

The prototype can operate in 5 different modes. Each operation mode is intended to reinforce a specific group of characters. First of all, visitors have to select the operation mode using the top button of the device (figure 1). Then, the prototype plays a sound that is nothing more than a voice saying one of the alphanumeric characters

randomly selected. Visitors have to type the corresponding Braille characters using the keyboard of the device. Once done, they are asked to press the confirmation button. If the code has been correctly typed a positive reinforcement is provided. It consists of a funny acoustic message congratulating the user. In case the code was wrong, visitors can hear a voice encouraging them to try again.

3.2 Assistive Device for Dependent People

The second prototype developed within the *TechnoMuseum* project aims to show how the technology can help people with cognitive decline to carry out daily activities. It is a simplified version of a real-world system that is currently being used by some groups of dependent people. In this sense, an adapted museum version has been developed with the objective of making the system understandable for the general public. Our idea is that people visiting the museum can put themselves in the shoes of the two main actors of the real system: the dependent user to whom the technological device is directed and his or her caregiver. Figure 2 shows the general schema of the system. Specifically, the demonstrator presented is focused on two functions:

1. *Location*: It aims to show how dependent people can be located in case they get lost. Additionally, the demonstrator enables visitors to act as caregivers by setting security areas where the person is supposed to stay. If he or she is outside, an alert is sent to both the dependent user and his or her associated caregiver.
2. *Reminders*: The demonstrator allows simulating a reminder module. Caregivers can set up personalized alerts that dependent people receive in an automatic way.

   The demonstrator developed comprises two different parts:

   1. *An interactive touchscreen*: It is the core of the prototype. Its objective is to guide visitors through the demonstration of the system operation. When interacting with the touchscreen, visitors are requested to assume mainly the role of caregiver.
   2. *An interactive mobile-phone application*: In a real-world scenario, the mobile phone would be carried by a dependent user. The operation of this device is conditioned by the actions carried out on the touchscreen, so it should be considered as a complementary part of the demonstrator.

The interface of the prototype has been designed to be self-explicative, visual, attractive, intuitive and extremely simple to use. For that, there is a high prevalence of pictures and photographs. The text is used only for clarification purposes, but it is not essential to understand the operation of the prototype.

When visitors have the first contact with the system, they are asked to assume the role of caregiver. This is consistent with the real operation of the system: firstly, caregivers configure the settings, and then, the mobile phones provide the required assistance to the dependent users according to the given instructions.

This first contact is made through the touchscreen. A home screen with two options (location and reminder) is displayed. Next, visitors have to select one of them.

If they choose the location function (figure 3), a visual explanation of its operation is first provided. The interaction starts with the definition of a new security area. Visitors can graphically define the limits of the area by clicking with one of their fingers in

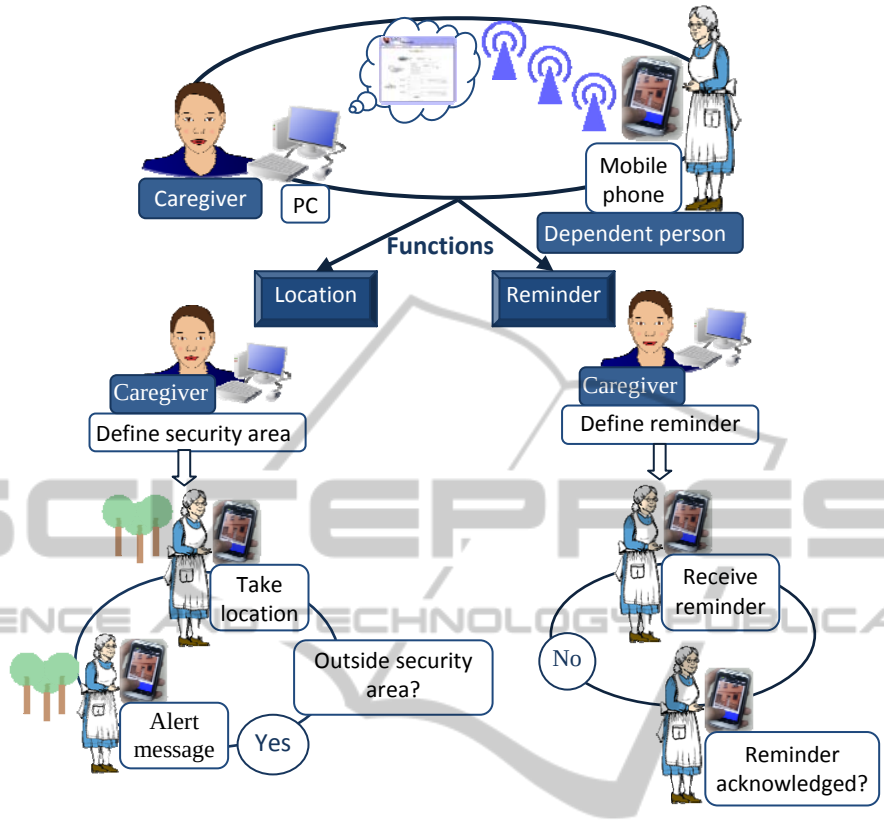

Fig. 2. General schema of the system to assist dependent people.

a map displayed in the touchscreen. Once the area is defined, they are asked to change of role. Now, they should get into the skin of a dependent user. In this sense, the next step is to indicate on a map the place where they are supposed to stay. Once done, a countdown timer appears showing the time left until feedback is provided to the mobile phone of the dependent user. When the timer expires, the mobile phone displays an alert message. It can be of two types: an off-route message if the user is outside the security area, or a positive reinforcement message if he or she is inside. With regard to the message format, a colorful image and a comic audio are simultaneously displayed in order to catch the attention of the visitors.

During this process, feedback is provided in the touchscreen in order to keep visitors active. Some of the explicative screens of the location function are shown in figure 3.

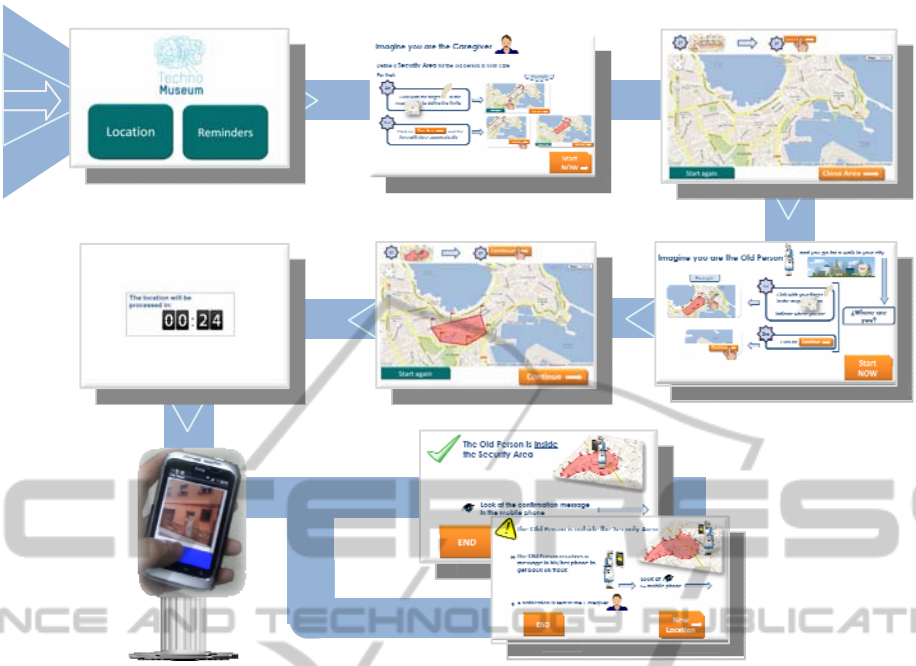

Fig. 3. Explicative screens of the location function of the prototype to assist dependent people.

Additionally, visitors can also choose to test the reminder function. Similar to the previous case, a brief description of the function is provided to add some context. Then, visitors are asked to assume the role of caregiver and define the type of reminder to be sent. In order to improve the understandability of the prototype, we thought that it would be desirable to restrict the number of possible reminders to 4, since the system would be easier to handle without losing generality. Therefore, visitors can choose among the following reminders: it's time to take the medicine, it's time to make dinner, it's time to go home, it's time to go to the doctor.

They can also select whether to display an image or a personalized text together with an acoustic alert.

Once the reminder format has been selected, a countdown timer is displayed again with the time remaining before the message is processed. When the phone receives the message, it is automatically shown. At this point, visitors are requested to assume the role of a dependent user who has just received the message. They have two options:

1. *To Acknowledge the Receipt of the Reminder by Clicking on the Phone Screen*: The message is immediately removed from the phone screen. Additionally, the touchscreen displays a visual notification informing of its receipt.
2. *To Ignore the Reminder*: If no acknowledgment is received the reminder will be sent back in 40 seconds. In this case, the touchscreen shows another countedown timer indicating the time left. This will be repeated twice. If, during this period, no acknowledge is received, the touchscreen shows a notification reporting on the absence of confirmation.

4 Conclusions

In this paper, we have presented the *TechnoMuseum* project a cooperative experience to bring technology to the general public, but especially to school, high school and undergraduate students of all branches. This project aims to show the potential of the technology to assist disabled people. As an example, we have presented two interactive prototypes that are currently available to be used.

This project has a clear pedagogical purpose. The prototypes presented are museum versions of actual technological systems. Visitors are reported on this fact when they start interacting with the demonstrators: they are told that real users with real needs are using the extended versions of those prototypes. We found that a high level of motivation was essential to be able to assume the role of real users successfully.

However, the adaptation of real systems to the specific characteristics of the museums is a challenging task, although essential to avoid prototype rejection. In this sense, the use of the real prototypes for informative and educational purposes would be inappropriate. Visitors cannot be asked to use a technological device that requires a long training period (hours). This would result in a lack of use of the demonstrators, especially among the youngest students since they usually visit the museum in groups under the teachers' supervision. Therefore demonstrators should be designed to guarantee that each visitor can interact with them, even if they come in group.

It is important to highlight that the implementation of a demonstrator faces the same issues and challenges as any other technological device. In the design stage, all possible use cases must be considered. Specifically, since the *TechnoMuseum* prototypes target the general public, they must be extremely easy to handle.

But *TechnoMuseum* is primarily an educational project. Although it does not target a specific group of people, this project may be of particular interest to school students. It can help achieve some of the basic skills that students are supposed to have at the end of their formal schooling [14]. This project requires students to be in a technological museum far from the usual academic environment. This place is much more conducive to arouse curiosity about the technology, allowing physical contact with assistive devices. During the preliminary tests, we realized that most of the students associated the concept of technology with leisure and recreation, but its use for assistive purposes was far less clear. In this sense, the *TechnoMuseum* project can help raise public awareness about the potential of the technology, clarifying some existing misconceptions. Additionally, it stimulates the creation of a social conscience, since users can experience firsthand the problems that disabled people encounter in their daily lives.

The *TechnoMuseum* project is still in its first stages. The preliminary results are promising, but there are some remaining research efforts. Although two prototypes have been successfully implemented, this number is still far from the final objective of the project. In this sense, we have evaluated the possibility of including remote laboratories [15], so visitors could experience the sensation of being in a real research environment. Additionally, two other prototypes are currently being developed, in this case in the field of robotics. They may have a great potential to catch the visitors' attention [16]. The work will be completed with practical activities aimed at students,

parents, teachers and anyone interested in the use of the technology as an assistive tool.

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