SpyCam and RoboCam: An Application of the Future Technology Workshop Method to the Design of New Technology for Children

Giasemi N Vavoula, Mike Sharples, James Cross, Chris Baber
University of Birmingham, UK
g.vavoula@bham.ac.uk, m.sharples@bham.ac.uk,
crossjw@eee-fs7.bham.ac.uk, c.baber@bham.ac.uk

Abstract

The Future Technology Workshop is a method for the design of future socio-technical systems. It builds upon existing participatory design techniques and provides a way of exploring the interactions between technologies and activities, now and in the future. The method has been applied to the design of future imaging technologies for children. Prototypes of such technologies have been produced and tested with children. The paper describes the method and its application in this design exercise.

1 Introduction

There are various methods for encouraging participation in design, many stemming from Scandinavian research. In general, these approaches encourage brainstorming, storyboarding of concepts based on current experiences, design templates, and role-play. (Druin, 1999a, 1999b; Druin et al., 1999) has developed methods for including children in the design process as legitimate design partners. In outline, the methods are based around participatory envisioning, contextual inquiry (Beyer & Holtzblatt, 1997), and lab-like observations. The children are observed in their normal environments, or in specially constructed labs that are technology rich, or are given various materials to construct a product and asked to explain how it is used. (Inkpen, 1999) has explored the design of handheld devices for children. Her methods have included (a) the administration of a questionnaire, from which she gathered information on children's general requirements for handheld computers, (b) a participatory design exercise where children worked in groups of 2-4 to produce lowtech prototypes of the handheld computers they would like to have, and (c) a diary exercise where children had to report the places where they would want to use a handheld computer and the activities for which they would like to use it. (Scaife & Rogers, 1999) worked with children as informants at various stages of the process of designing an educational software system for the teaching of basic ecology concepts. The children's role was primarily concerned with refining the user interface, whereas the decision of what technology to design was suggested by the curriculum.

The methods and techniques described above focus on children constructing and acting with objects, and encourage them to lead design. However, design is grounded in current experiences, which may constrain the children's designs, with the danger of missing more radical design opportunities. As (Inkpen, 1999) notes, "while this activity was successful in identifying important issues for the design of handheld computers, many of the children were constrained by their preconceived notions about what constitutes a computer and the functionality it can provide". Therefore, a methodology that encourages users to postulate future uses of technology and provides a transition from current to future thinking could be beneficial for the creative design of new technologies.

The Future Technology Workshop (FTW) method is being developed to address these shortcomings. The method is intended to serve both as a process of "discount sociocognitive engineering" (Sharples et al., forthcoming) and a means of envisioning future technologies and technology-mediated activities. It is a method of "imagineering" – envisaging and designing human interactions with future technology.

A series of the FTW have been undertaken with children aged 10 to 13. The workshops led to design ideas that were subsequently transformed into working prototypes and fed into further iterations of the workshop. The remainder of this paper presents the results of this design exercise. Section 2 briefly presents the FTW method; section 3 describes the applications of the method and the prototypes; and section 4 concludes with a discussion of our experiences and plans for future research.

2 The Future Technology Workshop Method

The FTW consists of a creative exploration of the interaction between activities and technology, now and in the future. The interactions can be shown as a grid (see Table 1).

The four items in the grid are explored in turn during the workshop. The aim is to reach an informed understanding of item 4 – how, in the future, we might perform new activities enabled by new technologies. Unlike conventional systems design, the starting point is not item 1 of Table 1 above – current technology and activity – as this might anchor the process to the present and miss more innovative design opportunities. In contrast, the starting point is item 4, and the workshop then circles through 3, 1, 2, and back to 4. This is done through a series of seven workshop sessions. The sessions and their correspondence to the four items of Table 1 are shown in Table 2 below.

	CURRENT TECHNOLOGY	**FUTURE TECHNOLOGY**
CURRENT ACTIVITY	1. Everyday technology-mediated activity	2. Familiar activities supported by new technology
FUTURE ACTIVITY	3. New activities that current technology might support	4. New activities with new technologies

Table 1. Interactions between activities and technology, now and in the future

The seven workshop sessions are described in (Vavoula, Sharples, & Rudman, 2002). In brief, during the first three sessions the participants envisage and create designs for future technologies and activities. In particular, in the first session the facilitator primes the group with a question regarding the design task at hand, in a way that it limits the scope of the ideas while at the same time does not pre-empt them to think about current technologies, and a brainstorming follows. The purpose of the session is to set the scene and to get the participants to think in terms of the future, with respect to both the technology and the needs satisfied by it. In the second session (see fig. 1) the participants are divided into 2 or 3 groups and are provided with a set of low-tech prototyping materials, such as PlayDoh and collage kits to build a model based on ideas produced earlier. The purpose of the session is to set the participants to imagine the future and produce models of useful and meaningful technology. In the third session the groups exchange models and are asked to plot a scenario demonstrating how the model might be used, and enact it. The purpose of this session is to bring the future into the present, by getting participants to "act" as if future technologies were already there to support new activities, and also to have them engaged in the future activities and make their ideas of them more tangible.

Interactions / Sessions	**1. Everyday technology-mediated activity**	**2. Familiar activities supported by new technology**	**3. New activities that current technology might support**	**4. New activities with new technologies**
1. Imagineering				☑
2. Modelling				☑
3. Role-play				☑
4. Retrofit			☑	
5. Everyday	☑			
6. Futurefit		☑		
7. Requirements		☑		☑

Table 2. Correspondence of FTW sessions with technology-activity interactions

Figure 1. FTW participants at work

Session 4 explores new activities that current technology might support. The groups are asked to modify their scenarios so that they only use existing technologies to enact them. The purpose of the session is to bring the future into everyday life, getting the participants to think how the futuristic activities they have imagined so far might be adapted into their current lives. Session 5 explores everyday, technology-mediated activities. The whole team is shown photos of current technologies and existing gadgets relevant to the design task, and is asked to discuss their current activities in relation to this design task and to identify relevant problems and shortcomings of the existing technologies. The purpose of this session is to remind the participants of the things they currently do and the technologies they currently use, as well as to set them thinking about how existing practices could be improved. Session 6 explores how familiar activities might be supported by new technologies. The group is asked to look at the outcomes of session 5 and discuss how they think those activities will be performed in the future, in relation to the models they had built in the earlier sessions, and to modify their initial models to accommodate as many of the current activities as possible. The purpose of this session is to set the participants thinking about what sorts of future technologies will be used to support the activities they currently perform. The final session relates to how both current and future activities will be supported by future technologies. The whole workshop team is asked to produce a set of requirements for each model, and are then asked to rate the requirements based on their importance/appeal.

This process can be repeated over a series of half-day workshops (preferably at least two), so that when the participants revisit item 4 they have an enhanced insight into 'new activity' and 'new technology'. Ideally, the process leads to a 'spiral' of design ideas, with each revisit to item 4 building on and pushing forward earlier conceptions and prototypes.

The method has been found to be appropriate for use both with adults and children. When used with children, however, minor modifications might be necessary, mainly in adapting the terminology and language used in a way appropriate to the specific age group. For example, in the final session, rather than asking the children to list requirements for future technologies, we asked them to produce a list of "instructions for the engineers who are going to build the models". Otherwise, all the activities involved were easily attainable by children.

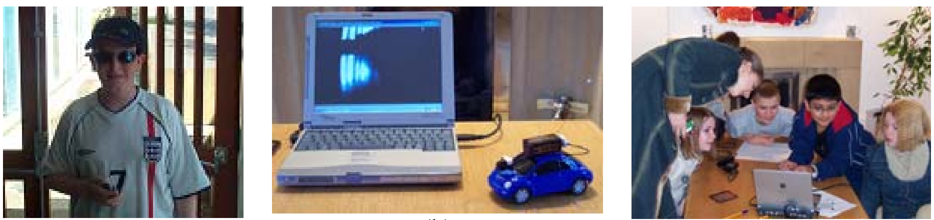
3 Applying FTW to the design of new imaging technologies for children

We have undertaken a series of four FTWs with children, aged 10-13, focusing on the design of new digital imaging technologies and activities. After the first two workshops, prototypes were built based on the common themes that appeared to be emerging. The final two workshops built upon these prototypes, taking the designs further. The prototypes were also tested independently of the workshops, with 32 children at a residential children's "education and adventure" centre. The remainder of this section presents the four workshops, the prototypes, and the results of the tests.

3.1 Initial FTWs, Prototypes, and Testing

The initial research that led to the conception of the method took place at a children's holiday camp. At that point, only the first two sessions were carried out. Six boys and six girls, aged approximately 11 years, participated. The concept of a 'spy camera' was a primary theme for the boys – to be able to send the camera off by remote control to capture images without being noticed, while being able to see the images on the screen of the remote controller. For the girls, a robot-type camera capable of a friend-type relationship was important. Reflections on the conduct of this exercise, and further piloting with adults, led to the full development of the method as it was applied in subsequent workshops.

The second children's workshop was carried out with six different children, three boys and three girls aged 11-12. The design task related to "capturing and sharing visual events". Again, spy cameras and independently mobile cameras were the main theme. The girls produced two models, one consisting of a spy camera operating through glasses that allow the user to secretly take photographs of anything they see, by pressing a disguised button on the glasses' frame. The second consisted of an independently mobile camera, that is intelligent enough to remember objects and people and knows where to find them, and can therefore be instructed to "go off and take a picture of my dog's basket". The boys produced a model of an amphibious camera that has the ability to propel itself safely in deep sea and take pictures of the bottom of the sea on behalf of its owner.



(a) (b) (c)

Figure 2. (a) the SpyCam, (b) the RoboCam, (c) children around the RoboCam control table

The common themes that emerged from the workshops are 'spy' cameras (miniature cameras hidden on the body that can capture everyday events, or relay the images to another person) and 'robot' cameras, where a camera is attached to another person, an animal or an object such as a remote control submarine, with the images viewed at a distance. As a consequence of these findings, we built a

"SpyCam" device that combined elements of both the spy and remote camera. The prototype consisted of an inexpensive wireless mini colour camera, mounted on a pair of sunglasses, which transmits a colour composite video signal to a Panasonic Toughbook computer that has a separate wireless-connected handheld screen. Thus, the camera and the view screen can be carried separately, each with a range of about 100 metres from the base-station. The quality of the video signal was variable, depending on range and interference, ranging from near-VHS video quality to flickering between colour and black and white. We used the SpyCam in two configurations. In the first, one child wore the glasses and another held the Toughbook screen. The child with the screen had a continuous transmission of what the other child was seeing, and could tap the screen at any time to capture a still frame. The children were able to communicate by voice through "walkie-talkie" handheld radios. This configuration exemplified the remotely controlled camera idea. In the second configuration, a child wore the glasses with the attached camera and also had a wireless remote control key-fob. A press of the key-fob's button sent a command to the Toughbook to take a picture. This configuration exemplified the spyglasses camera idea (see fig. 2a).

Different scenarios were tested for both configurations, with 32 children at a residential children's "education and activity" centre. We also carried out tests using two blindfolded treasure hunt games, designed to exploit the features of the SpyCam prototype. All sessions, including the treasure hunts and the subsequent interviews, were recorded on video.

The trials revealed that the children found no difficulty in operating the equipment. All the children gave very positive responses to the question of whether they enjoyed it:

"It was cool!" (Griffin, age 10)

"I had the power to do anything to him!" (Mark, age 12)

"Yes! It was really fun!" (Yasmin, age 11)

"It was just like, you didn't have to worry about holding it or nothing it was just, always on you and easy to use, because if you wanted to take a photo just tell them, just push the button" (Scott, age 13)

"It was just cool, being able to see what someone else saw" (Jamie, age 12)

"I liked that you could see what they were seeing instead of just seeing what you could... instead of just looking at them and trying to imagine what they could see" (Annie, age 11)

Their responses were also positive to the question of whether they would like to own a similar device:

"Yes, definitely!" (Mark, age 12)

"Yes, it's excellent!" (Nick, age 10)

"I would like to have the sunglasses and the hat, I think they are cool!" (Annie, age 11)

The children did not appear to be concerned by the poor quality of the captured images in this prototype or with the transmission problems. Although they did mention it as a problem during the interviews, while doing the task they did not seem frustrated. If they moved out of transmission distance, they patiently came back into range.

The children very rarely asked to see the pictures they had captured; they appeared more interested in the live transmission of video. This was verified during the interviews, where what seemed to impress them the most was the ability to see what someone else was seeing in real time, the ability to control where someone else goes, the need to trust someone's instructions on how to move and what to do, and the choice of whether to take a photograph or not.

3.2 Follow-up FTWs, Prototypes, and Testing

The third children's workshop was carried out with a different group of six children, again three boys and three girls. This workshop built on the outcomes of the previous ones, with the children being shown the prototypes and asked how they could be altered or improved. The design task therefore related to "capturing visual events remotely, without being noticed". Both the boys and girls group worked on spy-camera ideas such as cameras hidden in glasses and wrist watches, with the boys also producing the further idea of a 'remote landmark camera', a camera situated on a lamppost at some remote landmark and being able to transmit images to people who cannot visit the place.

The children in the third FTW seemed to converge on a design that includes a camera, which can attach to a number of different objects – sunglasses, wrist watches, etc. Our initial prototypes were therefore expanded to include, besides the SpyCam on the sunglasses, a RoboCam – a model car operated by remote control with the miniature camera mounted on top (see fig. 2b). The camera can easily be removed from the glasses frame and attached to the roof of the car, which the children can then operate by the remote control and receive the image from the camera on to a computer monitor or on a small-screen TV.

The new prototypes were tested with the same six children who participated in the second children's workshop, in the following two scenarios: The first scenario was, again, a blindfolded treasure hunt, where one child was blindfolded and wore the spyglasses and the other children were instructing her to wander around another room and collect clues. Six pieces of evidence were scattered around the room, one for each child to discover. The second scenario involved a collaborative mystery solving and made use of the RoboCam. Six pieces of paper containing key information about the mystery were put around a room different to the one where the children were, at floor level. One child was navigating the RoboCam through the remote control, and the other five children were watching the image sent by the RoboCam and instructing the navigator-child where to send the car (see fig. 2c).

The children enjoyed both scenarios and had no trouble in operating and making use of either the SpyCam or the RoboCam. As with the previous trials, shortcomings of the technology in terms of performance were not off-putting and the children were more interested in the live image than the captured still frames.

The same children then participated in the final children's workshop. They were asked to go through the workshop refining the designs and expanding the ideas of the RoboCam and the SpyCam. The imagineering session mainly produced a list of things on which the SpyCam could be mounted: briefcases, wristwatches, sunglasses, dog collars, model boats and many more.

4 Conclusions and Future Work

The SpyCam and RoboCam prototypes are now being developed further: We are looking at producing a base for the camera that can be fixed on different objects. For the task of designing new imaging technologies for children, the FTW method has proved a reasonable success.

The field studies thus far have shown that the Future Technology Workshop method can be successful as a means of rapidly generating and refining designs for new interactions between technology and activity. The FTW method has benefits over more traditional methods of product design and engineering, which include: the combination of creativity with practical design; the focus on interaction between activity and technology; the ease with which a FTW session can be run, at low cost, in one half-day; a clearly-defined set of activities within an easily-understood framework, the method is readily taught to other designers and engineers.

As part of the process of refining the method, we are planning to apply it to different design tasks. More specifically, it will be used in the design of new mobile learning technologies under the framework of the Mobilearn project (http://www.mobilearn.org/). Further work is needed in refining and documenting the "design, implement, deploy, evaluate, and redesign" cycle so that the FTW can become a practical tool for product and interaction designers.

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