

In Search of Tangible Magic

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ABSTRACT

This paper describes a small study of children's drawings in the context of tangible interaction. The study was intended to discover what children could draw that would indicate what they understood about tangible interactions.

Two different tangible interfaces were considered, and for each of these, a different reporting format was used. The children's drawings were coded by three researchers and the results aggregated.

The study shows that the coding method chosen was effective in conveying the information from the diagrams. The different reporting methods were similar but there was some evidence that one reporting format seemed to favour the inclusion of people in the drawings. Around a third of all the drawings conveyed information pertaining to user experience and in particular, expressions of tangible magic.

Categories and Subject Descriptors

H.5.2 User Interfaces: - Evaluation / Methodology

General Terms

Human Factors

Keywords

Drawing, Children, Evaluation, Reporting formats

1. INTRODUCTION

In recent years, there has been an enthusiastic interest in discovering how children can evaluate interactive products and in discovering new methods, and adaptations to old methods that can provide useful information for researchers and developers [1].

Methods that are known to work well with children include think aloud [2], peer tutoring [3], the fun toolkit [4], and the mission from mars method [5]. Some of these methods can only be used in specific contexts of use; think aloud is badly suited to collaborative play that includes children talking as they play, peer tutoring is difficult to apply with very easy to use interfaces, the fun toolkit, although used in many contexts, is limited due to its reliance on self report, and the mission from

mars method is better suited to early prototypes. Understandings of methods that can be used in tangible or physical environments are still uncertain.

The use of drawings with children is an area that has been studied for several years; initially children's drawings found great favour with psychologists who used them to interpret what children thought [6], more recently, drawings have been used to gather children's views of computer programmers [7], of school curricula and of computer technology [8]. An earlier study comparing different evaluation methods of Tangible User Interfaces, included the use of drawings [9].

Drawings are generally interpreted in one of two ways. They can be used to discover children's values and worth, typically by considering the size or position of objects in a drawing or by looking at the frequency of objects, or they can be used to find out what children know. In this context, the drawing is scrutinized for 'things' that convey understanding of a situation.

As an evaluation tool drawings can be advantageous because they can be produced by children who either may not be able to write proficiently (if at all) or may feel unsure of expressing themselves verbally to a researcher.

They may also capture some of the experience of the user in a way which may not be easily expressible in words.

2. TANGIBLE MAGIC

Tangible User Interfaces (TUIs) are interfaces that go beyond the traditional keyboard and mouse interface, and these are increasingly embedded into physical artefacts and merged into physical environments.

There are many tangible interfaces for children, for example, design concept 'Blok' [10] in Figure 1 is an interactive learning tool for the kindergarten classroom. Blok was designed as a result of working with children and watching them at play. The design won the Judge's Award 2007 at Microsoft® Next-Gen PC Design Competition.

Blok integrates a PC with a child's stool, some artefacts and a simplified keyboard mat. The 'stool' has a three-sided display which encourages children's collaboration. A child may regard toys and furniture as largely interchangeable objects in the serious work of play, but in the fascinating study of their design history [11], these everyday objects are revealed as vehicles for society's attitudes towards learning.

The educational potential of tangible technologies has been addressed by child educationists and psychologists [12] [13]. Price and Rogers described their approach for developing digitally augmented physical spaces, they claimed the major learning benefit of interacting in such spaces is that the technology facilitates both active and playful learning [13].

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Published by the British Computer Society

However, Marshall [14] suggested that tangibles may not have the putative benefits we would have expected, and that more grounded research is needed. He reviewed a range of literature and presented his analytic framework on tangibles for learning [15] which highlighted a few research perspectives. The main concern he had was the lack of theoretical, empirical and practical work in the area [14].



Figure 1 -Blok, a kindergarten classroom PC, by C. LeBlanc, J. Livingston and M. Goldberg [10].

The theory of Tangible Interaction for Children has recently been addressed by Alissa Antle who has presented the Child Tangible Interaction (CTI) framework [12]: a conceptual framework for the design of tangibles and interactive spaces for children from age four to twelve. The framework outlines five themes which include three mappings: perceptual, behavioural and semantic and two spaces: for action and for friends.

In studies of tangible interactions, one aspect that is often omitted is the extent to which the tangibility of the interface affects the interaction. The advantages of tangible interfaces are centred on the extra sensations associated with physical objects; we bring our existing knowledge and emotional responses from the world we live in to the interface in a more direct way than to non-tangible interfaces. There is something special about a well designed tangible interface that is difficult to theorise and hard to imagine. This ‘specialness’ is referred to in the work in this paper as ‘tangible magic’.

We consider there to be two components to this tangible magic. The first is simply the novelty of seeing objects that would normally be regarded as inanimate, doing unexpected things, such as controlling the behaviour of a program or responding intelligently. The second is the almost indefinable pleasure we receive in handling physical objects. The interaction of these two components comes together to produce the ‘magic’.

The clearest example of tangible magic in the study reported here was the use of a real paint brush to produce digital pictures on the wall. Both the researchers and the children were attracted to this interface in such a way that the set up was in constant use.

3. IN SEARCH OF TANGIBLE MAGIC

The study described here was intended to answer four questions:

1. Could the knowledge embodied in children’s drawings be coded easily and reliably?
2. Are there elements of interactions that children find easy and hard to convey?
3. How does the choice of reporting material affect what children draw after they have played with an interface?

4. Can the ‘magic’ of a tangible interaction and elements of the user experience be conveyed in a drawing?

3.1 Apparatus

Two tangible interfaces and two different reporting documents were created and used in this study.

The first interface was a competitive snakes and ladders game that used an RFID reader to read the score on a die that was thrown along a small cardboard runway. The die was around 10cm square. Children played the game by throwing the die and then moving their pieces on a tablet PC according to the number gained. The computer told the children what score the die had shown and told them where to move to on the board. The game was played in turns with up to four children being able to play at a time.

The second interface was a painting application that used RFID and touch sensors to create a painting interface for an interactive SMART board that used a standard paintbrush. The interface allowed children to pick colours from a cardboard palette, rinse their paint brush in water (not real!), change the paintbrush size, and mix colours. Children played the game on their own and created pictures on the screen.

For reporting, there were two methods chosen. The first (s) with a single drawing allowed the children freedom to simply draw what they wanted. For this a single sheet of blank A4 paper was used. The second (f) with four drawings, shown in Figure 2, was a divided A4 sheet with word prompts.

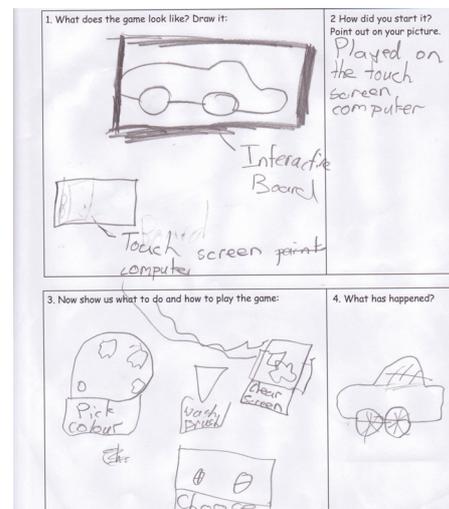


Figure 2 - An Example of an (f) drawing

These words used as prompts were:

- What does the game look like? Draw it
- How did you start it? Point it out on your picture
- Now show us what to do and how to play the game
- What has happened?

3.2 Participants

Children came to the study voluntarily in small groups of 3 or 4. The groups were not controlled for gender. The ten children in group A were aged between 8 and 9, those twelve children in group B were aged between 9 and 10. Group A completed the single sheet condition (s) and drew the snakes and ladders

game, group B completed the four square condition (f) and played the painting game.

3.3 Procedure

Children completed their drawings after they had played with the tangible interfaces. Group A and Group B both completed the drawings on different days. In each instance, the children were given paper and pencils and crayons and asked to draw what they had been using.

3.4 Analysis

Coding of the drawings followed the procedure outlined in [16]. Before the pictures were looked at, aspects that might be expected to be found in drawings of the two interfaces were discussed by two of the evaluators and an agreed list was created. The list was in two parts, the first part was a list that concerned the look of the interface, the second part was intended to capture some sense of the user experience, and, in particular the tangible magic.

The list used, with some examples, is shown in table 1 which also shows how each item was coded. For objects 1 through 5, a score of 0 or 1 was given – this depended on the existence of at least one piece of evidence to confirm that this object was represented in the drawing and is consistent with the method used in [16]. For the experience objects, the first, fun, was rated present or absent but the last two, ‘goal’ and ‘tangible magic’ were initially scored on a four point scale where 0 was ‘not evident’, 1 was ‘possibly evident’, 2 was ‘evident’ and 3 was ‘highly evident’. For the later analysis of these last two figures, the scores were normalized with the other data by dividing each score by three.

Table 1- The codes used in the Study

	Object	Example
L1	People	A person (1)
L2	Interaction	Wall, table (1)
L3	Input	Brush, die (1)
L4	Output	Picture on screen or image on tablet (1)
L5	Controls	Water, palette, size, runway, stylus (1)
E1	Fun	Smiling, words (1)
E2	Goal fit	Amount of user control – e.g. changing colours, size, rubbing out Amount of competition – e.g words, scores, happiness vs. sadness
E3	Tangible magic	Feel of the interface - Size of the brush, connectedness to the board Smartness of the interface – die on the reader

Once the coding method had been agreed, the drawings from both groups of children were brought together and divided into three sets (randomly). Each set was assigned to one coder who filled in a coding sheet for each drawing (and kept this until all the drawings had been seen) and then each set was passed to the next coder until all three coders had seen all the drawings

For each drawing, the three coding sheets were inspected for intercoder reliability and conflicts were resolved. An agreed score for each object for each drawing was derived using the following method – if all coders were in agreement that score

was used; if two were in agreement and one was 1 point out, the majority score was used; if (which only happened in the experience objects) each coder gave a different score but the scores were consecutive, the average was taken. In those (rare) cases where scores differed by 2 or more, the drawings were re-investigated and agreement quickly reached.

3.5 Results

The children all drew pictures that could be coded. Figure 3 shows the average ‘scores’ for the children’s drawings, an average of 1 implies that there was evidence of every object suggested by the coding scheme on the drawing.

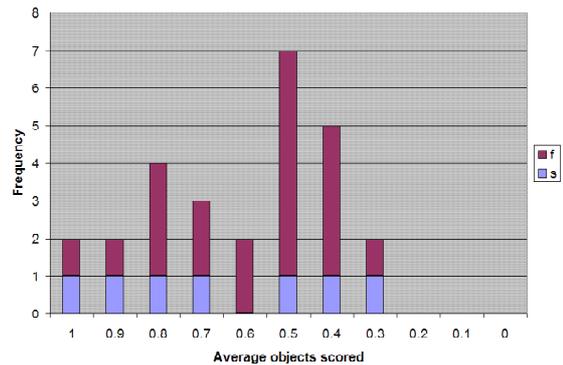


Figure 3 – The amount of information in the drawings

The average rating for each of the objects is shown in Figure 4 which also shows the different averages for the single sheet condition (shown first) and the four corners condition (shown second). An average of 1 indicates that every drawing in that condition included the object in question.

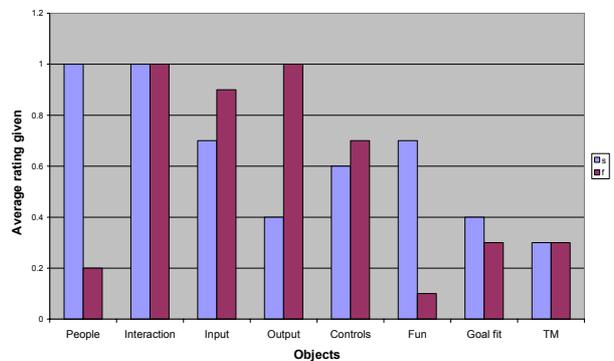


Figure 4 - The objects included in the drawings

4. DISCUSSION

The first point of discussion is in respect of the coding scheme. This was found to be both easy to create and easy to use and the intercoder variation was extremely small. There was more variation with the experience objects than with the interaction objects. Being able to design a scheme that could be used across two different tangible interactions was considered a success. Occasionally all coders had difficulty interpreting some elements in the pictures and it would probably be useful to add annotations to the pictures. These could be added to the drawings by researchers by asking clarification questions following the production of the drawings. Some children added their own annotations describing how tasks were accomplished. This highlighted the fact that drawings were useful for static

representations but it was difficult to show process in a drawing.

Considering what the children placed in their drawings, results show that every child's drawing included information about the 'location' of the interaction, and that most also included input and output information. Around a third of the drawings included some indication of user experience, evidenced by the bars to the right of the graph in figure 4. It was noted, on inspecting figure 4, that Fun and people were related; this was probably as it was almost necessary to have a person on the drawing to convey fun.

Both reporting methods were easy for the children to use (as evidenced in figure 3). Variation across the reporting conditions might be in part explained by the fact that the interfaces were different but it was noticeable that people were only seldom drawn in the four square condition, this may have been a result of the layout of the reporting instrument or a reflection on the game being evaluated. The four corners condition was more prescriptive and gave more evidence of understanding the technology especially the input devices and controls. The single sheet condition probably gave more information on the children using the interface and their reactions to it. In both reporting methods, children were easily able to describe the look of the interface, and the input tools. They were less able to describe outputs, especially in the snakes and ladders interface. This might have been the reporting method, but it is more likely that the children found it hard to describe the output to that particular game as it was a rather detailed computer screen that would be hard to draw.

It appears that some of the magic of the tangible interface can be conveyed, examples found in the pictures included smudges of movement, expressions of movement, and drawings of the physical workings. In respect of conveying 'match to goals' children wrote how they had experienced the games and added speech bubbles to people on their drawings.

5. CONCLUSION

This study has shown that children's drawings can be coded and that it is possible to devise a coding scheme that is reliable and easy to apply. Further work will validate this coding scheme by testing it out with many more interfaces.

It appears that the choice of reporting material might affect what children draw after they have played an interface in so far as the single sheet condition resulted in many more drawings of people. This cannot be confirmed however in this study due to the confounding nature of having the two interfaces tied to single reporting methods. Further work will be carried out to incorporate better reporting of fun in the drawings, especially in the four square condition.

Other reporting styles using drawings could also be developed and tested to determine which styles produce the best results for which types of information gathering.

More work will be done to determine what makes the tangible magic for any given interface. This will require both theoretical and empirical work.

6. ACKNOWLEDGMENTS

Our thanks to Emanuela Mazzone, the children who participated in the study and the teachers of the children.

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