Designing a Drawing Tool for Children: Supporting Social Interaction and Communication

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Abstract

Children constitute a growing segment of potential users of interactive software technologies, and graphical interactive drawing tools may support children in developing social skills and in expressing emotions and stories. In this paper, we present Tuzz+ which is a graphical interactive drawing tool for children that enables the sharing of drawings between children and facilitates theme-based drawing. We outline the theoretical and empirical background for the tool, present the graphical interface, and evaluate our solution in a usability test.

Keywords

Drawing technologies, children, social interaction

INTRODUCTION

Several technologies for children support social interaction between children. SAGE is a graphical desktop-based storytelling software environment that supports ill children in the creation of their own wise storytellers to play with (Bers et al. 1998), e.g. SAGE has been installed at the Boston's Children's Hospital to facilitate personal storytelling for the children as a way of coping with their cardiac illnesses, hospitalization, and invasive medical procedures. Drawing technologies for children often yield orthogonal purpose since they may serve educational purposes, training of collaborative or communicative skills, storytelling. Klump is a graphical collaboration environment where children can manipulate a virtual 3D figure at the interface simultaneously to create simple stories (Bederson et al. 2000). The stories are derived from sculpting or modelling the 3D figure.

Children's drawing skills and preferences have received great attention over the past several years and support software drawing technologies have emerged. Children's drawings play important emotional and psychological roles in such areas as psychology, psychiatry, or art therapy . Historically, children's drawings have been seen as artefacts that offered windows into the thoughts and feelings of children [13]. Children progress through different development stages of drawing as they constantly grow during and these include: Scribble (age 2-4), pre-schematic (age 4-7), schematic (age 7-9), dawning realism (age 9-12), pseudo-realistic (age 12-14), and decision (age 14-17) (Malchiodi 1998). Whereas no stage is important than another, children start to develop social skills when they reach the dawning realism stage (age 9-11), and they begin to realize that group work and collaboration yield more powerful results than individual work. Furthermore, children start to acknowledge their surroundings as a community of equal partners (Lowenfeld and Brittain 1975, p. 187). Thus, children often find wall painting fascinating since it provides group-based drawing (Lowenfeld and Brittain 1975, p. 202).

This paper presents a study on children's drawing with the objective to create a drawing tool for children. The tool enables the children to share their drawings with other children and it facilitates theme-based drawings. Section two illustrates children's drawing using pencil & paper and software tools, section three outlines the developed graphical drawing tool, and section four concludes our work.

CHILDREN'S DRAWING

We wanted to analyse children's drawing in order to illustrate children's interaction by drawing activities and through the produced drawings. The objectives of our study were to 1) illustrate a (typical) drawing situation for children, 2) illustrate drawing at the dawning realism stage (age 9-12), and 3) illustrate opportunities and limitations in children's interaction with existing software drawing technologies. This should form the design of drawing tool for children (next section).

Experimental Design: The study involved 27 children aged 8-10 years. The children were all pupils from the same school class in Aalborg. We studied the children in two different drawing situations. First, we observed some of the children in traditional paper and pencil-based drawing and secondly, we observed some of the children's interaction with two software drawing technologies. We wanted the children to share experiences

through their drawing and set up the session after they had visited a theatre showing the fairy tale 1001 Nights, and the children were requested to draw people or situations from this fairy tale. Both sessions took place in the school class setting as suggested in (Hanna et al. 1997).

1) The paper and pencil-based drawing sessions involved 19 of the 27 children engaged in a traditional drawing situation. Through this session, we aimed to explore and evaluate children's drawing preferences and drawing situations. The children were placed at three different tables in their class room consisting of five, six, and eight children; this comprised a normal drawing situation for the class. The children applied traditional paper and pencils for their drawings. One researcher was placed at each of the three tables for observing the children's drawing and for conversation with the children. The researcher would make notes for later analysis. The teacher strolled around between the tables inspiring the children.

2) The software-based drawing tool sessions involved the remaining eight of the 27 children. We wanted to explore children's interaction with existing software drawing technologies in order to understand their preferences and to illustrate potential problems with such technologies. Eight children (four girls and four boys) interacted with KidPad 1.0 and Adobe Illustrator 9.0. KidPad was chosen for the study due to its explicit focus on children and due to its significance in other research studies involving children. Adobe Illustrator 9.0 was chosen for its advanced features and complexity and due to the fact that it's primary target group is not children. For the interaction sessions, we applied constructive interaction as suggested by Nielsen (1993) and paired the children gender wise. The children were paired by the teacher according to how well the children knew each other as suggested by (Scaife et al. 1997).

Results: We identified a number of characteristics concerning the children's drawing. In the following, we outline some of these characteristics that have influenced the design of our drawing tool. The children would all initiate their drawing by outlining key objects, e.g. animals or humans. This was usually done by applying pen and erasers in the paper and pencil-based drawing sessions enabling them to erase parts of their drawings (thereby undoing their actions). This approach seemed to direct their drawing with software tools where they started by outlining key objects before filling in with colours. When drawing humans, the children would typically pursue the following procedure 1) drawing of the head, 2) drawing of the torso, and 3) drawing of arms and legs. Further-more, the proportions of elements of e.g. human bodies would typically not comply with real life, e.g. as illustrated in figure where human heads are bigger than torsos. Later the children would colour their drawings and they attribute colours certain characteristics, e.g. one colour was perceived as human skin colour. In fact, more children seemed to have rather elaborated perceptions of colours and meanings of colours.

Figure 1: Examples of paper-based drawings made by four of the participating children illustrating the 1001 Nights fairy tale.

Some children engaged in repeated behaviours where they would draw the same element again and again. This is illustrated in figure 1 where the drawings on the left and right integrate a large number of stars. The repeated behaviours seemed not to annoy the children, but rather as a natural component of drawing. The children featured drawing as a highly social activity where they would constantly interact and display their drawings primarily to the other children, but also the teacher and the researcher. After a typical drawing session, all children would put up their drawing on a pin board in the class room where the drawings could be publicly displayed (and admired). Thus, the access to other children's drawings seemed important to most of the children.

Regarding the children's interaction with existing software technologies, we discovered a number of interesting issues. First, the children understood icons of basic functionalities in the software tools that resembled basic properties of paper and pencil-based drawing, e.g. use of erasers and pencils, and they applied these functionalities. However, the children found it difficult to understand icons representing more advanced features, e.g. moving or pasting objects, properties not directly found in paper and pencil-based drawing. Secondly, the interactive element of software tools provided the opportunity to dynamically change e.g. colours or shapes of objects which is not possible in paper and pencil-based drawing. Thus, the children applied certain types of functionalities in the drawing tools in exploratory manner in order to see how colours and shapes could be dynamically altered.

DESIGNING TUZZ+: A DRAWING TOOL FOR CHILDREN

Tuzz+ was designed and implemented in a project by a team of eight researchers with diverse backgrounds in programming, human-computer interaction, and user involvement. The design team had varied experiences with children involvement prior this project. The project took place during five months in spring of 2002.

Architecture and Design Process: Tuzz+ is implemented in Java 1.4 and the graphical Java toolkit Jazz]. Jazz is open source and enables 2D vector graphics and constitutes key parts of other drawing tools e.g. KidPad. The programming and lines of code was documented in CVS (Concurrent Versioning System) for later analysis. Principles from extreme programming were adopted as the underlying de-sign methodology since it provides means for 1) short development cycles with involvement of users and 2) involvement of the children. Two releases were delivered in this project, called Tuzz (the first version) and Tuzz+ (the second version). This paper addresses the Tuzz+ version. In total, Tuzz+ consists of approximately 5.000 lines of code. Tuzz+ was named as a contraction of the Danish word Tusch (Indian ink pen) and Jazz (the graphical Java toolkit). Due to the lack of focus on documentation in extreme programming, we wrote daily diaries during the entire period to capture information related the design process, e.g. design decisions, feedback from the children. This information was primarily used in our academic process and secondly in the design process.

Interface Design: Tuzz+ consists of a number of different graphical elements for drawing. The primary part of the interface is allocated the drawing canvas where the children can create drawings.

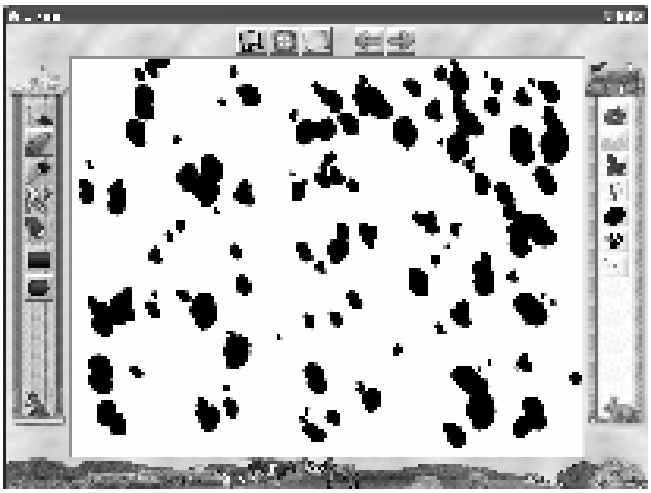

Figure 2: Screen shot of Tuzz+ (on the left), navigation tools at the top, drawing tools at the left side, drawing tool characteristics and theme brushes at the right side, and the drawing canvas in the middle.

The interface layout is illustrated in figure 2 left. Tuzz+ is theme-based in the sense that its layout reflects the chosen theme and it integrates drawing features related the theme. For this version of Tuzz+, we implemented only one theme and chose the farming theme due to its expected gender neutral appeal. The farming theme is introduced in various parts of the interface, e.g. at the bottom and above the feature listings.

At the top of the interface, the children find the navigation tools. These provide overall functionality for creating, storing, and retrieving drawings. Storing and retrieving of drawings has been made transparent to the children in Tuzz+ where we deliberately left out information on file names in the interface. The metaphor applied is the pin board where the children can either put up a drawing for display and where they can take down a drawing for further activities. For practical reasons, taking down an existing drawing creates a new drawing including existing elements of the drawing. At the left side of the interface, the children will find basic (and advanced) features for drawing (illustrated in figure 3).

Figure 3: Menu item icons in Tuzz+: (a) pencil, (b) Indian ink, (c) swab, (d) theme brushes, (e) eraser, (f) solid block, and (g) solid circle

Figure 4: Theme brush icons the farming theme (a) grass, (b) hay, (c) chicken, (d) duckling, (e) cow spots, (f) cat tracks, and (g) bird tracks

The interface of Tuzz+ integrates icons (as shown in figure 3) for pencils, Indian ink pen, paint brushes, the theme brushes, eraser, solid blocks, and solid circles. When using these features, the children can choose from a palette of colours. The cursor changes appearance according to the chosen feature. When children select the theme brush feature, they can choose from a palette of different theme brushes (figure 4). These are located in the right hand side of the interface replacing the palette of colours. The children in the software-based drawing tool

sessions found the interactive aspect of software drawing tools interesting which enabled them to quickly modify their drawing or quickly add new elements. The children participating in the paper and pencil-based drawing sessions exhibited repeated behaviour where they would constantly draw the same element again and again. This aspect is supported in Tuzz+ by the theme brushes that provide the children features for supporting repeated behaviours.

EVALUATION AND DISCUSSION

The evaluation of Tuzz+ took place in the same class room context as the study of KidPad and Adobe Illustrator. Four children (two girls and two boys) participated in the study and these four children were taken from the pool of the 19 children that participated in the paper and pencil-based drawing session. The test sessions consisted of pairs of children and once again we adapted constructive interaction. The children were given no assignment for the evaluation and we did not inform them about the implemented farming theme. Thus, we wanted to see how the children reacted towards the theme and to what extent the theme influenced their drawing.

The children had problems in understanding some of the graphical representations of features through the icons. As an example, the children were all unable to under-stand the undo and redo icons and none of the children applied these voluntarily. Also, as expected the children had problems in understanding the theme brush icon; none of them were able to predict the functionality of the icon. On the other hand, the children had no problems in understanding the other icons including the solid box and solid circle icons. However, they could not fully utilize these two features since they did not know how to increase or decrease the size of the boxes or the circles. The theme brushes in Tuzz+ highly influence the kind of drawings made by the children. Overcoming problems of understanding the theme brush icon, the children highly used the various theme brushes to create different kinds of drawings. Further, the theme brushes seemed to stimulate conversation (and communication) between the pairs of children as the children would start to create stories when using the brushes. This further gave them inspiration to develop their drawings in new and different directions. On the other hand, we are unable to conclude the actual influence of the farming theme since even though the children applied the theme brushes; they indicated that they would like to draw anything.

REFERENCES

Bederson, B. B., Meyer, J., and Good, L. (2000). Jazz: An Extensible Zoomable User Interface Graphics Toolkit in Java. In Proceedings of ACM Symposium on User Interface Software and Technology (UIST 2000), pp. 171-180

Bers, M. U., Ackermann, E., Cassell, J., Donegan, B., Gonzalez-Heydrich, J., DeMaso, D. R., Strohecker, C., Lualdi, S., Bromley, D., and Karlin, J. (1998) Interactive Storytelling Environ-ments: Coping with Cardiac Illness at Boston's Children's Hospital. In Proceedings of the Hu-man Factors and Computing Systems CHI'98, ACM, pp. 603 - 610

Hanna, L., Risden, K., and Alexander, K. J. (1997) Guidelines for Usability Testing with Children. In interactions, September + October, pp. 9 - 14

Lowenfeld, V. and Brittain, W. L. (1975) Creative and Mental Growth. Macmillan Co., New York

Malchiodi, C. A. (1998) Understanding Children's Drawings. Guilford Press

Nielsen, J. (1993) Usability Engineering. Academic Press Professional, Chestnut Hill, MA

Scaife, M., Rogers, Y., Aldrich, F., and Davies, M. (1997) Designing for or Designing with? Informant Design for Interactive Learning Environments. In Proceedings of the Human Factors and Computing Systems CHI'97, ACM, pp. 343 – 350

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