DEMYSTIFYING THE INTERFACE FOR YOUNG LEARNERS WITH AUTISM

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ABSTRACT

This study illustrates a design framework for a social routine instructional prototype for young learners with autism. Requirements and user profile data were previously gathered from an Applied Behavior Analysis (ABA) school. Software currently available for young learners with cognitive impairments and web accessibility guidelines have been reviewed.

The early design phases of the usability engineering lifecycle are documented, to construct initial design sketches of the software and social routine lesson interface. Image editing software is used to create a graphical representation of the design sketches. The paper prototypes are evaluated by tutors in the ABA school. Comparisons are made between different prototypes, and recommendations for further design and development are established.

We conclude that colour and animation should be minimized, and an individual windowed interface should represent the main navigational display of the prototype. A customizable option for colour, font type and font size should be integrated to accommodate for the specific needs of individual learners with cognitive impairments. Multi-modal input such as a touchscreen, switch and mouse should be incorporated into the design. A further computer-based implementation is recommended to provide for an additional investigation into the needs of the learner.

KEYWORDS

Autism, Cognitive Impairment, Interface Design, Human Computer Interaction, Animation, Usability Engineering.

1. INTRODUCTION

This body of work documents the early design investigation of a social routine prototype for young children with autism. Findings from requirements analysis provide a foundation for conceptual model design and storyboards.

Social stories are miniature stories consisting of a set of instructions or guidelines to teach social skills to young children with learning disabilities. The use of these stories as an educational tool was originally proposed by Gray, an educational consultant (The Gray Center, 2008). The stories are primarily used to prepare young children for an upcoming event or routine i.e. dentist visit or washing hands (Wallin, 2004). For the story to be effective, it should be introduced as part of the child's everyday routine.

Additionally, Siegel (2003) describes pictures and photographs as effective tools used to assist the educational needs of the learner. Pictures and animation can help overcome a range of learning deficits, i.e. communication barriers and cognitive load while learning. Thus, pictures do not require as strong an amount of processing from memory (Howlin, 1998). The initiative of using pictures and symbols as an educational tool has shown positive results, as it works on the learner's visual style of learning. The PECS system is a method currently used in many schools which employs the use of pictures and symbols (Bondy and Frost, 2008). The method incorporates the use of objects as symbols to encourage communication in non-verbal children through building on the concept that children *'think in pictures'* (Siegel, 2003). Through a combination of two successful areas, pictures and social stories, there is scope to suggest that these areas can collectively increase the social development of young learners with autism.

Discrete Trial Instruction (DTI) is an adult-to-child method of learning which teaches a task using small repeated steps (Desrochers et al., 2002). Elements of the DTI framework are evident within the instructional format of social stories, as each story is broken down into small step-by-step procedures. DTI breaks down

the user's everyday task into a structured set of activities to reach its goal (Jarrett et al., 2005). Schools have adopted this technique within their classroom curriculum. Each lesson is broken down into small repeated steps to teach a child a specific task. The integration of online social stories within the current classroom program could be implemented efficiently. Each individual story can be personalised to meet the different skills development and lifestyle of each child (ASAT, 2006). The main discussion within this paper will focus on the conceptual design and creation of storyboards, based on data received from requirements analysis and information gathering.

2. BODY OF PAPER

2.1 Investigation

A special needs and Applied Behaviour Analysis (ABA) School has been enlisted for fieldwork.
Children attending the school range from preschool to eighteen years. Each pupil has been diagnosed with autism and a special need. Our study is based with a class of five mixed gender learners, with autism and special needs, aged five to nine years. A teacher and special needs tutor manage these pupils.

The Usability Engineering Lifecycle is used as a framework for prototype development. Mayhew (1999) recommends adapting the lifecycle to suit different types of technology development. We use different elements of Mayhew's lifecycle for this prototype. Prior to the design phase, we conducted user profiling and task analysis, to create the initial interface design sketches. Current educational software available within the classroom was also evaluated. Observations and interviews have led to the following findings:

- Children relate better to clear realistic photographs that are familiar to the child's everyday environment.
- Children prefer software that has an instant effect or automatic reaction on a single click.
- Some of the children have difficulty using drag-and-drop. Therefore software suited to touchscreen and mouse access would be beneficial.
- As the research is based in Ireland, some American terminology can cause confusion i.e. automobile instead of car. Irish or European phrases and audio with an Irish accent may be clearer to follow.
- The design elements of the screen should be clutter free and minimalistic. This prevents distractions and helps the child to focus more on the important elements on the screen.

During development of the prototype the findings listed above are merged with HCI principles (Schneiderman, 1998; Norman, 1998) to facilitate the main requirements of learners with autism. Murray & Lesser (1999) state that features such as visual cues, repetition, unhurried pace and controllability should be incorporated into the design. Nielsen's child and web usability report (2002) confirms that features such as inconsistent navigation, difficult vocabulary and lack of perceived clickability can have a negative impact on children's web usability. Further findings suggest that children favour animation and multimedia. Pictorial navigation maps included within a website are preferred by children (Nielsen Norman Group, 2002). However, it was noted that children would often abandon a webpage if it consisted of a lengthy scrollbar, or content not targeted at their own specific age group.

2.2 Design

To expedite the design, paper-based prototypes were created as part of the conceptual design process, as advised by Mayhew (1999). Image editing tools are used to create graphical representations of the interface, buttons and images.

A number of different online children's websites were reviewed prior to design. This review provided information in relation to navigation, technology and use of colour. We created rough pencil sketches to use as a framework of the overall screen design. Photoshop was used to create computer-generated images of the sketches. Online graphic and font repository archives were used to experiment with different graphics and fonts (Open Clip Art Library, 2008). Two themes were chosen for storyboard experimentation and presented for tutor review, one being the main interface (Figure 1) and the second, the story window (Figure 2).

The first storyboard (Figure 1) depicts the design of the interface as follows:

- Screen Safe Area: On the main pages, text areas and lessons were developed within the recommended safe area of width 760px * height 410px. The researcher felt this was important as all information should be displayed to the learner on the screen, without causing the added user task of scrolling the page to view additional information (Lynch and Horton, 2002).
- Printer Preferences: The learner/parent/teacher may also wish to print lessons from the screen so the safe area provides for an appropriate print area. See Figure 1 for diagrammatical representation of the screens dimensions.
- Navigation: The main navigation consists of three buttons: home, stories and quiz. Three simple buttons as opposed to a drop down or cascading menu is more appropriate for a child with motor disabilities. Donker and Reitsma (2007) recommend a button of size 27px wide and tall to get a more accurate and quicker reaction time from a child learner. Each button measures 216px *106px (as in Figure 1). The button displays a subtle change of colour when rolled over by the cursor.
- User Interface Agent: The interface agent, represented by a caricature figure, will trigger relevant advice and tips in relation to navigation, form-filling, software etc. depending on the page visited (Mandel, 1997).

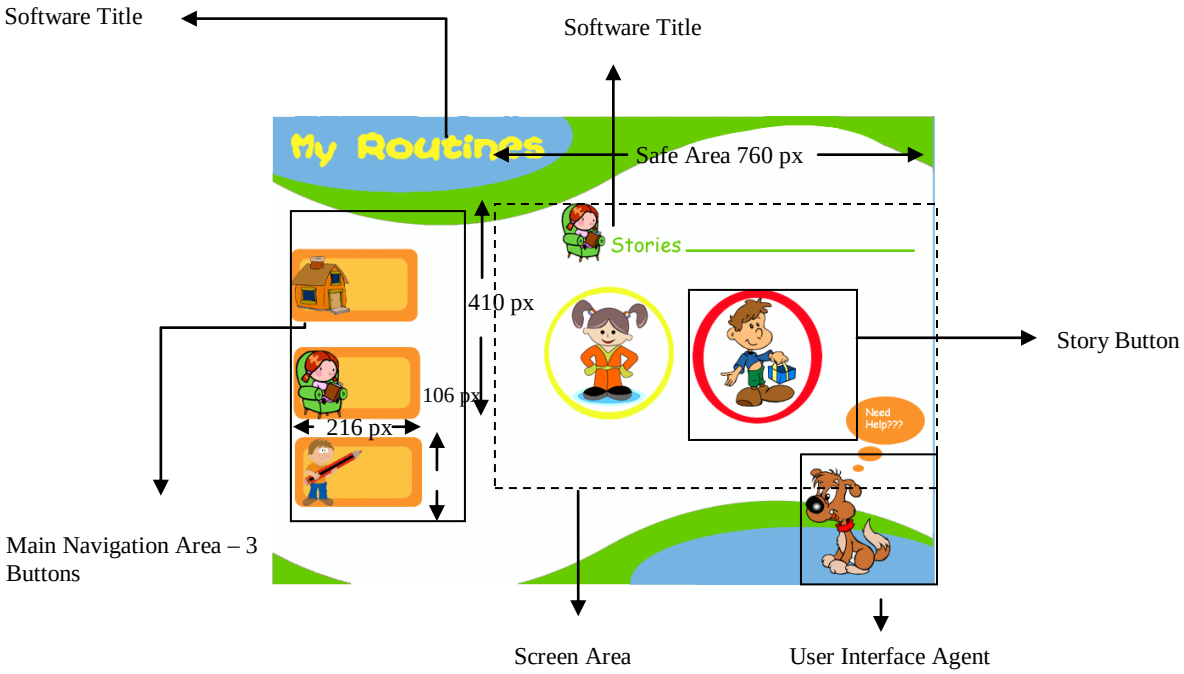

Figure 1. Storyboard 1-Interface

The second storyboard (Figure 2) represents a prototype of the screen display of a social routine story.

- Screen Safe Area: The safe screen area spans a height 410px *width 760px in order to display the complete story within the screen and prevent the user from scrolling (Lynch and Horton, 2002).
- Navigation: Three control buttons, displaying the universal symbols for play, pause and stop, are incorporated to enable user control of the story. Each individual button spans a width of 257px * height 249px for a more accurate response time (Donker and Reitsma, 2007).
- Interface Agent: The interface agent is also present to provide additional help on different elements within the story (Mandel, 1997).

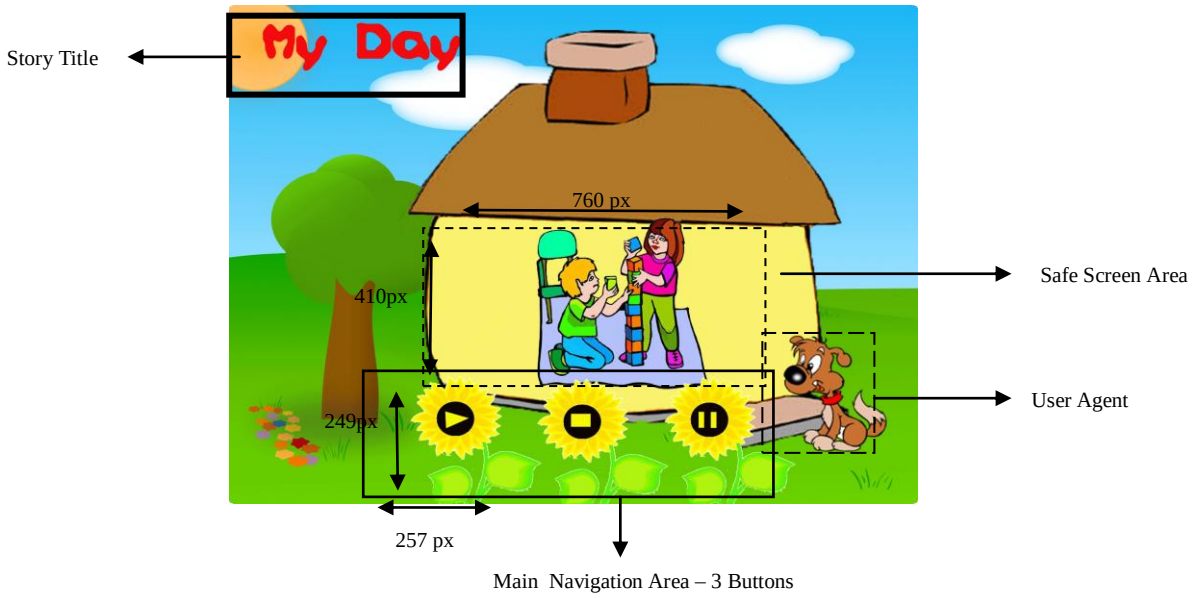

Figure 2. Storyboard 2 – Story Interface

2.3 Evaluation of Storyboards

Tutors gave feedback via semi-structured interviews. A synopsis of the core questions presented to tutors focused on the areas of navigation, colour, story themes, universal symbols and buttons.

1. Is the menu easily navigable and easy to locate?
2. Do children understand a) the use of text, b) the use of a symbolic image or c) a combination of both in order to navigate buttons/ menus etc.?
3. Should the buttons have a rollover effect or could this be distracting for the user?
4. Is the clickable area of the buttons convenient for both mouse and touchscreen use?
5. Do children recognise operating systems (e.g. Windows, Mac.) menus symbols/icons such as  to close a window?
6. Is the chosen font size 14/16 px clearly legible?
7. Do the children have a preference for specific combinations of colours?
8. Would the use of background audio and/ or voice-overs be effective?
9. Should the story lesson display within the main screen or in its own individual window?
10. What topics would be most suitable to include within the lessons? School issues, homes issues?

Feedback is summarised as follows:

- Children do not have a preference for the position of buttons on the screen; the buttons can be positioned on the top of the screen or along either side on the interface.
- Clear simple vocabulary along with a meaningful symbol should be displayed on a button, and the addition of audio would be of added benefit, when the learner selects a button.
- The children's understanding of universal symbols such as play and pause is individual to each learner's prior knowledge. However, the tutors suggested incorporating these symbols as it would be beneficial for the child to learn them. A gradual introduction was considered more appropriate, beginning with two buttons, and adding more when the learner becomes familiar with the buttons. Walker and Reynolds' findings (2002) propose that icons may have benefits for children once they represent clear actions and are accompanied by an unambiguous caption indicating the icon's intended action.
- A font size of 14px was recommended as an appropriate size for the interface. A typeface of Comic Sans or Century Gothic is clearer for the child. The PECS symbols within the classroom

demonstrated a better success rate from both these typefaces, as opposed to serif fonts. However, the option will be available to the users to customise the size of the font in order to suit their own requirements. As reported by Mackay (2002) san serif fonts, similar to Comic Sans have proved successful in training children with dyslexia and reading difficulties.

- A clear white or pastel background was recommended. A minimalistic, clutter free workspace provides better results than numerous animations and bright colours which can lead to distractions. However, the choice of colour should be easily customisable by the learner or tutor.
- The prototype should consist of one window at all times; the target audience cannot cope with the additional task of navigating between multiple windows.

2.4 Findings

Tutor feedback indicated that the first storyboard incorporates more of the perceived user requirements than Storyboard 2. In comparing both prototypes tutors observed:

- Storyboard 2 is encumbered with many graphics. The background graphic serves as a distraction from the main screen area. In comparison, Storyboard 1 has a minimalist background graphic and the main workspace area has clear whitespace.
- The control buttons depicted as flowers in Storyboard 2 could be difficult for a young child with autism to comprehend.
- The overall design to include two separate interfaces, main interface screen and story screen should be reconsidered, as children with autism have difficulties navigating between two screens. It was suggested to incorporate the story within the safe area of Storyboard 1.

3. CONCLUSION

Storyboard 1 promises more advantages for learners with autism. Next we will create a computer-based model of the prototype using HTML and ASP as the main scripting language. The interface for the social routine story (Figure 2) will be reviewed and displayed within the safe area on the main interface as opposed to its own window. Flash 8 animations will support each story. Online image and graphic repositories (Open Clip Art Library, 2008) shall be used to obtain relevant elements, and audio clips will be recorded. Tutor recommendations in relation to fonts and use of colour shall also be incorporated in the development.
This user-centered design approach has provided valuable insights and we will continue the consultative process in subsequent phases based on Mayhew's usability engineering framework (1999).

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