

A Child-Centered Approach to Designing Small Interfaces with an Educational Focus

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ABSTRACT

Children are the largest growing demographic of computer and web users, and are quite arguably one of the most diverse demographics in regards to learning and motor abilities. Many industries are successful at targeting this specific demographic, however the computer industry has largely overlooked it, forcing them to adapt to technologies that were developed for adults. This study focuses on the use of PDAs in an educational setting and proposes guidelines that can be used by designers in order to develop small interfaces that meet the accessibility, cognitive and dexterity needs of young children.

INTRODUCTION

As technology continuously becomes more widespread in the everyday lives of ordinary people, it becomes more important for designers to develop products geared towards specific user groups. One such group is children. Today's children have more technology available than any others before them. Currently children are one of the fastest growing demographics of computer and Internet users. With the world available to them at their fingertips the possibilities for knowledge acquisition and growth are endless.

As children continue to grow up more quickly, we are aiding in the process by forcing them to interact with technologies that are specifically designed for adults. This study will take a look at how a PDA, generally a device designed for the 'upper-class businessperson', can be adapted into a powerful educational tool for children. More importantly this paper will explore different design approaches and guidelines that can be used to develop small screen devices for elementary aged children. These guidelines focus on four main aspects; age appropriateness, literacy, dexterity and familiarity.

BACKGROUND

One of the initial steps for this project was to explore the literature already available and determine how the findings could be applied to the development of these guidelines. It was apparent from initial research that there is a lack of literature specifically on designing small interfaces for children. Because of this, an approach was taken that narrowed in on three main categories of literature; a general overview that looks at children's use of technology, different approaches to web usability for children and case studies that address the use of PDAs in schools.

Currently over half of the American population, between the ages of 2 and 17, uses the Internet from home, while 83 percent of American households own at least one personal computer. [1,5] Between 2000 and 2002, the preschool population in America was the fastest growing group of users to get online, with an amazing 29 percent growth. [5] When these children go online they are primarily doing so from their parents' computers using the same internet search portals that their parents do. [6] Considering the growth of this user population, why are they using technologies that are not specifically designed for them?

Many companies have gone out of their way to target this demographic. Yahoo! is one such example. The company developed a search portal specifically for children called Yahoooligans! This interface takes a more iconic and playful approach compared to the more text based boxy look of Yahoo. This is only one example of how companies have accepted the challenge of designing for young children, realizing that they need to design products that take into account the reading limitations and unrefined motor skills of this younger population. [6]

The majority of web usability studies that have been conducted are geared towards adults. [12] However, more recently designers have been conducting studies that have focused on designing web interfaces for children. Some of the major design issues that have been discovered include; literacy, motor skills and attention span.

In terms of literacy, it is important to remember that during the early elementary years all children are developing at

different levels. There has to be a great deal of attention paid during the design phase to ensure that the cognitive load being asked from the children is not too high. [3] Studies on the motor skills of young children (in terms of computer use), have found that certain interactions that they partake in are not acceptable. For example, children find it difficult to perform drag and drop tasks that spans over a large screen area because it is difficult to maintain pressure on the mouse for long periods of time. [7]

In regards to attention span, studies have shown that simplicity is vital. Many of the children who are using these sites are not capable of understanding everything on the screen, so they rely on using the mouse to mine-sweep. In many cases children click on banner ads and are inadvertently directed to a completely new page, without realizing how this occurred.

Finally, when it comes to the use of PDAs in an educational setting, these devices could provide a light at the end of the tunnel for some of the design issues stated above. Currently 28% of school districts in the United States provide PDA devices to both their students and teachers, mainly middle and high schools. [2] The use of these devices ranges from schedule planning to homework submission. At this time, personal computers and laptops are frequently found in classrooms, but because of the space they require and the cost of each system, these devices are not reasonable solutions for integrating technology into every school around the nation. Because of its low cost and compact size, a PDA can act as a powerful learning device that can be used for short periods of time and easily be stored away when not in use. [8, 10]

METHODS

This section will discuss some of the approaches that were used in order to gain an educated foundation upon which to build the guidelines. Before establishing any strategies on taking a child-centered approach, a number of questions needed to be answered, including: Can children interact with small interfaces?; Can PDAs effectively be used in an educational environment?; and How can current child-centered web standards be applied to small screen devices? To answer these questions, I turned to literature research (which was included in the background), observations and interviews.

Observations and Interviews

Three rounds of ethnographic observations were conducted in a third grade classroom at a local elementary school. The class consisted of 16 students between the ages of 8 and 9, and one teacher. The students' desks were set up in clusters of four which were used for collaborative work. The classroom was equipped with 3 desktop computers, 1 laptop and a Smart board. In order to organize the class, the teacher had stacks of paper assignments lining his desk as well as lists on the walls.

The main purpose of the first two sessions was to observe the participants and see how they interacted with the tools that they use on a daily basis. The following are some of the more poignant findings from these observations. Every morning when the children come to class they take out their day planners and show the homework signatures, collected from their parents, the previous evening. This is the main form of communication between the teacher and parents. It was observed that students primarily make use of pencils and notebooks when completing individual work; however solutions for group work were all solved on the whiteboard with the aid of an overhead projector. Children had an easier time remembering the instructions for a game than they did recalling academic information. Finally, incentive was a main motivation in every activity that was observed. Everything from sticker books, school cash and positive reinforcement was used in order to entice the children into participating.

The third observation session was conducted during a time where the teacher had the students interact with various PDAs. This activity took place during a math lesson and the children were asked to complete various tasks using both the calculator and the notepad. Initially when the students were given the PDAs the teacher asked them if they knew what the devices were and what PDA stood for. Some comments that were heard include: 'Oh my parents have one of these' and 'Personal data arranger'.

During this session, the first task that the children were asked to complete was to find the calculator application and calculate various math equations. The second task was to be completed using the notepad. The teacher read a number aloud and the students had to write down the numbers in the correct place values. All of the children were eager to complete the tasks and they had a difficult time putting the devices down when the session ended. However, these observations did show that using a PDA is not always the most efficient method. They also provided first-hand evidence that the icon sizes and the idea of a home screen were both easy to work with and understand.

RESULTS AND OUTCOMES

From examining these results, it was obvious that structure needs to be established in order to propose design guidelines. To accomplish this, the following four categories will be used as groupings: age appropriateness, literacy, dexterity and familiarity.

Age Appropriateness

For years children have grown up surrounded by small devices; Game Boys and calculators to name a few. Unlike the interfaces of traditional operating systems and desktop computers, PDAs offer a less complex approach for children. These interfaces offer a more age appropriate experience by minimizing the amount of necessary multitasking. [4] The limited real estate also minimizes the

amount of distracting material that can be displayed on a screen, playing towards children's short attention spans.

Proposed guidelines: In order to overcome these difficulties it is important to take into account the small interface and ensure that the screen layout is not overcrowded. Because only one frame is seen at a time it is important to eliminate any unnecessary information and focus on the task at hand.

Accessibility (Literacy)

Children develop at different speeds; physically emotionally and educationally. This and their limited vocabulary lead to literacy considerations that need to be addressed when designing systems for young children. Throughout the classroom observations, it was noted that the children were broken up into hierarchical groups that either segregated different reading skills or integrated them. These two methods are used to foster a challenging environment for all types of learners.

Proposed guidelines: In order to overcome these issues there are many tactics that can be used. For instance, rollover states which reads aloud the textual information, gives the child the ability to navigate without having to read. Also the use of consistent and age appropriate terms throughout the system eliminates the ambiguity that can occur with the use of multiple terms for one object.

Accessibility (Dexterity)

Similarly to children's literacy skills, dexterity skill development also varies. Throughout the observations it was apparent that children had an easier time interacting with devices that allowed them to use a touch screen rather than through the use of a mouse. It took the children using a mouse a longer period of time to find their target and orientate themselves on the screen.

Proposed guidelines: It has been shown that subtle sounds can help people with vision and dexterity problems. [9] This gives the user the ability to have a form of reinforcement that lets them know when they are on their desired target. Another important feature is the integration of large hit areas that contain apparent rollovers. Hit areas that are too small, make it difficult for the user to be precise when selecting their target. Another accessibility option that can be implemented is the ability to change the size of the font. This is currently used to meet the Section 508 accessibility requirements. Finally, one area to avoid is the use of Graffiti. At this point in their development, children are still learning how to read and write. Providing different methods of doing so causes unnecessary confusion.

Familiarity

Children understand what they know; to ensure that the child is comfortable with the system it is important to incorporate aspects of familiarity. In a classroom environment teachers are taught to use positive reinforcement. This tactic plays to the child's short attention span and continuously allows them to evaluate

their own performance. They also have methods of incorporating prior knowledge and metaphors into teaching techniques.

Proposed guideline: These teaching methods can be integrated and applied when designing applications for children. First, choose design metaphors that are familiar. For instance use backgrounds that are seen in the everyday classroom environment; or notebook paper or a font that resembles a teacher's handwriting. Secondly, have a process that allows for instant feedback. This and the use of positive reinforcement gives the child the ability to know the results based on their actions. [11] It also gives them the chance to be continuously engaged in the system.

DISCUSSION

Applying the Guidelines

These guidelines open the door to a whole new dimension of design. The possibility to continue the development of similar guidelines is limitless. These guidelines have been developed for use by designers. Although the focus of this study was children, it is the designer who is responsible for bringing the experience to the child. The guidelines themselves should not be viewed as an absolute solution to every design problem. However, taking them into consideration throughout the design process may result in a more thought out and child-centered design.

Uses for the Guidelines

As previously mentioned, there are many similarities between the guidelines that are proposed in this paper and guidelines used for designing web interfaces for children. [12] For the most part these guidelines can be interchanged and the main difference lies in the medium of interaction and screen size.

With this said, it is obvious that PDA devices are not the answer for everything. They can not replace a web interface that provides an encyclopedia's worth of information in one screen. Also, as observed throughout the study, PDAs are not a replacement for the traditional interaction between the child and a pencil and paper. During the observations when the children were asked to write out math problems using the PDA, it took them considerably longer than those children who were using paper and pencil. The design of a PDA device for children should take the approach of a way to enhance the educational experience and not replace it.

Uses for small screen technology in a classroom setting

Although PDAs cannot replace everything, there are multiple areas where they can benefit children in an educational setting. A particularly appealing aspect of the devices is the cost. For the price of one PC, a school could outfit multiple students with PDAs. With this, they provide an opportunity for lower income children to gain a first hand experience of interacting with technology.

Another possibility is the use of PDAs to open the lines of communication between parents, teachers and students.

The scheduling, beaming, and Bluetooth capabilities of the PDA can cut back on the administrative time required by the teacher. Also, by providing students with PDA devices they will gain both a sense of responsibility and accountability through the care of the device.

FUTURE STUDIES

In order to test these guidelines and their foundations, future testing has been planned and is currently in process. This testing will take place in the form of two separate classroom sessions. These will test some of the core foundations of the guidelines and provide a clearer vision as to how this area of design should be approached.

Planned Studies

The first additional area to be tested is the ease of use and preference of different interaction methods of devices. This part of the study has already undergone its preliminary stage during the third round of observations. The students were handed individual devices with the stylus in its holding position and were not at any time prompted to use the stylus. Initially the children started using their fingers to interact with the screens but when they wanted more precision they selected the use of the stylus.

The second study being planned is to test preferences of different icons and text styles. This phase of the study will be done using paper prototype cutouts of different icons, which will range in size, color as well as types of images (cartoons, graphics or pictures).

Perceived Results

The results from these two studies will help establish the guidelines that have been discussed in this paper. By gaining a better understanding of how children interact with these devices and also what kind of metaphors they understand and prefer; designers will be able to make educated decisions throughout their design process.

Future Research

Beyond the planned testing, this study has inspired the exploration of additional areas of research. One such area is our general understanding of how children interact and accept different technologies that were initially designed for adults. Examples of such technologies include; PDAs, tablets and cell phones. As these technologies continuously become more available for children, the importance of understanding how they can be designed increases.

CONCLUSION

As children continuously grow, so should the technology that they surround themselves with. These guidelines only open the door to a world of design that targets the largest growing demographic of computer users. The importance of designing specifically for this group is immeasurable because the needs of children are widely different than

those of the adults who design for them. This study has shown that it is possible to accomplish the goal of establishing guidelines for children and that there can be such a thing as a child-centered approach when it comes to technology.

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