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DESIGNING SOFTWARE FOR CHILD USERS: A CASE STUDY OF A WEB PAGE CONSTRUCTION KIT FOR CHILDREN

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ABSTRACT

User interface design is a part of what users can see, touch, hear and communicate with. To produce software applications that are good, effective and high usability in terms of interface design, the involvement of users are needed in system development especially when designing for children. Almost all of the software applications designed for children are developed by adults based on what they assume children want. As a result, the application may not be easily learned or used by children. There are three goals of this research 1) to know children's abilities and skills in computer usage; 2) to know their problems with the existing kits; and 3) suitable designs for them. This paper describes the prototype of web page construction kit for children as a case study. The requirements are based on interviews with children, analysis of the existing tools and analysis of homepages created by children. The design of the prototype has also been evaluated in order to determine whether or not it is suitable and fulfils the children's requirements. As a conclusion, this paper reveals a few questions that need to be considered in designing children's software.

Keywords ***User interface, Design, Webpage construction kit, Children***

1.0 INTRODUCTION

Carroll (1988) says that if a system is fun, people are more likely to use it. Ease, however, can be measured in terms of performance time, time to learn and count of errors [5]. The question is, how can fun be measured? Before we can gauge the factor of fun, we must know what features make a particular software fun. To recognise the features is one and to impart it is another. No matter how interesting the features are, if they are not well presented, they will never make any sense, seem less attractive and will not hold the child's interest. This is where the interface and interaction design are playing their roles.

User interface has direct effects on the usefulness of the computer systems and the success of the software product. There are so many theories on children's development and learning but not so many studies on how children interact and communicate with the computer [5]. This is something that children could probably tell us how to do.

A web page construction kit is a tool that is used to create homepages. Before the existence of the Graphical User Interface (GUI) based web page constructor, users needed to understand and manipulate the HTML language themselves in order to create the homepage. Therefore, not so many people could develop their homepage, least of all, children. Nowadays, knowledge in HTML is no longer needed in the existing tools. The question is: can the children use today's state-of-the-art software?

Almost all of the software applications designed for children are developed by adults based on what developers assume children want. As a result, the application may not be easily learned or used by children. This paper focuses on some of the current trends in child-oriented technology, the problems and shortcomings of interface design and recommendations to improve interface design. It is based on the design of web page construction kit for children. This research has three goals: 1) to know children's abilities and skills in computer usage; 2) to know their problems with the existing kits; and 3) to suggest factors and questions that need to be taken into consideration when designing software for child users.

1.1 Understanding Children's Needs in Software Development

There are two main considerations that developers need to take into account before designing any software for children (as shown in Fig. 1): children's requirements as to how the software should function and graphical presented, as well as their knowledge of existing technology which includes factors as how the children learn, how they use computers, how they interact with computers, how they manipulate objects on screen and so forth [1].

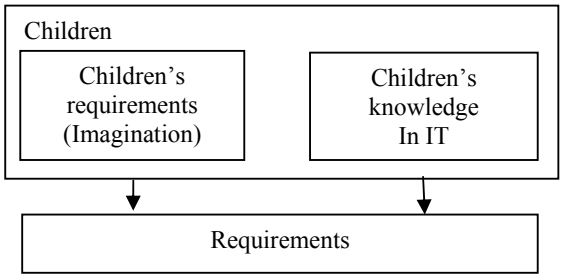

Fig. 1: Requirements understanding

This research is focused more on direct interaction with the students. An interview or discussion with students, gives more chances to the students to express their imagination as interviews or discussion allow free reign of lots of wild ideas that probably better represent their real requirement.

As we know, a good and effective software design is based on the usability of the interface. The usability of any software depends on whether or not the developer takes children's mental model into their design consideration. The mental model is the first impression and ideas of users on a system's function as well as their response [2]. Developers and users might have a different model and this is shown in Fig. 2. This could be observed during the discussion session as describe in analysis 3 in this paper.

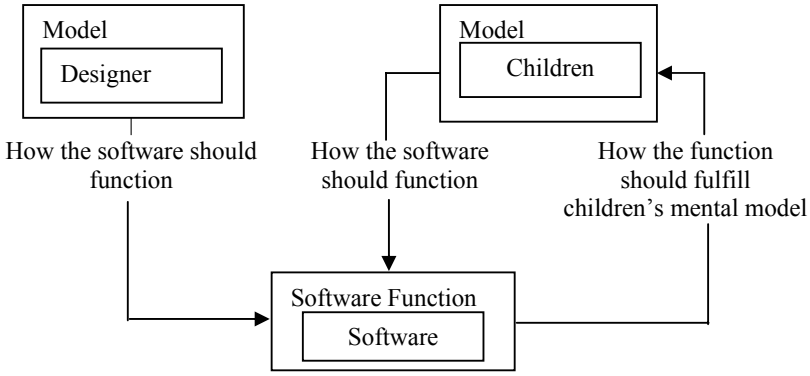

Fig. 2: Differences of mental models between designer and children

1.2 Metaphor and Interaction

Elissa et al. found in their research that the use of metaphor in interface has reduced errors compared to interface without metaphor. The purpose of using metaphor in designing software is the same as in the world of education. Lots of educators observed that by giving comparison in explanation will accelerate learning process [3]. The current interface designs are more oriented towards familiar objects and activities as used in Microsoft 98 by Microsoft Corp. As for interaction, the most popular input device for children is the mouse and there are two operations involved; "drag and drop" and "point and click" [4]. Children have problems with the keyboard because they need to scan the keyboard to find the correct key to be pressed [5].

In this study, the design of web page construction kit places more emphasis on using the mouse as the main input device and "drag and drop" and "point and click" as main operation concepts by assuming all elements in the web page are objects.

1.3 Games as Model for Motivating Children

Before designing any software for children, a few questions need to be resolved such as how they learn, how they use the computer, gender issues, their imagination and expectation of how the software will respond to them. Students' interaction with the computer is influenced by their everyday activities and surroundings such as playing video games. Children are more attracted to video or computer games because it is fun. The questions are; why it is fun? And what makes it fun? It might because of the combination of multimedia elements in their presentation, having goals to achieve or that they can compete not only with the computer but also with their friends and so forth [6]. By using and implementing these attractive features to non-game software, it might attract as well as sustain their interest as they learn to use it.

One of the effective communication techniques attractive to children is by manipulating all elements including texts, sound, visual and so on as suggested by Hakansson (1990) [5]. They also found that children do not like reading and have no patience. Strommen and Revelle (1990) suggest that the usage of sound together with graphics are helping a lot the students to obtain a better understanding of certain functions or events [5]. Response time for children must also be faster because children usually need faster response as feedback for any action initiated by them. As we can observe, all these features are applied in computer games.

Age is one of the significant reasons that influence the motivation towards the usage of software. There are fundamental differences of reasons in using software between adults and children. Adults are using software to accomplish their work but children are using software for fun [7]. As a result, to motivate and maintain children's interest in certain software, it must be fun such as what might be found in video and computer games. Games characteristics must be taken into consideration in designing software for children. Games are more on manipulating information in the form of visual and audio elements which help users to assimilate information faster rather than text reading. By designing software and looking to computer games for design references, it might be able to attract children in using the software. These were observed in 3 analyses in this research.

2.0 METHODOLOGY

This research emphasises more on interfaces, metaphors and interaction design for children. The audience comprises children aged between 9 to 12 Years old (Standard 3 to 6). There were 3 methods used: analysing the existing tools, observing published homepages on the Net created by children and personal interviews with them.

There were 21 web page construction kits used in this research to discover the minimum features and requirements for any web page tools. The second method is to find out the content, features and development process of children's published homepages. As we know, children are very creative and innovative. They might want to develop something better than what they had already published (as in analysis 2). The third method is to find out what they really want and whether they are able to use the existing tools to develop it. Information acquired via all three channels help form an impressive of an interface and interaction design of tool suitable for children. In order to determine the actual problems and needs, interviewing them is on of the better ways. This is known as Participatory Design Technique [1].

This technique was used because the children involved in this research were between 9 to 12 years old. This range of age is ideal enough to be a design partner because children of these ages have the ability to think, interact and work independently. For this research, several series of discussions were held with some students from secondary schools in the area of Petaling Jaya, Selangor, Malaysia. Via this methodology, students were directly asked to work with the researcher to collaboratively create a homepage and design a "low-tech prototype" from paper.

During the discussion, they were put together especially with their friends so as to make them feel more comfortable and to facilitate the flow of opinions amongst them. We also encouraged them to come up with as many wild ideas as possible. Indirectly, this made the discussion more fun and less stressful for them. Adult interaction is very important in this technique; between researcher and children as well as children and children. Researcher had to behave informally and sometimes even playfully especially during brainstorming sessions so as to encourage them to give more imaginative ideas. At the same time, researchers observed and jotted down any important facts that could be used later on.

From all of the features and characteristics in brainstorming sessions, researcher and students finally came out with the prototype of tools made from paper. As a result, we can divide the output into 4 parts; children's ability and skills, characteristics of children's web site, problems with the existing tools and finally a design of web page construction kit for children.

3.0 ANALYSIS 1: EXISTING TOOLS

The purposes of this analysis is to find out the available web page construction kits on market, and the minimum features and requirements for any web page construction kit. There were 21 existing web page construction tools used in this study.

In general, the tools can be divided into 2 types; WYSIWYG based and text based. There were 58 features, divided into 4 main categories:

(a) General features: comprised features that were found in almost all web page construction kits and also advanced features that only appeared in certain tools.
(b) Graphical features: comprised features that involved any graphic, animation or video operation.
(c) Publishing and online operations: comprised features that allow users to do publishing or uploading of homepages.
(d) Sound features: comprised features that are involved in sound recording and editing.

Almost 35% of the tools had publishing features and only 5% had sound feature. This result shows that these features are not really implemented in most of the tools.

An analysis of web pages created by children is needed in order to determine whether all these features are used in their homepage development and this is done in Analysis 2.

4.0 ANALYSIS 2: HOMEPAGE CREATED BY CHILDREN

There were four significant levels of information observed in the published homepages created by children. They are: age categories, goals, content and characteristics of web pages. After browsing through several web pages created by them, the web pages can be categorised according to ages; 8 years and below, 9 to 12 years and 13 years and above.

From the observation, web pages for children 8 years old and less were normally created by their parents. It was based on sentences found in their web page such as "she is 7 years old". The sentence "she is" clearly shows that the web page was not created by themselves. The differences of web pages between 9 to 12 and 13 years and above can be divided into 3: features, contents and development as shown in the table below.

Table 1: The differences of homepages between children aged 9-12 and 13 years and above

	9 to 12 years old	**14 years and above**
Features	• Simple (interface design) • Contains text and static images • No advanced features • Lots of cartoons	• More interesting • More advanced features for instance the usage of java applet.
Contents	• Information oriented towards their family, friends, hobbies and pets.	• Showing something that can be shared • Girls were more straightforward compared with boys (more information about their favorite artistes and hobbies) • Boys were trying to hide their identity such as through the use of nicknames or pen names.
Development	• Mostly found at free web base such as Geocities. • Homepages were also based on Wizards provided by the web site.	• Also found at free web sites. • But they were using more advanced features • They might upload their own html file or code their own homepage.

From the observation, children aged between 9 to 12 years old were using web page construction wizards provided by the free homepage space web site to create their home page. The design was very dependent on the resident wizard and seems to be unable to show what they really want. It was also quite difficult to find their homepages. In order to determine the actual problems and needs, interviewing them directly is one of the better ways and it was done in Analysis 3.

5.0 ANALYSIS 3: DIRECT INTERVIEW WITH THE CHILDREN

The technique used in this research was Participatory Design Technique. This analysis is used:

(a) to determine the existing features as listed in analysis 1 used by children
(b) to know the new features that were not found in the existing software compared in Analysis 1
(c) to determine what type of web page they actually wanted to create as compared to web pages found in analysis 2
(d) to determine whether or not the existing tools are able to create their web pages
(e) Finally, to find out the features needed as well as the design for web page construction kits.

3 schools with 8 students at each school were involved during this research. The same students were also involved in the evaluation phase.

5.1 Modules Used for this Technique

There were eight students involved in every session. Each session was done in a different secondary school. The children were divided into four groups (a group of two for each age levels; 9, 10, 11 and 12 years old) and all team members sat together and implemented module by module as described below.

MODULE 1: Introduction (Allocated time: 15 minutes)

Objectives:

- To get to know each other.
- To lessen the divide between researcher and students.
- to attract and increase their interest in the discussion

Activities:

- All members of the team were asked to introduce themselves giving information such as their name, hobbies, favorite video games if any and so forth.
- A few interesting computer applications and web pages were also showed to them.

MODULE 2: Introduction to Computer, Software and Internet (Allocated time: 20 minutes)

Objectives:

- preparation for brainstorming in Module 3
- preparation for the topics to be discussed

Activities:

- As their interest increased, an informal discussion (two-way communication) was done to introduce, step by step, the purpose of the meeting by discussing a few guide line questions as for instance What is "computer", History of the computer, What computers can do, What is "software", Who develops software?, How software is developed, What are the relationships between computer and software?, What is "Internet", How and why is the Internet important?, What is "homepage", Who creates homepage, Why do we need to create homepages?, How are homepages created?

MODULE 3: Brainstorming 1 (Allocated time: 30 minutes)

Objectives:

- To recognise and determine the type of web pages that they are interested in developing through drawings and followed by oral elaborations or presentation.

Activities:

- This activity was basically based on drawing and presentation.
- Students were asked to draw their own homepage on paper. This activity was done in groups and 15 minutes were given to them to finish the drawing.
- Then they were asked to present what they have produced.
- During the presentation several questions were asked: why is such-and-such an item included? Why are those features important to the homepages? Why must the features be there? Etc. Presentations are important in allowing students to explain something that could not be as easily expressed through drawings.

MODULE 4: Brainstorming 2 (Allocated time: 30 minutes)

Objectives:

- To list out the features needed in developing their homepages.
- To determine the new characteristics of web page tools that might not be available in any existing features as in analysis 1.

Activities:

- Results from Brainstorming 1 were used in this module where all features were listed out based on the characteristics of web page tools as stated below.
- A few topics were discussed informally according to the questions below:
- If they want to develop the homepage that they have been drawn in Module 3, what are the characteristics of tools they need?
- How will the tool assist them in developing their homepage?

MODULE 5: Designing (Allocated time: 30 minutes)

Objectives:

- To design a prototype of web page construction kit on paper based on all existing as well as new features and also characteristics that have been discussed in all the modules above.

Activities:

- The sketch of prototype was done on only a piece of paper by the researcher based on instructions from the student(s).
- It was done according to listed features from Module 4 where the feedback on how the features should be presented was given by the students.
- From all of the features and characteristics in Module 4, we finally came out with a prototype of tools to be developed.

From the discussion and activities in all modules during the interview, a lot of information was gathered and can be divided into 4 main ideas:

(a) Children's ability and skills in computer interaction and any existing web page construction kit
(b) Children's web page characteristics
(c) Problems with the existing tools
(d) Design and characteristics needed for web page construction kit (from Module 5)

5.2 Children's Ability and Skills

Most of the respondents are already familiar with several basic operations in windows environment. Below are several basic operations and interactions that were observed during the discussion.

(a) *Mouse Operations :* They already know several basic mouse operations such as choosing the menu by mouse pointer, clicking left hand button to select the menu, holding left hand button to drag and release it to drop and holding mouse button to draw.

(b) *Keyboard operations :* Basically, they know the character keys on keyboard accept the usage of Ctrl, Alt and Shift buttons.

(c) *Menu*: They are quite familiar with several types of menus for instance; pull down menu, single menus as well as tools bar. Respondents also did not like the tree structure menu because it was too difficult for them to predict and determine the menu group of certain operations.

(d) *Drag and drop* operation: They have no problem with this operation because they are quite good in using pointer devices especially mouse and joystick.

(e) *Deleting*: They are familiar with this operation especially for text editing either using backward button or delete button on the keyboard.

(f) *Icon:* They have also the ability to recognise and understand several operations described by icons. For instance;
- Object icons such as printer to print document.
- Control icons such as scroll bar.
- Tools icons such as pencil to draw.
- Status indicator icons such as hourglass showing that processing is still in progress.

(g) *Knowledge of Internet*: The sketched web pages that they have produced clearly show that most of them already know about hyperlink, homepage or web page address and email. During the discussion, they can talk about the Internet and they also mentioned about web pages that they used to visit.

5.3 Children's Web Page Characteristics

The results are based on web pages that they have produced and presented on paper in Module 3. There were 2 main differences between boys' and girls' web pages; the design and the content as shown in table below.

Table 2: Children's web page characteristics (Module 3)

Issues	Boys' Web Page	Girls' Web Page
Design	♦ More complex ♦ Difficult to be understood ♦ More creative ♦ Filled with currently cartoons ♦ Involve games	♦ Not as complex as boys' web page ♦ Straight forward ♦ Use of pastel or less gaudy colors
Content	♦ More likely to share what they have ♦ Hiding their identity	♦ Talking about themselves, family and friends ♦ Describing their hobbies

5.4 Problem with the Existing Tools

A problem in using the existing tools is one of the reasons why most of them are not interested in creating their own web pages. The results are compiled based on interaction and discussion in Module 4 and comparing it with the existing tools in Analysis 1.

(a) *Usability*: The existing tools were quite difficult to use especially for beginners. The buttons used in the existing tools sometimes did not describe and match the operation that it should present. The text based construction kit needs an understanding of HTML tags which were of course difficult for children. Sometimes also, it takes a long time to execute a simple operation such as text arrangement which they need to do manually either by hitting the spacebar or creating a table.

(b) *Wizard*: The wizard in existing software only require them to fill in the information needed and then the web page will be created automatically after pressing the 'finish' button. Thus relying on the wizard did not help them in actually learning how to use the software. Consequently it is quite possible for them to lose interest in learning to use the software and creating homepages.

(c) *HTML tag*: Many of the existing tools are still required knowledge in HTML tags. This will take time to create homepage because they need to understand and learn HTML tags which is not easy for children.

(d) *Preview*: They did not know how to put their own images, background, bullet and divider into their homepage. Most of the existing tools need a few steps to insert any graphics. The user needs to browse the file and select it. The image will be inserted automatically and only after that can it be highlighted and changed to the different places. Unfortunately, some of the existing tools did not have the preview feature where the user needs to check the images using an external viewer before inserting it into the webpage.

(e) *Animation:* For animation, some of the existing tools require knowledge in Java Script, VB Script and so forth. It was quite impossible for children to write a script as they have problems in learning HTML Tags which is easier. Some of the tools that provide this feature were not easy to set especially the terms used in setting and configuration part.

(f) *Sound*: Normally, sound insertion and recording and are not offered in existing tools and it is difficult for them to insert it manually by editing

(g) *Icon:* Some of the buttons did not represent the real operation that it supposed to, and sometimes cannot be understood at all.

(h) *Help:* Sometimes they encounter difficulties in starting a project; they might not be ready or familiar with the tools or lack ideas on what to do and where to start. The Help features provided by existing tools are quite difficult to understand because they are presented in text.

(i) *Publishing:* They did not know how to publish or upload their homepage to the Internet. They have problems with the terms used in these features in the existing tools.

(j) *Interface design*: Several existing tools are also too complex being suitable only for intermediate and advanced users. The interfaces are not easy to learn especially for the first time user. The interfaces are not attractive and do not encourage them to learn or even to try them.

5.5 Characteristics Needed for Web Page Construction Kit

The characteristics are based on results from Module 5. The needed and suggested features or characteristics can be categorized into 4 parts.

(a) General features
- Guider – will guide them in constructing web pages and at the same time help them learn to use those tools.
- Link – easy to set hyperlink and displaying either in text or images. They need only to key in the address.
- WYSIWYG
- They can produce more than one page at the same time
- Text and Icon – lots of choices and easier to understand
- Printing – will be done by pressing only one button
- Counter – calculating web page visitor
- Email – they only need to insert their address

(b) Graphics features
- Image editor – they must be able to edit images directly on web pages without executing another graphics tool.
- Inserting images – images include background, images, bullets, dividers and buttons. They must be able to see all the possible images before they make the selection.
- Animation – to animate text or images, they only need to select the particular text or image as well as the animation. Pre-view for the selected animation must also be provided.

(c) Publishing
They can upload their web page with the minimum setting.

(d) Sound
They can make their own voice recordings which can than be inserted automatically without the need to execute outside programs.

From these 3 analyses, the results were compiled and synthesised to become a reference in designing web page construction kit for children.

6.0 CONCLUSIONS

From this research, conclusions can be made that the 3 concepts; point and click, drag and drop and object oriented are suitable to be implemented in web page construction kits for children and also in any tools or software for children. Together, the 3 concepts make the software easier to use and to learn. Besides these concepts, some of the video game features also can be implemented in any non-game applications such as measurement and sound effects. By doing so, it will attract the children to learn and use the software.

The wizard that based on helping and teaching is giving them better and faster understanding of the software. This research also found that, in order to develop any software especially for children, the developer needs to understand their mental model. The direct involvement of children in this project is an important element as it shows the difference between the actual children's mental model and the developer's impression of the children's mental model. Developer must act like a friend to encourage them in giving unlimited information.

Below are factors that need to be considered in designing software for children.
1. Reduce number of menus to be displayed
2. Reducing number of buttons to be pressed for any operations.
3. Considering the existing tools
4. Quick display option
5. Brightness, sizes, shape and color of icon
6. Able to encourage children and making fun
7. Combination of icon and text

Below are several questions that need to be considered in order to develop any software for children.
1. How will the children understand the software being developed?
2. How will software reflect the children?
3. How will the children learn?
4. How will children use the computer?
5. How do we encourage children to use computer?
6. What will the children use as a reference for any software and hardware?
7. What are their problems that are not usually addressed?
8. How can we measure their ability to interact with the interface and manipulate the item on screen?
9. How do gender issues influence the interface design?
10. How do the children differ from adult, in terms of development level and the way they use the tool?
11. What are the influences of hardware and tool technology as their interface requirement?
12. How will the children interpret size and location of icons on screen?
13. What is the limit of sound to support user interface design?

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BIOGRAPHY

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