Internet for the Youngest: Computer Usage and Web Design for the Early School Age Children

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Abstract - In this paper we will talk about the Web usage practices and Web page design aimed at children of an early elementary school age. Learning about differences in understanding and using the Web should aid in the development of Web content for children. Thus research in opinions, practices and needs of the Internet's youngest users should today be considered a must, also in order to provide a better education about those topics. Data was collected through the field research in an elementary school in Zagreb. 90 students answered the questionnaire and additional 12 students were randomly selected for the interview.

***Index Terms*—early elementary school age children, Internet's younges users, web design, web usage.**

I. INTRODUCTION

Main ideas behind this paper are to learn more about the Web usage practices among the early elementary school age children and to find the most appropriate page design for them. The authors believe that children ages six to ten do not perceive web the same way that older web users do. Their needs, interests and searching habits differ largely and thus should be taken into account accordingly.

We believe the research i.e. knowledge about their needs, habits and opinions to be very important and should receive much more attention than it did so far. As to our knowledge, no similar research has been done so far in Croatia. It seems that children's opinion is not taken into consideration even when pages are partly or fully aimed particularly for them.

In order to learn more about the perception of web among this particular group of web users we have conducted a research in one elementary school in Zagreb. Larger group of students has taken a questionnaire while randomly chosen smaller group has been interviewed in more details.

The paper is divided in three sections. The first section gives a short overview of foreign research about the children's usage of computers and web and tips for building the children appropriate web design.

In the second part our own research is shown with more details and includes methodology of the research, description and explanation of questionnaire data.

The third section brings our commentary on obtained data and gives suggestions for their further usage in developing web pages.

The aim of this paper is to give concise and yet usable introduction to children's web usage since web is considered to be one of the fastest growing media of today. At the same time we are hoping that our data can serve as a reference for building better web pages for children as well as a reference data for some larger future research.

II. THEORETIC OVERVIEW

In this section we will give a short overview of recently undergone research in the USA and EU which show the increased usage of computers and web in particular by the youngest users. Although their researched groups included both preschoolers and high school students, it will be interesting to see their results. The main aim of both researches was to alert both parents and teachers to dangers of web usage and to stress the point that web is not only filled with educational and fun contents but with inappropriate ones as well.

The number of adolescent web users is constantly growing. Thus, it is important that web developers and designers keep in mind their specific needs that in some aspects largely differ from those of an ordinary user. These two studies have offered specific data on most often online activities of younger web users. Due to the constant growth in number of young web users it is quite clear how the web pages designed mainly for them have to be customized to meet their needs.

A. USA Research

The US study [2] includes 1735 households with children ages two to seventeen. Questionnaire was submitted through the phone calls in which 601 children ages 9 to 17 took part. 61% of those children have declared themselves as regular web users. This data is particularly interesting since only 52% of their parents use web.

Most of the interviewed parents say that the main reason for buying a computer is their children's education. Furthermore, they have noticed that children web users, spend less time watching TV and pay more and more attention to non-electronic activities such as reading a book and/or magazine, artistic or outdoor activities.

Although both girls and boys spent approximately same amount of time using web, their web activity mostly depends on the gender. Girls rather use web for educational and interactive purposes (e-mail and chat). At the same time, 30% of boys do not use e-mail at all and

50% use web once a week at the most and only for entertainment (playing games).

B. European research

EU study [3] brings data similar to the US study, but with more specific division among age groups. Online games seem to be the most frequent activity for the nine and ten year olds regardless of the gender. This age group uses the web 3 to 4 times a week.

Twelfth to fourteen years old ones use the web daily. Online games remain the important activity only for the boys of this age group. On the other hand, girls are starting to use e-mail and chat as their main activities, just as it is the case in the US study. Entertainment still seems to be the most common activity while educational content is solely connected to homework. Other activities are quite rare and mostly apply to older age group (12 to 14 years old). These activities are writing own blogs, commenting other blogs, and downloading (pictures, games, music). General conclusion is that girls, compared to boys in the same age group, have much wider online activities.

C. Croatian research

At the present time we were unable to find any empirical research related to views and habits of Croatian younger children as web users. There are only two references for Croatia that we have used in this paper. The first one is the research on criteria for evaluating educational web context [7]. The second one is the research on computer assisted spelling practice [5].

D. Adjusting the web design

As the number of younger web users increases, the number of web sites intended for that age group increases proportionally.

Children as the target group are quite specific. Adjusting the web design to meet their needs implies the knowledge about the development of cognitive processes and motorical skills. The situation becomes more challenging due to the fact that it is almost impossible to create an Internet site that is at the same time interesting, attractive and useful for the entire age group. Thus, it is necessary to determine whether the site being built is intended for the three, five or eight year old ones. Such adjustments do not only include the theme of the site, but its overall design, navigation and organization.

We agree with Denmer's explanations [4] as to why should children ages 3 to 12 be divided into (at least) three separate groups, depending on their psychophysical level of development. The three groups that she suggests are:

- *3 to 5 years old:* it is important to bear in mind the level of concentration that ranges between 8 and 15 minutes for this age group; site has to offer more audiovisual content and less text;
- *5 to 8 years old:* the direct environment ceases to be the only children's world allowing the sites to be more imaginative but still in accordance with motorical skills (essential for playing games);
- *8 to 12 years old:* sites should have as much of interactive content as possible.

Finally, relying on CNET Builder.com, Denmer [4] lists ten fundamental guidelines when creating web design for children:

1. determination of age groups,
2. inclusion of interactive elements (discussions, chat, e-mail, the possibility of independent page adjustments),
3. caution when seeking personal information (it is necessary to explain to both kids and parents the kind of information they are being asked for and for what purpose),
4. use of (animated) characters (for presenting useful information),
5. avoid boredom and /or excessive kindness (especially when treating somewhat complicated issues),
6. clear and intelligible way of navigating through the site and icon usage,
7. regular updates,
8. list of other sites dedicated to the same population,
9. testing the site (may include the observation of certain selected sample of children and their use of pages),
10. love for children as essential point for making a good web design for children.

Still, there are no general rules. The way children interact with a computer is still being researched. Thus, it is more then often recommended that children be directly involved into web design procedure. Such involvement on their part usually ends up with interesting suggestions. As the end product of this collaboration we are left with a quality web page - which is, after all, our primary concern.

III. QUESTIONNAIRE

The questionnaire included 90 students attending the first to fourth grade of an elementary school. They were asked what they know and think about computers and web. They also had a chance to write their likes and dislikes about Internet and web page design.

A. Methodology

The research took place at an elementary school in Zagreb. The sample consisted of one first grade (20 students), one second grade (18 students), two third grades (31 student) and one fourth grade (21 student). All questions were read and explained to the subjects.

The questionnaire was one page long, written in child-accessible language. There were 13 questions divided into two parts. Questions were formed as both qualitative and yes/no questions. First part was designed to gather data on general computer usage: presence of a computer in subject's home, usage onset, frequency and manners, subject's computer skills and their (and also their family's) views on the computers.

Second part consists of network-related questions: prior experience and knowledge (web sites, usual activities), interests and opinions of the web.

B. Problems

The sample size does not allow us to interpret our results as generaly valid neither for Croatia nor even for Zagreb. However, since there is no other data on the given population, the results can give us some basic pointers about matter in question.

The demographic statistics of the sample show some inconsistencies. Three out of four grades in the sample have 60% of boys, while only one (the fourth grade) has 75% of girls. Thus, the gender-dependant data should be viewed with this fact in mind.

Also, some answers were extremely polarized according to the grade in question. Those results are, in the opinion of the authors, not merely due to the age difference, but to the intraclass correlation and conformance to peer's opinions.

Because of these facts, results will be shown statistically and explained according to other influences.

C. *Results*

TABLE I.
QUESTIONS ABOUT COMPUTERS

Question	YES	NO	DK[1]
1. Has a computer at home	91%	9%	n/a
2. Used a computer	96%	4%	n/a
3. Used a computer before the age 5	37%	63%	n/a
4. Used a computer before the age 7	88%	12%	n/a
5. Learned to use a computer by her/himself	28%	72%	n/a
6. *Computers are meant for studying*	64%	20%	16%
7. Likes computers activities more then other activities	19%	81%	n/a
8. Considers computer-related profession in future	22%	48%	30%
9. *Computers are for boys*	23%	63%	14%
10.Can use a computer less then one hour a day	35%	65%	n/a
11. Can use a computer more then three hours a day	38%	62%	n/a

From the given table we can see surprisingly large presence of computers in the subject's lives. Most of them have computer constantly available and have used it before the average school age, some even from the age three. The fact that computers are used since the earliest age must be kept in mind when planning computer education, to point out the useful aspects of the computers, and warn about potentially dangerous ones.

Most of the subjects agreed that computers are, besides other usages, used for studying. But are they really using it for educational purposes? Only 15% of subjects named those purposes in qualitative questions.

As we can see from questions 7 and 8, computers are still only passively present in the children's lives. Only a smaller percentage consider computers as their favorite pastime or is already thinking about computer-related profession.

The most frequent answer on the question about method of computer education was that the subjects were taught by older family members. That points out how computer-related subjects are still absent from the early grades and are usually not present in public education curriculum.

The stereotype about computers being "the boy/male thing" is only loosely present. More then half of the sample disagrees with this statement. Among those who agreed, we find that only 10% percent were girls.

[1] *Don't know*, where applicable in answer

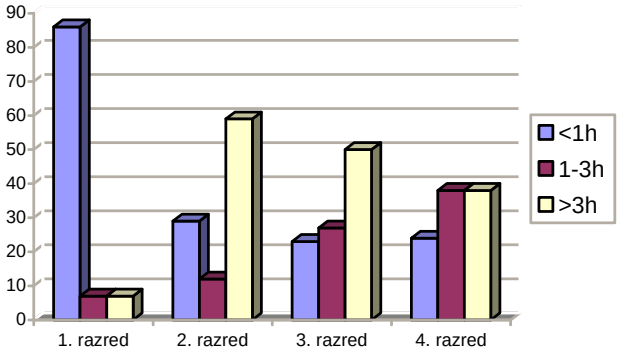

Figure 1. Daily computer usage limit

TABLE II.
INTERNET-RELATED QUESTIONS

Question	YES	NO	DK
Heard of the Internet	98%	2%	n/a
Actively used Internet	89%	11%	n/a
Can name some web sites	79%	21%	n/a
Has likes and dislikes about Web	44%	56%	n/a
Thinks Internet can be dangerous	65%	24%	11%
Wants to know more about Internet	84%	11%	5%
Internet is not for kids	22%	59%	19%
Internet is boring	78%	10%	12%
Internet should be more fun then it is now	67%	27%	6%

The question about time limits on computer usage given by the parents can be viewed more correctly considering the age of the subject. The graph in Figure 1 shows gradual increase of daily computer usage limit, with slight inconsistencies due to sample size.

Table II presents data from the second part of the questionnaire, the Internet-related questions.

Understanding the concept of the Internet is fairly problematic for some of the subjects. The boundaries between offline and online content can often be misunderstood. Some answers show that Windows applications like MS Paint are wrongly considered to be "one of the favorite web sites", or reversely, that subject was unaware that he or she was in fact using Internet when they named some online games they played and later stated that they have never used the web.

This data also shows that in the first and second grade, general computer entertainment and Internet entertainment are understood as interchangeable. Also, computers are still mainly perceived and used for entertainment purposes. Starting with the third and/or fourth grade, educational aspect becomes more prominent.

Still, even the youngest of the subjects show strong interest in finding out more about Internet. They learn about it fast, regardless whether the content is purely entertainment, educational, or combined.

The average scope of knowledge about Internet is fairly small, as it was expected. Most subjects are familiar with only few sites while a small number provided extensive lists. Most frequent answers are given in table 3, sorted by their frequency.

70% of all the answers are mainly online game portals, which show again the salience of online gaming in the list of main interests.

Also, most of the subjects agree that Internet should provide more fun. When asked to state what they would improve in order to make Internet more fun, the answers were less clear. Only few of the subjects explicitly stated their suggestions, and the other answers were concluded from the qualitative answers connected to the subject. Table 4 shows those results. First grade students' data were mostly taken out because of the lack of information in their answers.

Table 4 directs our attention to the points which are important in organization and design of children web content. Even when it is not recognized by subjects, the matter of usability of web content should be one of the top priorities in children's web design because it automatically disables other advantages, rendering the site virtually useless. The interview results show the basic principles on which children's web page usability is based, and their differences from what is usually considered as standard in usability.

TABLE III.
WEB SITES MENTIONED BY SUBJECTS

Grade	Web sites named	% of answers
1st	*Funnygames, Larina igraonica, Barbie, Bratz, Spiderman footage (Youtube?)*	20%
2nd	*Google, Youtube, Larina igraonica, Games2Girls, Miniclip, IgreIgrice*	53%
3rd	*Google, Youtube, Bratz, StarDoll, 247igre, TvProfil, PetShop, Games for girls, Funny games, Net.hr, Yahoo, Motherload, Best games land, Besplatne igre, Mousebreaker*	68%
4th	*Google, Youtube, Tulumarka, Yahoo, Playtoy, Miniclip, Besplatne stvari, T-portal, Funny games, Stardoll, Forum.com, Igre123, World's hardest games, Barbie games, Nora Fora, 24 sata*	95%

TABLE IV.
PREFERENCES ABOUT INTERNET

Rank	Best things about Internet	Dislikes	Suggestions for improvement
1	Availability of free games	Slow loading and errors on pages	More child related content (in quantity and quality)
2	Amount of information available	Lots of content irrelevant to subject's interests	Faster loading
3	Vast possibilities	Boring, too long or straining presentation	Greater availability and usability of content
4	Broadening one's knowledge	Potentially dangerous content	Protection from unwanted or pornographic content
5	Easy to change and add content	Content rarely renewed	Faster change of content on specific pages

IV. INTERVIEW

A. Introduction

In the interview, subjects were asked to view, navigate, and comment on five chosen web sites which fall into category of children web sites. All data about their interaction has been noted for later interpretation. Twelve subjects from the previous sample were randomly chosen for the interview: four from each grade except the first.

B. Methodology

The method chosen for the interview was adapted usability testing, as suggested by S. Krug [6], without filming the test on camera, with one moderator and two subjects examining the given pages simultaneously. After a short introductory conversation with the subjects, they were shown the pages and asked to navigate by themselves. Later some tasks were given to test specific usability issues. The interview took between 30 and 40 minutes for each pair of subjects.

The web sites used were previously selected with the following criteria in mind: Croatian language, a site being obviously suited for children regarding topic and representation, and maintaining diversity within sample.

Sites included are as follows: a children toy store site (www.crtic.hr), a children's web portal (www.klinci.net), a site for a television game show (norafora.hrt.hr), a site presenting the candy/toy product (www.magic-kinder.com/mkv2/HR_hr/index.html) and a site about a popular cartoon character (www.hlapic.net).

C. Results

1) Crtić Kids Club

The first site shown produced a positive reaction on the first glance, because of its cartoon-like interface with sound and animation. The site itself is colorful and interesting, but lacks the standard organization of content and pointers for correct usage. Thus it was expected the site will prove to be difficult to navigate and less usable. Most subjects did show some bafflement over site's theme and purpose and thought of it as an interactive animated film. Younger subjects have shown greater interest. Regardless of their age, most subjects were impressed with multimedia presentation which they considered the most interesting aspect of this site. There have been some difficulties navigating, and only one of the subjects managed to correctly identify the site's purpose. Nevertheless, it is important to note that majority of children pointed out that they enjoy the interface and "investigative" character (e.g. clicking on the animals which appear randomly to get to a part of the site, not knowing what to expect). The site in whole was considered as an interactive game.

This analysis has shown that, although the site didn't provide easily available information about its topic, it was generally well accepted because of its entertaining interface. The other important point is that the same usability standards do not apply equally to adult and children population. In children's web page design the choice to use fewer standards and more of interactive play opportunities can provide better results then to copy pre-made usability rules.

Still, it is advisable to give more simple and subtle pointers for correct usage, in order to prevent confusion and shift of the young viewer's focus elsewhere.

2) Klinci.net

The second site was organized more like a classic web portal or blog, but using child-friendly characters, animations and content design. Although the impressions were not as great as for the previous page, subjects managed to reach more content without outside help or suggestions. Smart usage of standards can be useful to implicitly develop knowledge about content organization on the Internet and prepare children for later web usage. This manner of design is best choice for a site where content is more important then the presentation and where is no distinct topic but more of a general content.

This site was perceived as an online magazine with both educational and fun content (nearly vast choice of games provoked most interest). Generally it was better accepted by older subjects because they could relate to more content. However, all subjects with the previous knowledge about using Internet found it usable.

3) Nora Fora

The television character, which this site is based on, was previously known to subjects, which caused some bias in their judgment. The site is full of educational and fun content as well, not necessarily connected to the show, for instance surveys and knowledge quizzes or interactive Flash "house" which incorporated various games user can reach by clicking the "furniture" or "characters". Both parts were well accepted among subjects. They showed great interest in testing their knowledge and comparing their opinion about sportsmen or artist to others in surveys. Also, the part with the interactive "house" was chosen by almost half of the subjects as most fun part of all sites shown.

This site has once again proved how "investigative" design is useful in maintaining interest in the content, and proposed a way of combining educational content with challenge, which is one of main points in gaming. Usage of quizzes and surveys is advisable if they fit in the site's content.

4) Magic Kinder portal

The fourth site was thought of as most baffling at first sight. The purpose could not be precisely identified, although the subjects are familiar with the candy product with toys this site is presenting. The site is a mixture of commercial content, games and advices, some of which are most likely meant for usage with adult supervision, because it has not been adapted to child-accessible language and presentation. It should be noted that this site is a Croatian translation of its international version.

The design follows standards on the surface, but deeper examination shows some inconsistencies and causes the user to miss a lot of content. Games on the site were received well, but it took a lot of time for them to be found. Without directions, some subjects were giving up, because presentation didn't clearly promise any content and it lacked pointers for easier navigation or game-like investigation. In general, this site was perceived as the least interesting one.

5) Hlapićev portal

The last page viewed was also about previously familiar characters from various media, and the initial impressions depended on subject's opinion of the characters. Seemingly simple design was in fact organized in less logical textual menu, although the whole site uses Flash. Because of its simplicity, most of the site was covered in the navigation, but since it lacked organization principles, it was difficult to find specific areas when asked.

Introductory animation appeared on every reload of the home page, which was necessary for further navigation, and constant repetition was thought of as uninteresting. Games on the site were again the most popular content. Some activities, like making school schedules, were also popular. The site in whole lacked educational aspiration as it was aimed more as a presentation of the product and, similar to fourth site analyzed, provided mostly product related entertainment.

Subjects generally thought that site lacked multimedia presentation and interactivity, because of its surprisingly static design despite using the Flash technology.

Using this data, we can list a few basic pointers for web site design adapted for children population.

Main points of interests on a web site are as follows: games, animations, sounds; quizzes and surveys; fun characters (especially animals); and variously themed articles.

Content organization pointers:

- usage of multimedia,
- providing explanations and directions where necessary,
- possibility to investigate content; or a clear logical organization faithful to web standards; but not both in the same area,
- saliency of most important parts,
- gradual introduction of elements,
- simplicity of navigation: using standard control buttons on a browser and a mouse, differencing between static and clickable content,
- replacing the standards only if its replacement is usable enough (proven through usability testing),
- previous planning of the whole concept.

It is not imperative that all of the elements listed should be present in a well designed and usable children's web page, but their interests, motorical and cognitive abilities should be considered in each phase of a design.

Another interesting point is a choice of web technologies to be used in children's web design. Most of the sites includes in the interview were made with the Macromedia Flash. The issue weather to use Web 2.0 technologies could be pointed out. Main aspect of Web 2.0, the social interaction, is still rarely used on the web if the user is aged six to ten. This situation could be changing soon, but at the moment the sample population showed a little interest in blogging, social networks or even instant messaging. The only example was YouTube site which was very popular with web-savvy subjects, but they explained that they like it because of the funny videos and music. We can see it is still used for a linear enjoyment of videos while advanced functions are still neglected.

The issue about chosen technologies is not the primary issue in children's web page design, but more advanced technologies facilitate adapting the ideas to a final product, fulfilling the requirements for a well designed children's web site.

V. CONCLUSION

This paper shows the habits of using computers and Internet in children from the first to fourth grade of an elementary school.

The first part is a brief theoretical overview of similar studies in the United States, Europe and Croatia.

The second part presents the survey given to 90 children. The main emphasis was on their attitudes toward computers and towards the Internet. This gave us an introduction to their understanding of the world of information and an overview of their attitudes towards it. The survey concluded that the children's knowledge of computers and the Internet is quite extensive considering their age, and grows almost exponentially between first and fourth graders. Also, children's interest in it is surprisingly large, as well as is their desire to learn more about computers and about the Internet. Subjects expressed the greatest interest in online games, multimedia content such as music and videos, and the older ones in educational content as well.

The 12 subjects from the survey group were selected for further, more detailed interview during which they tested the efficiency of five web pages in Croatian language. Their comments are represented in the third section of this paper, where they are interpreted in the context of the survey. This interview gave us a better insight into the elements that first attract child's attention, methods of orientation they use at the site and possible traps in the organization of contents.

The usage of web design standards seems not as important for this age group as it is for the adult population. What is important is that the content is logically organized, easily available and well explained, thus enabling the user to find the essential parts at any point in time.

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