Children design their interfaces for Web search engines: A participatory approach

Abstract: This study involved eleven seventh-grade children in designing interfaces for Web search engines that meet their needs. Using a participatory approach, children drew interfaces and articulated their purposes. The layouts of these interfaces varied, but the features/capabilities described in them were similar. These were: keyword searching with instructions; natural language/phrase with instructions; subject categories (minimal to extensive), links to advanced search engines that are designed for adult users (Yahoo, Altavista, Askjeeves, and Google), and help. Minimal color was used in these interfaces; however, children expressed the need for color in writing.

1. INTRODUCTION

Today, children are more exposed to computers and technology than ever before. The Internet/Web has become one of the major investments in information technology in schools. Young people are fascinated by, challenged, and motivated in using the Web (Bilal, 2000; Large & Beheshti, 2000; Hirsh, 1999; Watson, 1998). In a recent survey of Internet use by young people ages 12-17, 94% mentioned that they use the Web for school research and 78% said they believe the Web helps them with schoolwork (Pew Internet & American Life, 2001). “The Web is causing educators, from preschool to graduate school, to rethink the very nature of teaching, learning, and schooling” Owston (1997, p. 27). Researchers are investigating how children use this information technology tool and to what extent it supports their information seeking and needs.

Research on children’s use of the Web is modestly covered in the literature (Bilal, in review; Bilal, in press; Bilal, 2000; Bilal, 2001; Bilal & Kirby, in press; Bilal & Kirby, 2001; Large & Beheshti, 2000; Hirsh, 1999; Bilal, 1998; Schacter, Chung, & Dorr, 1998; Kafai & Bates, 1997). However, research on children’s involvement in the design of Web search engines is non-existent. Today, there are at least three Web search engines that are specifically designed for children (Yahooligans!, AskJeeves for Kids, and KidsClick!). These engines have not leveraged to make children’s interaction with their interfaces optimal (Bilal, 2000; Bilal, 1999; Large, Beheshti, & Rahman, 2002). In fact, system designers hardly consult with children when they develop interfaces for them (Druin & Solomon, 1996; Jacobson, 1995). Many children (ages 7-12) prefer to utilize search engines that are designed for adult users due to the vast amount of information they can find and the variety of searches they can perform (Bilal, 2000). Use of these engines forces children to negotiate interfaces that require complex content knowledge,
sophisticated search syntax, abstract concepts, and adult vocabulary, as well as necessitate a high level of reading skills that are beyond children's cognitive developmental abilities.

The design and implementation of effective interfaces should attempt to anticipate the user's needs and wants. As Tognazzini (2001) notes: "The computer, the interface, and the task environment all "belong" to the user" (p. 1). Of course, user autonomy does not mean abandoning rules that are vital to the operation of interfaces. Today, there is a great need to develop prototype interfaces that use children as "informants" or "design partners." How can such endeavor be achieved? What design methods should be undertaken? Examination of how children design interfaces for a Web search engine could lead to the development of a prototype search engine that meets their needs, as well as provide guidance for improving existing interfaces that are designed for children.

2. RELATED LITERATURE

Many studies of children's use of the Web have had implications for system design improvement. In three studies of children, ages 11-13, Bilal (2000; Bilal, 2001; Bilal, in press) examined children's information seeking and success in using Yahooligans! to locate information for an assigned fact-based task, an assigned research-oriented task, and fully self-generated tasks. These studies employed both quantitative and qualitative inquiry methods. Children's Web activities were captured using the Lotus ScreenCam software package. Their affective experience and perceptions about the engine were elicited during individual interviews that took place at the end of the research experiment. The experiment was conducted over the course of five days. The fact-finding task was performed on the first day, the fully self-generated task on the third day, and the research-oriented task on the fifth day. The key findings of these studies are below:

Children's success varied by task. They were more successful in finding information for the fully self-generated task (73%) as opposed to the fact-based task (50%) and the research-oriented task (69%). Overall, children were more successful when they browsed than when they searched by keyword on the three tasks. This was due to the poor structure of Yahooligans! keyword searching.

Children's information seeking-behavior (cognitive and physical) also varied by task. They browsed more sites on the fully self-generated task than on the fact-based and the research-oriented tasks (means=12.26, 8.4, 4.15, respectively). Children looped searches and hyperlinks (reactivated previously executed searches and launched previously visited hyperlinks) more often on the fact-based task than on the fully self-generated and the research-oriented tasks (means=5.1, 1.93, 1.54, respectively), and backtracked (used the Netscape Back command) more often on the fact-based task than on the fully self-generated and the research-oriented tasks (means=12.2, 7.4, 6.07, respectively). Children took equivalent time to complete the fully self-generated task (mean=14.35 minutes) and the fact-based task (mean=15.78 minutes), but they spent less time completing the research-oriented task (mean=10.42 minutes). Children had more instances of misspelling
errors on the fact-based task (35%) as opposed to the fully self-generated and the research-oriented task (13%, 2%, respectively).

Most children (47%) preferred the fully self-generated task to both the research-oriented and the fact-finding tasks due to their ability to find the information sought. However, only 67% were able to formulate a focus for their fully self-generated tasks during mediation that was initiated by both the researcher and the school librarian.

The inadequacy of Yahooligans! interface design, especially keyword searching, was at the crux of the “breakdowns” that most children experienced. Interview data revealed that most children (87%) liked using the engine mainly because it provided keyword searching, had colorful graphics, and was fun to use. However, they did not favor its slow response time, lack of relevant information, and return of zero retrieval. The complex design of the retrieval interface was confusing to many children.

Children made these recommendations for improving the design of Yahooligans!: (1) add more sites, (2) add more categories, (3) add more keywords, (4) improve screen display, and (5) make response time faster. The first recommendation (add more sites) denotes that the database needs enhancement. The second one (add more categories) implies that the content of the subject categories should be better represented. The third recommendation (add more keywords) indicates that database indexing should be enriched. The fourth recommendation (improve screen display) refers to the retrieval interface, which shows subject categories and sites within categories. Although the hierarchical structure employed in Yahooligans! facilitates browsing, the retrieval interface of subject categories and sites within categories were confusing to many children. Broad categories, for example, had multi-level hierarchical menus that many children found difficult to navigate. The fifth recommendation (make response time faster) suggests the need for speed in page loading to ease children’s frustration.

In sum, these three studies uncover the need for design improvements in Yahooligans! In addition to children’s recommendations for improvements, system designers should provide effective keyword searching, more instructions and search examples, effective help and feedback mechanism, an on-line tutorial, a natural language interface, simple retrieval interface, and a thesaurus or an alphabetical listing of terms indexed in the database.

Surprisingly, not only children, but also adults experience problems with using Yahooligans! In a study that compared children’s and graduate students’ information seeking and success in utilizing this engine, Bilal & Kirby (2001) found that both student groups were more successful when they browsed than when they searched by keyword. Graduate students liked Yahooligans! hierarchical structure due to its simplicity and comprehensiveness and favored its uncluttered interface and colorful graphics. However, they were dissatisfied with the zero retrieval it returned, lack of advanced search features, and the poor guidance under the Help file. The students recommended these design improvements: (a) provide a more in-depth database with more sites; (b) improve the help files, make headings and text in the help files more precise, and include how to use
Boolean in these files; (c) employ Boolean operators; (d) add a browsable index; (e) add more search options (phrases, proximity, and nesting); (f) improve keyword searching; (g) enhance response time; and (h) reduce the number of redundant sites.

There is no doubt that these graduate students' information needs were more sophisticated than those of the children's. Since Yahooligans! provides sites for adult users (e.g., teachers and parents), system designers should take adult users' recommendations (e.g., graduate students) into consideration to improve the engine's interfaces.

Bilal (1999) evaluated and compared the performance of three Web search engines specifically designed for children (Yahooligans!, AskJeeves for Kids, and SuperSnooper) using queries submitted by twenty-two seventh-graders. She concluded that each engine had strengths and weaknesses. Despite the positive features SuperSnooper offered (e.g., large database size, a spell-checker, a feedback channel), its lack of online help and FAQ were main weaknesses. While Yahooligans! strengths was, and still is, in its directory structure that facilitates browsing, its poor structure of keyword searching, as well as lack of effective Help, a spell-checker, search instructions and examples, a corrective feedback channel, and a thesaurus or browsable index are major problems. Despite its natural language interface capability, AskJeeves for Kids weaknesses were, and still are, in its limited knowledge base, lack of descriptions or annotations of hyperlinks, and complex retrieval interface.

In a study of young users, ages 10-13, Large, Beheshti, & Rahman (2002) explored the design criteria that these users liked and disliked in four Web engines: Yahooligans!, AskJeeves for Kids, KidsClick, and Lycos Zone. They concluded that effective search engines should employ attractive screen designs with color, graphics, and animation. Both keyword searching and browsing by subject categories are needed. The complexity of the retrieval interface in these engines, especially AskJeeves for Kids, provoked children's frustration.

Kafai & Bates (1997) investigated elementary school students' interaction with the Internet at five different elementary classrooms that participated in the SNAPdragon Project. Children evaluated Web sites and created an annotated directory for use by other children. Few advanced students used search engines to locate information; the names of these engines were not provided. The findings of this study have implications for Web site design. Children prefer sites with high visual content and short, simple, textual content. In addition, they also want more animation and interactivity on the Internet. Children have a low tolerance for long download times, a finding that is congruent with Bilal's (2000; Bilal, 1998) and Neilsen's (2002) research findings.

The above studies have contributed to our understanding of the problems that children encounter in using the Web and search engines. They have also crystallized the features and design criteria that are important to children. However, these studies did not use children as "design partners" in developing interfaces for Web search engines that meet their needs. This study is the initial attempt to fill this research gap.
3. RESEARCH QUESTION

This study addressed this research question: *What kind of search interfaces do children design for Web search engines that meet their information needs?*

4. RESEARCH METHOD

This study employed a participatory design process; that is, it involved a group of eleven middle school children in designing interfaces for Web search engines.

4.1 Participatory Design

The studies reviewed in this paper employed a user-testing approach (also known as usability testing) to either examine children’s information-seeking behavior and/or to elicit their feedback about the design criteria they favor and dislike in the engines. While user testing is an essential part of Web development, participatory design goes one step farther. Through this approach, "users move out of roles such as observer, approver, "knowledge repository"...and into roles such as peer co-designer, design owner, expertise contributor, and self-advocate" (Fleming, 1998, p. 37). Druiu, et. al. (2001) add that children are capable of being “design partners,” and with this role, they are equal stakeholders in the design of new technologies.

4.2 The Students

Eleven students from seventh-grade classes participated in the study. Based on the researcher’s selection criteria, the Guidance Counselor at the Middle School where the study took place compiled a list of male and female students with high and low achievement scores on Tennessee standard test. The school librarian selected every 5\textsuperscript{th} student from the list, male and female, with high and low scores. The final list resulted in thirty students whose parents were contacted for permission to participate in the study. Eleven students were in the final sample, but they were not equally comprised of male/female or high/low achievement scores. Therefore, neither gender nor achievement scores were used as a factor in data analysis.

The sample size (11 students) is sufficient for conducting this kind of study. Fleming (1998) comments that there is no point in using more than 10-15 people at a time since it will be impossible to observe them all in a meaningful detail.

4.3 Procedures

This study took place in June 2001 at a middle school located in east Tennessee. Children gathered at the school library and were asked to sign a consent form to participate in the study. Each child was given a number to identify himself/herself. The research team comprised the researcher, two school librarians and one trained research assistant. Each team member had an instructions sheet indicating his/her role in data collection..
The researcher and one of the school librarians explained the purpose of the study to the children and provided them with instructions on how to proceed with the drawing of interfaces. Children were given color crayons, pencils, and color paper to complete this task. Children drew their initial interfaces on "blue paper" and transcribed on the verso of the paper the purposes of the interfaces. Children were given the time they needed to complete this task. After a short break, they used Yahooligans! to find information for a topic of interest to them. Later, they provided feedback about using the engine on a questionnaire that had these two open-ended questions: 1. What did you like about Yahooligans!, and 2. What did you dislike about Yahooligans! Children used the blue paper given to them and wrote down the feature(s) from Yahooligans! that they choose to add to their drawings. Each child was interviewed individually to elicit his/her rationale for adding the feature(s) to the original drawings.

Like Yahooligans!, children used KidsClick to locate information of interest to them. Later, they provided feedback about using the engine on a questionnaire that had these two open-ended questions: 1. What did you like about KidsClick, and 2. What did you dislike about KidsClick. Children used the green paper given to them and wrote down the feature(s) from KidsClick that they decide to add to their drawings. Each child was interviewed individually to elicit his/her rationale for adding the feature(s) to the original drawings.

5. RESULTS

This study reports the preliminary results of partial data analysis. Due to space limitations, only four out of eleven drawings of search engine interfaces are shown (Figures 1-4). Analysis and interpretation of the four drawings are provided below. Children's responses to the questionnaires and results of the interviews are being coded and analyzed; therefore, they will not be reported in this paper. Since analysis of children's drawings vis-à-vis Yahooligans! and KidsClick interfaces are still in progress, a comparison of the drawings to the interfaces will not be provided here.

As seen in Figures 1-4, children were very capable of drawing interface for Web search engines. They gave their engines these names: Alibb.Com, World Wide Search, Kids.Com, and Cattrin.Com.

Alibb.Com interface (Figure 1). This interface includes two labeled boxes, one for keyword searching and another for natural language searching. Subjects are organized in three categories, one for School related topics, one for Miscellaneous (the child misspelled as “missalanaus”), and another for Sports. The child lists four search engines that are designed for adult users (Yahoo.com, Askjeeves.com, Altavista.com, and Dogpile). This child wants the search engine to be "easy to find what the person wants and should be colorful." After using Yahooligans!, the child chose to add three subject categories to his/her drawing: Games, Jokes, and Chat rooms. No feature was selected from KidsClick after using it.
World Wide Search interface (Figure 2). This interface has a search box for keyword searching and another for phrase searching. The interface has five subject categories and includes a section for finding geographic information. The section has search boxes for city, state, zip code, keyword, and phrase. The Help feature appears twice on the screen, one under the subject categories and another in the lower right hand corner. The child believes that the engine "should find the quickest way to where you want to go. It shouldn't let the people into adult rated screens." After using Yahooligans!, the child chose three subject categories to add to his/her drawing; Chat rooms, News, and Maps. No feature was selected from KidsClick after using it.

Kids.Com interface (Figure 3). This interface has a box for keyword and phrase searching. It links to these advanced search engines (Askjeeves, Altavista, Google, and Yahoo). This child organizes the subjects of interest into four categories: School, Sports, Friends, and Fun Stuff, three of which have boxes labeled "Search." Only one picture is included and color is only used for the name of the site and the headings of subject categories. This child wants this search engine to do the following:

If you click on something, you will immediately be taken to a lot of information on that topic. Everything that can be clicked on has a dot (.) next to it...You can also search by typing in the subject or specific info. you are looking for and then click on that search button [a search box is drawn]. The website is very colorful and (hopefully) attracts a lot of people (kids).

Clearly, this child is very articulate of his/her information needs. Although he/she did not use lots of color in the drawing, he/she expressed the need for this feature in the comment above.

Caitlin.Com interface (Figure 4). This interface has a list of subject categories for both educational and entertainment purposes. It includes a Search box for entering a natural language question and another for performing a keyword search. The Help feature is provided in two places, one in the lower right hand corner and another in the middle of the screen. The interface links to URL addresses of these engines (Askjeeves, Altavista, Google, and Yahoo), and includes URL addresses for Fun sites. Like the two children who drew Kids.Com and Alibb.Com interfaces, this child favors engines that are developed for adult users. Only three images are included on the screen, and use of color is minimal. The child wants the engine to "have fun atmosphere while still letting the kids learn stuff." After using Yahooligans!, the child chose to add these features to his/her drawing: Movies, Music, Games, Quizzes, Daily Jokes, and Pictures. Interestingly, the child cited the Help feature for the third time. No feature was selected from KidsClick after using it.
Figure 1. A child’s drawing of the Web search engine interface Alibb.Com

Figure 2. A child’s drawing of the Web search engine interface World Wide Search
Figure 3. A child’s drawing of the Web search engine interface Kids.Com

Figure 4. A child’s drawing of the Web search engine interface Caitlin.Com
6. WHAT DO WE CONCLUDE FROM THESE DRAWINGS?

A final conclusion cannot be derived since the data analysis and interpretation is in progress. However, based on the eleven drawings that children designed, one can conclude that children can be effective design partners and informants in developing Web search engines. In this capacity, children are able to design screen layouts, dictate the features they need, and describe how these features should look like. Caitlin.Com interface, for example, has precise instructions for querying the engine in natural language (type a question here) and by using keyword (type a word here).

Based on Figures. 1-4, children desire these features in search engines: search by keyword, natural language, and phrase along with instructions for entering each respective search; browse by subject; a link to search engines that are designed for adult users (Yahoo, Askjeeves, and Google), help, images, and color.

The preliminary results of this study indicate that children prefer to use search engines that are designed for adult users (e.g., Yahoo, AskJeeves, Google, Dogpile). This finding is congruent with the results of both Bilal’s (2000) and Nilsen’s research (2002). Why do children favor use of “advanced” search engines and not the ones that are specifically designed for them? This issue should be addressed by system developers to ensure that the engines they design for children are not only “cool,” but also offer high “usability” so that kids do not go elsewhere (Nilsen, 2002).

The design process of a prototype search engine will require additional analysis of children’s information needs. In addition, this process will require the expertise of a software engineer, graphic designer, and an educational psychologist, as well as children’s participation. Usability testing of the prototype is vital for assessing how well it supports children’s information-seeking behavior and information needs.

Children can be effective partners in designing their own Web search engines. Druin (1996; 1999) notes that if we give children a chance to tell us what they are thinking, they most certainly will tell us honestly; and in fact, they can be brutal in their honesty.

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