
Interface Design, Web Portals, and Children

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ABSTRACT

Children seek information in order to complete school projects on a wide variety of topics, as well as to support their various leisure activities. Such information can be found in print documents, but increasingly young people are turning to the Web to meet their information needs. In order to exploit this resource, however, children must be able to search or browse digital information through the intermediation of an interface. In particular, they must use Web-based portals that in most cases have been designed for adult users. Guidelines for interface design are not hard to find, but typically they also postulate adult rather than juvenile users. The authors discuss their own research work that has focused upon what young people themselves have to say about the design of portal interfaces. They conclude that specific interface design guidelines are required for young users rather than simply relying upon general design guidelines, and that in order to formulate such guidelines it is necessary to actively include the young people themselves in this process.

INTRODUCTION

Children do not think in the same ways as adults (Bjorklund, 2000; Siegler, 1996). This has been recognized, for example, by the publishers of specialized reference books for children and in the separation of the children's library from the adult's library. Children now are using the Web widely as an information source for both learning and leisure, yet overwhelmingly they are using not specialized portals designed for children but rather adults' search engines or portals such as Google and MSN (Large, Beheshti, & Moukdad, 1999; Large, Beheshti, & Rahman, 2002; Bilal, 2000,

2001, 2002a; Large, Beheshti, Nasset, & Bowler, 2004). In some cases this might be because young people are unaware that children's Web portals exist, but even when they have encountered such portals, typically they do not use them. Is it possible to design Web portal interfaces in such a way that they appeal to young users and become their preferred entry point to Web-based information?

The interface to any digital information system—the means by which the user issues search and browse instructions and through which retrieved information is displayed—can be a major determinant in the success or failure of an information-seeking task as well as a mechanism through which assistance can be offered to the user. This article elaborates guidelines for the successful design of Web portal interfaces to be used by children when seeking information in an educational (rather than a leisure) context. Although it draws upon support from other researchers, it primarily is based upon our own research, in which we have worked with children in various ways in order to understand how they use interfaces, what problems they encounter in so doing, and what suggestions they themselves have for overcoming such problems. In particular, it will focus upon our work with students in the sixth grade of public elementary school (students of eleven or twelve years of age). Nielsen (2002), in his work with children and usability, has commented on the keen awareness that children have about their age relative to those even slightly younger or older than themselves. Our own studies support this observation. Caution therefore must be exercised in extending the following discussion either to much younger children or to older teenagers.

We shall not discuss in this article the equally important topic of Web site (in contrast to Web portal) interface design for children. Nielsen (2002) reminds us that very little is known about how children actually use Web sites or how to design sites that will be easy for them to use. He says that most Web site designs are "based on pure folklore about how kids supposedly behave—or, at best, by insights gleaned when designers observe their own children." Harbeck and Sherman (1999) propose seven principles that should be followed when designing Web sites for young children, and Agosto (2002) has developed a model of the criteria used by young people to evaluate individual Web sites.

Many authors have discussed interface design, and in such discussions it is not unusual to find an emphasis on the user. For example, Shneiderman (1998) argued that any design should be based upon an understanding of its intended users, and he includes age as one user characteristic alongside gender, physical abilities, education, cultural or ethnic background, training, motivation, goals, and personality. It is less common, however, to find in practice that interface design guidelines explicitly have taken into account youthfulness as a user characteristic, and even more unusual to involve the young users themselves in the design process.

Stevenson (2001) discusses several educational portals and assesses them in the light of eleven main categories that *she* considers critical for a children's portal. Broch (2000) examines Yahoo!igans! and Ask Jeeves for Kids in terms of children's cognitive and mechanical skills. McDermott (2002) reviews a variety of specialized subject portals that are relevant to students with homework assignments. Haycock, Dobor, and Edwards (2003) provide detailed evaluations of the twenty "most highly recommended and popular" portals designed explicitly for children's use on the Web, as well as short annotations on eleven others. Kuntz (2000), then manager of one children's portal, KidsClick (<http://www.kidsclick.org>), identifies five broad criteria that can be applied to evaluate children's search tools: database size, accountability, categorization, search access methods, and other features (like help, spell checking, and layout). Najjar (1998), in discussing educational multimedia user interface design, makes it clear that the guidelines were almost entirely based upon the opinions of (adult) experts rather than on the results of empirical research.

DESIGNING FOR CHILDREN AND CHILDREN AS DESIGNERS

Not all interface designs, however, have excluded children from participation in the design process itself. For example, Druin (1996, 1999, 2002); Bilal (2000, 2002a); Hanna, Ridsen, and Alexander (1997); Hanna, Ridsen, Czerwinski, and Alexander (1999); Kafai (1999), Large, Beheshti, and Rahman (2002); Large, Beheshti, Nettet, and Bowler (2004); and Large, Nettet, Beheshti, and Bowler (in press) all have advocated a child-oriented approach to design. They argue that children have a lot to offer in the design process as a whole and that it is advisable to include them in it. Children can come up with ideas that adults might not think of (Druin, 1996; Scaife & Rogers, 1999), but the downside is that they may want things included in the design that are impossible to realize.

Bilal (1999) has compared the performance by grade seven students on three Web portals specifically designed for youthful users: Yahoo!igans!, Ask Jeeves for Kids, and Super Snooper. She concludes that, as novices, children should use the portals designed for them, but she also found that each of the three portals had its own strengths and weaknesses for information retrieval. In a later study of Yahoo!igans!, Bilal offers a number of suggestions to system designers, who "should develop search engines with powerful searching and browsing mechanisms that build on children's cognitive and physical behaviors to search, browse, navigate and explore information with certainty and positive affective behavior" (2000, p. 662). She proposes more instructions, search examples, a natural-language interface, output ranking, simple screen displays, context-sensitive help, spell checking, effective feedback, and an online tutorial.

In our work with children we have employed four methods to explore their thoughts and ideas relating to interface design: observation, interview-

ing, focus groups, and intergenerational design teams. These are not mutually exclusive, and in practice we have used more than one in a study.

Observation

Observation is a technique employed in user-centered design where the user is brought in after design completion to assess the design's impact on the user. Children can be observed directly by researchers as they employ interfaces to find information. Such observation may be direct—the researcher is present while the interface is being used. This offers several advantages. The researcher can see what is happening on the display screen but also can observe the children themselves, noting their body language as well as their verbal communication. It is also possible to discuss with the children their use of the interface. A potential problem with such direct observation may be that the observation becomes intrusive, with the presence of one or more researchers influencing the behavior of the children.

In our case we opted for indirect observation. In 1998 we captured on videotape the seventy-eight sessions (with a mean of twenty-six minutes per session) undertaken by fifty-three grade six students searching the Web in groups of two or three to find information for a class project. Although the primary purpose of this research was to explore the information-seeking behavior of the students, analysis of the videotapes provided insight into how the students used two adult (rather than children's) Web portals: AltaVista and Infoseek. It might be argued that this is also intrusive, but in practice it seems clear from the irreverent comments on occasion made by the children that they quickly forgot that searches were being recorded. The main drawback encountered was that we could not identify which student in the group was doing what, and we could not intervene to ask why a particular move had been selected. It also proved difficult and slow to analyze interface use from the videotapes as typically cursor moves were executed rapidly and frequently.

Interviews

Interviews are another technique favored in user-centered design. Individual interviews with children after an interface has been used can probe the "why" of interface use: unlike observation, it enables the researcher to delve into the reasons why an interface was used in a particular way, as well as to elicit any ideas from the children as to how it might be improved. The children's comments are likely to be more reflective in comparison with ideas expressed during the heat of the search. However, children may find it difficult to recall after the event exactly what they were thinking at the time, and this problem likely will be exacerbated if the interview is not conducted immediately after interface use.

In our case, exit interviews were employed in the same class project discussed above (observation). The grade six students were interviewed after the completion of their project using open-ended questions, and

these interviews were audiotaped and subsequently transcribed. Many of the questions related to Web content, but the interviews also collected student feedback on the efficacy of the AltaVista and Infoseek search engines used in this project.

Bilal (2002b, 2003) used a different approach. She had several grade seven students individually draw an interface on one side of a paper and list the purposes of the interface on the reverse side. After a short break the students used a commercial children's Web portal, Yahoo!igans!, to search for information. They then discussed what they liked and disliked about it and noted the features they would want to add to their original drawings. Bilal interviewed the students individually to discover their rationale for adding these features. She then repeated the same procedure with KidsClick, another children's Web portal.

Focus Groups

A focus group can be defined as an informal assembly of target people whose points of view are requested to address a selected topic (Vaughn, Schumm, & Sinagub, 1996). The goal is to elicit the perceptions, feelings, attitudes, and ideas of participants through group interaction that encourages a range of opinions. The focus group has a moderator who sets the scene for the session and controls the proceedings. It is widely agreed that focus groups can be used with children so long as they are older than around six years. Although here we did not go so far as to design portal prototypes, the focus group members were invited to go beyond a mere critique of existing portals; they were encouraged to suggest how they would like to improve such portals so as to make them more effective for young users.

In summer 2000 we established four focus groups, each including five or six children aged between ten and thirteen years, plus a moderator and a note taker, to evaluate four operational children's Web portals: Ask Jeeves for Kids, KidsClick, Lycos Zone, and Yahoo!igans! Two of the groups comprised all boys and two groups had all girls (following recommendations in the literature that in the case of young people it is preferable to use single-sex groups). The groups were encouraged to critique the portals as they used them to answer four questions, and the discussions were audiotaped and later transcribed. In 2004 another focus group of seven elementary school students from grades five and six and all eleven years old, again with a moderator and note taker, was asked to evaluate a Web portal previously designed by an intergenerational team (see below). In all cases these focus groups met just once and the session lasted for around one hour.

Intergenerational Design Teams

Observation, interviews, and focus groups have been employed to gather children's reactions to existing interfaces, whether operational or prototypes. The intergenerational design team approach goes a step further by involving children actively in the actual design process, employing what

Druin has called “Cooperative Inquiry.” Here children are treated as full design partners in the team alongside the adults (Druin et al, 2001, 2003) The team of children and adults meets regularly with the goal of developing a prototype. Druin (2002) argues that when children are restricted to the role of informant they can only offer feedback without an opportunity to elaborate or build upon ideas: the intergenerational design team provides an opportunity to create rather than merely critique.

In our case we established an intergenerational team comprising eight student volunteers from grade six and three adult researchers. Through a combination of discussions, critiques of existing Web portals, brainstorming, and pen and paper drawings, the team designed a low-tech prototype Web portal over multiple sessions. This portal now has been built and tested by a focus group of five students aged eleven and twelve years (subsequently it will be evaluated more thoroughly using both observation as it is used to find information for a class project and several focus groups). Both the design session discussions (Large, Beheshti, Nessel, and Bowler, 2004; Large, Nessel, Beheshti, and Bowler, in press) and the resulting prototype provide insight into children’s thinking about Web portal interface design.

The following design guidelines derive from five data sources gathered by us in the following ways:

- Observation of children using two “adult” Web portals
- Interviews with children who had previously used these two portals
- Focus group evaluation by children of four children’s Web portals
- Design concepts as discussed and realized by an intergenerational team
- Focus group evaluation by children of the Web portal designed by the intergenerational team

Data were collected from different children over several years (the earliest in 1998 and the latest in 2004). Nevertheless, the similarities in findings suggest that, despite children becoming more familiar with the Web as an information resource, their criteria for a successful Web portal design have not much changed over this time period; where there is an indication of a possible shift, however, this will be discussed.

DESIGN GUIDELINES FOR CHILDREN’S WEB PORTALS

The following discussion of Web portal interface design guidelines is organized under the following main headings: portal objectives, metaphor, visual design, icons, portal name, characterization, terminology, advertisements, retrieval capabilities, results display, online help, personalization, and interactivity. This categorization is based upon a design matrix for children’s Web portals originally developed by Large, Beheshti, and Cole (2002).

Portal Objectives

A portal can have three possible objectives: to provide information, education, or entertainment, although any one portal can pursue more than one (Rosenfeld & Morville, 1998). While the objective of an entertainment portal would be to provide leisure and fun, and the objective of an educational portal would be to promote learning, the objective of an information portal, as its name suggests, is to retrieve information either to support leisure activities or, in the context of our studies, to support school-based projects and assignments.

A portal that has the objective of retrieving information for class assignments should focus upon this specific objective. Although entertainment features might be attractive to some children as offering a welcome temporary diversion from information searches, overall children tell us that their inclusion distracts them from the information task at hand. If entertainment aspects are incorporated into an information-based portal, they should be related in some way to the portal's main objective. For example, the grade six intergenerational team decided to incorporate into its portal a link to several Web-based quizzes but only because these quizzes were directly related to the portal's main objective of finding information about Canadian history (see Figure 1). Furthermore, it is entertainment features in Web portals (such as animation sequences) that children tend to find age sensitive and that are most likely to provoke criticism of portals as being too childish.

It may prove valuable to include educational objectives within a portal intended for information retrieval, but we cannot verify this from our studies with children as none of the portals evaluated incorporated educational goals to any extent. However, the children's strongly expressed desire to find information as quickly and effortlessly as possible suggests that again they might well find educational features distracting from their main task, as they do entertainment features.

We recommend that designers of Web portals for young users should seriously consider restricting a portal's subject focus. The operational portals evaluated by children in our studies were not subject restricted. However, the History Trek portal designed by the intergenerational team was confined to finding information about Canadian history. Although this decision initially was made by the researchers and not the children (largely for logistical reasons), in practice it greatly facilitated the team's task in deciding upon many design issues, such as the portal's name, screen layout, and even retrieval tools, as will be discussed more fully below.

It should be added that a major drawback of children's Web portals when compared with "adult" portals has been the relatively small numbers of Web pages that are accessible from them. The attempt to provide universal subject coverage, combined with the labor-intensive task of identifying pages suitable in content and style for children, typically has resulted



Figure 1. Homepage of History Trek (version 1.0) designed by the Intergenerational Team

in very superficial coverage of any topic on which students need to find information. Although not an interface issue, undoubtedly this is an important factor contributing to children's reluctance to use such children's portals and instead opting for portals like Google and MSN; the lack of child-friendly features in the latter is likely to be outweighed by the sheer quantity of information that likely can be found on the child's topic of interest (even though much of this information may be difficult for young readers to assimilate). Although History Trek's database only contains links to around 2,500 Web pages, it is able to provide sufficiently detailed information for its users because of its highly restricted subject focus (and in practice includes all that we have been able to find in English or French and appropriate for elementary school students). The focus group that undertook a preliminary evaluation of History Trek certainly considered this kind of restricted subject coverage to be a great virtue in comparison with the very general coverage of other portals they had used, whether "adult" or for children.

Metaphor

Metaphors are tools with the potential to reduce cognitive overload and help users apply their own mental models. Fleming (1998) describes them as one of the most powerful (though also one of the most misused) tools available to an interface designer. Metaphors should be based on familiar mental models so as to reduce cognitive effort rather than increase it. They may be used to provide a unifying framework for design as well as to facilitate learning by allowing users to draw on prior knowledge.

Children appreciate metaphors, but only if they are readily intelligible to them. The metaphor of an elderly butler assisting them to find information (as in Ask Jeeves for Kids) failed miserably as none of the children had encountered this literary figure from P. G. Wodehouse's novels; in this case the metaphor acted as a confusing distraction rather than a focusing tool. Metaphors are related to age and, as the Jeeves example suggests, culture. An appropriate metaphor can play a positive role in user orientation, but it must be carefully selected as it will tend to determine many other aspects of the interface's design.

Visual Design

A clear layout is important to ensure that individual features can readily be identified in the interface. For example, the help button on the MSN portal was considered too small to attract attention. The visual prominence of individual retrieval mechanisms (for example, positioning of keyword search boxes or subject directories) in our experience plays an important role in determining their relative levels of usage (see, for example, Bilal, 2000; Large, Beheshti, & Breuleux, 1998). The prototype interface design from the intergenerational team reflects the students' desire to avoid giving undue prominence to any one of the various searching techniques, and

although the interfaces present many features, their layouts avoid clutter (see Figure 1).

Children tend to dislike white, empty space on the screen, or even the use of white as a background color. In contrast, they do like bright colors that immediately catch the user's attention, though they do not necessarily agree on which colors meet this criterion. Interface personalization (see below) is a good way to cater for this. Children's comments on color combinations often run counter to widely recognized guidelines for the use of color in interfaces (see, for example, Galitz, 2002; Mandel, 1997) as well as contradicting the results from experimental studies (at least with adults) on screen readability, where dark colors superimposed on a light background are recommended (Muter, 1996). At the same time, it is not enough for designers to use as many color combinations as possible in the belief that this will make an interface instantly popular with young users. A colorful interface is necessary but not sufficient to ensure a successful children's Web portal.

The designers of children's Web portals such as Lycos Zone or Yahoo!igans! obviously believed that graphic devices are essential in an interface intended for children, and they may have been correct. The children in our earlier focus groups reacted positively to graphics as used, for example, by Lycos Zone (see Figure 2), and indeed they were critical of portals that did not make extensive use of them, such as KidsClick (see Figure 3). The children in the subsequent intergenerational design team, however, opted for graphics only if they contributed in some way to the overall visual design; gratuitous graphics were not popular. For example, the team chose two beavers, animals with a Canadian connotation, facing each other as if in conversation, to represent email and chat facilities in its portal prototype (see Figure 1). The use of cartoon-like figures in some children's Web portals, however, were considered "childish" or at odds with children's sense of rightness; for example, the mascot who was skateboarding in the Alf portal (<http://www.alfy.com>) was criticized for not wearing a helmet. Cartoon figures also were seen as being potentially distracting from the portal's objective of finding information (see above under Portal Objectives).

Animated characters are becoming increasingly popular as interface presentation agents (Shaw, LaBore, Chiu, & Johnson, 2004). Animation should be used sparingly, however, in a portal whose objective is information retrieval. The intergenerational team's prototype has only one animation; the SOS flag held by the portal mascot moves from left to right and back. The team was quite explicit that it did not want gratuitous animation—the flag waving is intended to draw attention to the mascot's role in representing the portal's help facilities. The team wanted to minimize unnecessary distraction from the portals' primary information-finding task. Ironically, the focus group that tested this prototype was only unanimously critical of one design aspect in the entire portal, and that was this animation. It was con-



Figure 2. Lycos Zone (As of Summer 2000)

sidered by some children to be distracting and superfluous. The 2000 focus groups had been more enthusiastic about animation: they thought the more animation, the better, and criticized interfaces with little animation.

Based on these findings, the tendency of adult designers to associate young people, Web portals, and gaudy, animated features is misplaced. At the same time, the students in the 2004 focus group, who used Google for their everyday searching, found History Trek more attractive and appealing. Designers, then, must strike a balance between a plain and unimaginative but functional design on the one hand, and a gratuitously colorful and animated design that makes it both narrowly age specific and potentially distracting from its primary purpose—information retrieval.

It may be that in the intervening three years between the year 2000 focus group and the design team judgments, children have become less impressed by mere color and movement for its own sake and are now more interested in portal functionality. The focus groups had criticized KidsClick (see Figure 3) for its dullness, but the latter's designer, Kuntz (2000), may have been simply ahead of his time in his belief that gratuitous color and movement simply distract users.

Children also have opinions about the fonts used in an interface. In



Figure 3. KidsClick (As of Summer 2000)

both focus groups and the design team, the children commented on font choices, especially the need for font sizes that are clearly legible on the screen. It is interesting that young users should share the concerns of old users at least on this matter.

Icons

Icons are popular with children but tend to be interpreted very literally and therefore criticized if not accurately matching the associated concept. For example, an icon of a TV set in Yahoo!igans! was dismissed as being much narrower than its associated concept, “Arts and Entertainment” (see Figure 4), as was an icon showing children but representing “People.” Icons need to be carefully selected and given a text label to avoid any misinterpretations.

Portal Name

What’s in a name? For children, at any rate, the name really does matter, as it is an important means of gaining users’ attention. It should convey the purpose of the portal to its target audience and, ideally, also be fun (the focus group students liked the name “Yahoo!igans!”). A well-received name instantly increases the portal’s attractiveness (and vice versa). We have seen above that the literary character Jeeves is not familiar (at least to Canadian

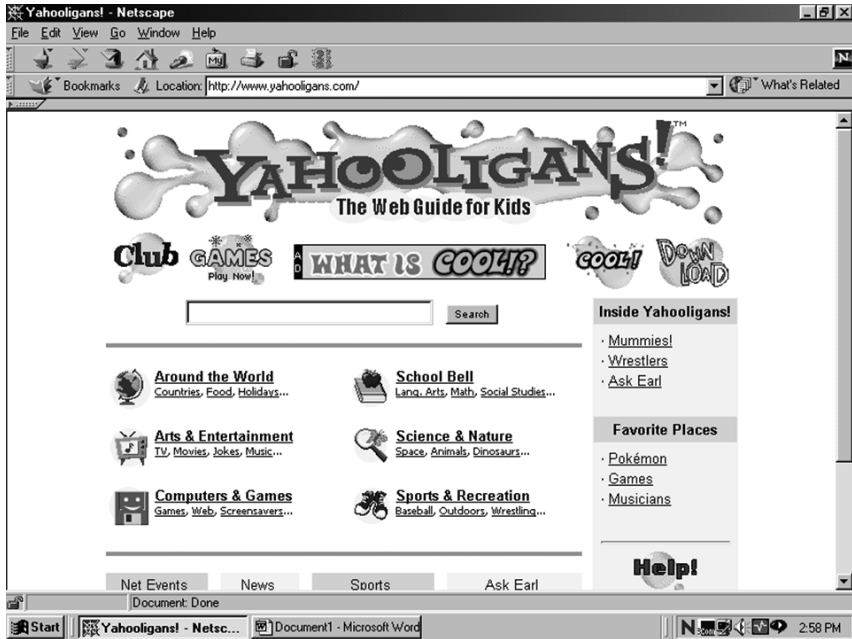


Figure 4. Yahoo!igans! (As of Summer 2000)

children), and therefore the portal name “Ask Jeeves for Kids” conveys nothing to them (see Figure 5). The intergenerational design team chose a name for its portal prototype—History Trek—that directly related to its purpose. The name should be prominently displayed on the screen (as in Yahoo!igans!, as shown in Figure 4) and not lost among other graphics. A related issue is the predictability and memorability of the portal’s URL. In this respect, the focus groups gave KidsClick’s former URL (<http://sunsite.berkeley.edu/kidsclick!>) a low rating.

Characterization

Mascot characters are popular with children as long as they are considered appropriate for their age group and play a role in the interface. The intergenerational design team members chose a mascot for their prototype portal that was very much in character with the overall portal design based on a Canadian theme—a personified maple leaf—and which had a purpose—to activate help (see Figure 1). Any character included in the interface should be used consistently and throughout the entire portal rather than appearing only on the home page. Young users appreciate the presence of a character that will give a personality to the portal, but selection and design of such a mascot is likely to prove idiosyncratic and



Figure 5. Ask Jeeves for Kids (As of Summer 2000)

subjective to individual users (again, interface personalization can be invoked here).

Terminology

Terminology used in the interface, it goes without saying, should be suitable for the target age group. For example, the intergenerational design team members were keen to offer interface personalization but were unfamiliar with this term and chose instead “My Site” as the best representation. Textual labeling itself must be determined with care. The intergenerational team had opted to label the mascot on the homepage “I’m Willy the Web Wonder. Need help? Ask me!” This confused the focus group that subsequently tested the portal; they thought it meant that a search for information on the Web should begin with a click on Willy.

Advertisements

All the children in our various studies were unanimous in their dislike of advertisements in children’s portals. The intergenerational design team, however, was less hostile than the earlier focus groups, unless the advertisements were pop-up advertisements. This might be explained by their greater familiarity with the Web, and its ubiquitous use of advertising, compared with the students in the earlier focus groups.

Retrieval Capabilities

It might be assumed that young users would find it easier to express search queries as complete, natural-language sentences rather than having to identify one or several keywords in which to encapsulate their information need. In practice, however, we have found that children take readily to keyword searching. That is not to say that they eschew a natural-language approach, and indeed the grade six intergenerational team included "question" searching along with keyword searching options in its prototype interface (see Figure 1). But they appear to choose keyword searching when they can readily come up with keywords, reserving natural-language questions for instances when this proves difficult. It may be simply that they are much more familiar with keyword searching, or that their occasional experience with retrieval systems that claim to accept natural-language questions has not been positive.

Spelling prowess obviously will vary according to age and individual ability, but it should be required that any children's portal incorporates some form of spell checking. Ideally children want the portal to automatically correct their spelling and find what they want without any intermediate steps. At the very least, the portal should respond to a misspelling by presenting them with an array of alternatives, prefaced by "Did you mean . . . ?" (much as do many "adult" portals).

Subject directories are appreciated as long as they mirror the way that students themselves would represent their own information needs (Hirsh, 2004). That is to say, a subject directory is useful if it gives direct access to the subjects currently under study in the curriculum. Students had little patience with a directory that required them either to navigate multiple hierarchical levels to reach the desired information or that was at odds with their own categorization. The design team students were able to identify potentially appropriate categories because the History Trek portal not only was designed specifically for grade six students but also to find information on one specific topic—Canadian history. Nevertheless, the focus group students who tested History Trek did not always find matching their information needs against these categories straightforward. When faced with a portal whose subject categories are intended to encompass the entire universe of knowledge, children are much less likely to appreciate subject categories as a simpler entry point than keywords. The cognitive effort required to select the correct subject at each hierarchical level is likely to prove more demanding than thinking of keywords and probably will lead to poorer results. More research will be required into exactly how children categorize and hierarchically arrange concepts before truly effective subject directories can be constructed.

Bilal (2000) studied the ability of middle school children using the Web to handle fact-based queries. She believes that the high percentage of keyword searching (in contrast to selections from hierarchically organized

subject directories) undertaken by the students was due to the factual nature of the task they were given, with the assignment containing concrete keywords. Subject content, then, influenced the relative importance of searching rather than browsing as a means of finding information.

Alphabetical searching—the possibility to click on a letter to search for a concept—is popular with children; although they must still think of a suitable keyword, they do not need to be able to spell it correctly (an example of this approach is shown in Figure 1). The design team also included a scrollable timeline in *History Trek* to help find major events in Canadian history according to their dates. The year 2004 focus group that tested the portal, however, did not even notice this timeline (admittedly, they used the portal only once and for one hour); perhaps this was because they were not used to encountering such a retrieval device in a portal.

In an earlier study (Large, Beheshti, Breuleux, & Renaud, 1994) we conducted with grade six children and a CD-ROM-based encyclopedia, we found that the children were able to determine which of several different retrieval options was likely to be the most effective for a given search (in this case they could choose from keyword search, title browsing, and using subject categories).

Results Display

As Kafai and Bates (1997) pointed out, sometimes titles and descriptions returned by portals can be misleading and difficult for elementary school students to evaluate. Homonyms in particular create problems for students; they ideally should be tackled through categorizing results by the homonym's individual definitions. For instance, in the 2000 focus groups the students were confused when searching for "tigers" to retrieve Web pages dealing with the Detroit Tigers baseball team.

Display should be limited to between ten and twenty hits per screen. The title and summary of the pages should be short, informative, and written in child-friendly language. Search terms should be highlighted within the displayed hits. *History Trek* incorporates such features in its display screens (see Figure 6).

Output ranking is important. Typically young students place a very high value on precision and dislike having to scroll through long hit lists in order to identify relevant pages. Furthermore, they are used to sophisticated ranking algorithms on the "adult" portals they use. The indicators of reading levels included in the KidsClick Web portal were popular. One student in the design team suggested an area on the screen that would show sites already visited as a kind of search history, but this idea was not taken up by the team as a whole nor incorporated into the prototype.

The design team viewed and discussed the graphical presentation of hits used by Web Brain (<http://www.webbrain.com>) and PubMed (<http://www.ncbi.nlm.nih.gov/entrez/query.fig>). In neither case did they express

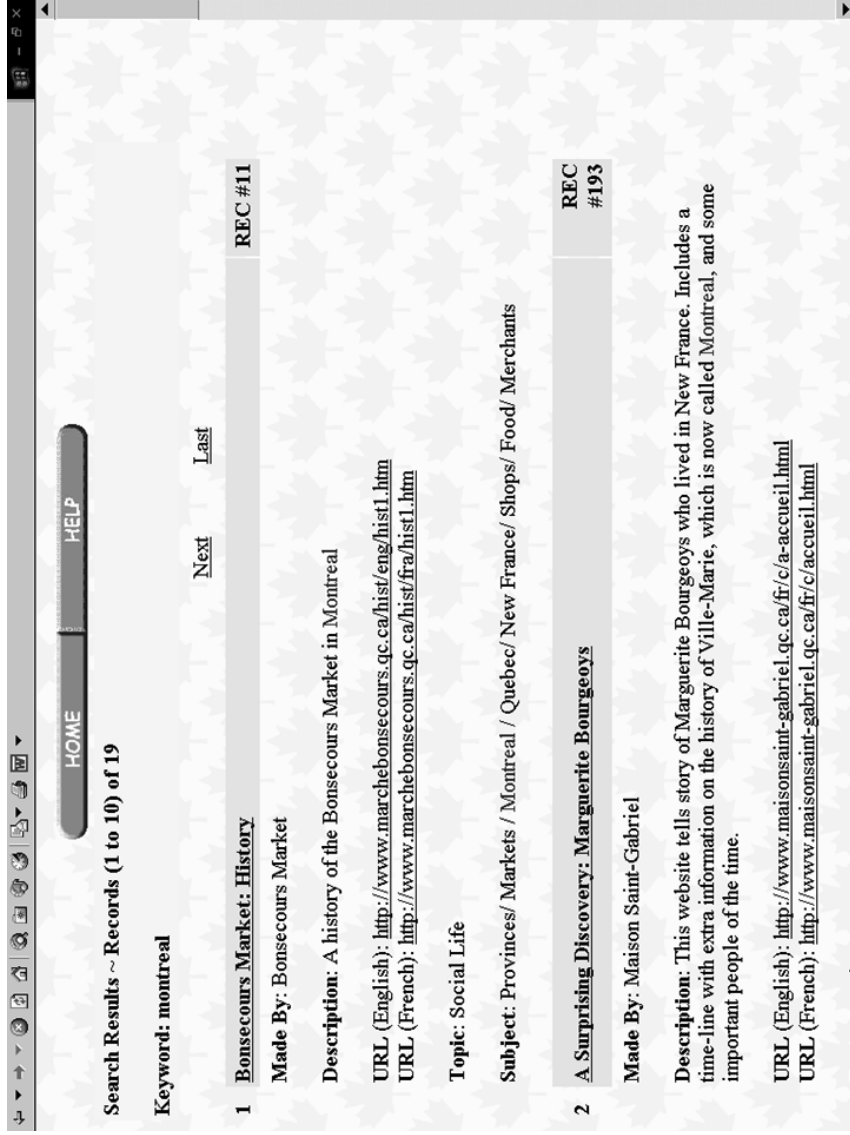


Figure 6. Results Display Screen, History Trek (Version 1.0) as designed by the Intergenerational Team

any enthusiasm for this technique, claiming that “it looks really adult” and “it has too much that you don’t need.” It would be unwise to conclude from these negative reactions, however, that visualization has no merit in a children’s portal. The students found it difficult to separate design from content; the fact that these two portals were presenting complex concepts and the relationships between them may have influenced negatively the children’s appreciation of the underlying design approach that might equally be used with children’s information content.

Online Help

In general, people do not read online documentation (help pages) voluntarily (Nielsen, 2000), and our research has confirmed this observation for children. For example, in 78 separate search sessions extending over 2,041 minutes that we captured and analyzed (Large, Beheshti, & Moukdad, 1999), grade six students only accessed help on one occasion (see also Bilal, 1999, 2000). This is not because children do not perceive themselves as needing help but rather because the specific kind of help they want—how to turn a failed search into a successful search, taking the form, for example, of substituting alternative keywords or subject categories that will immediately retrieve the sought information without further input from the user—is not provided by Web portals. They want a precise solution to be provided for their precise problem. Instead they are given general explanations of the portal’s retrieval capabilities, perhaps with a few examples thrown in to illustrate various searching techniques. Furthermore, such explanations often are presented in a way that is difficult for young users to understand; one boy suggested to us, for example, that help should be delivered through a movie that shows someone searching (rather like the technique used in some computer games). The members of the design team criticized the help features available from several children’s portals: Yahoooligans!, for example, has “nothing on searching,” and Lycos Zone suggests alternative search terms but does not automatically implement them. The students thought children would not understand that KidsClick’s “search tools” or IPL KidSpace’s “searching tools” meant help, and as a result would likely ignore them. Ideally help facilities should be context sensitive, but this may prove relatively difficult to implement in an online environment. Any online documentation must be searchable to allow users to seek specific help topics.

In fact, in their own design the students stressed the importance of good help; the History Trek help screen consists of four help components: an explanation of how the site works, information about the design team (the “Web Wonders”), an opportunity to contact a subject expert and, finally, the most important element for them, “help with my search,” which they intend should do exactly that—offer specific guidance on the search at hand. Of course, successfully achieving this objective is another matter!

Personalization

Children should be offered an opportunity to personalize the Web portal interface. First, this is important because reactions to things like mascot, colors, screen layout, icons, and animation are personal and will differ from child to child. Furthermore, such differences are likely to be more strongly drawn among children than adults. Certainly in the design team, areas like color and mascot selection were the most difficult about which to develop a group consensus. Personalization is the way to respond to individual preferences. Second, personalization is a way to increase a portal's appeal to wider age groups. It is the presentation aspects of the portal that are most age-sensitive, and what is attractive to one age group is "infantile" or "too grown up" for another. Third, from our year 2000 focus group studies, there is evidence to suggest that presentation is also related to gender, and personalization is a way to cater to the tastes of both girls and boys. (Passig and Levin [1999] also report different preferences between boys and girls for color use in interfaces.) The portals reviewed by these focus groups were criticized for the total absence of personalization capabilities; the intergenerational team design includes personalization options, such as different costumes for the mascot to wear (accessed from the "My Site" icon as shown in Figure 1).

Interactivity

Should a children's Web portal include interactive features such as email and chat facilities? On the one hand, these features enable students to interact one with another, to exchange information, and to discuss class projects. Especially when schools often favor group rather than individual assignments, it can prove useful for both students and teachers that the former can communicate with each other, either within one class or on a much broader geographical scale. They can also contact subject experts in order to discuss projects with them. On the other hand, interactivity, like games and animation, can be a distraction from the primary information-seeking task. Especially when being used from the school classroom or information technology lab, teachers may prefer to eliminate any temptation for their students to email and chat with friends. Furthermore, the children themselves are aware, from both teachers and parents, of the dangers lurking on the Web, especially in chat rooms. For example, the students in the intergenerational design team initially were skeptical about such interactivity. After some discussion, however, they could appreciate the value of exchanging information and ideas with fellow students, teachers, librarians, and other subject experts. Even then, though, they only proposed to include email and chat on their own prototype if security provisions (through user authentication) could limit access to bona fide users such as fellow students or identified adults with relevant subject expertise.

Multilingualism

All the students with whom we have worked at various times have been functionally bilingual in English and French. Furthermore, almost all of them attended schools in which teaching is divided between these two languages. In such an environment they were unanimously in favor of a bilingual approach as a minimum (several suggested the inclusion of additional languages). A portal interface, therefore, should be available in more than one language. The History Trek portal, for example, has a prominent button by which the interface can be toggled between English and French (see Figure 1). If a bilingual or multilingual approach is adopted, it should be applied throughout the entire interface. This means that all access screens, help pages, subject directories, etc., should be available in all the selected languages. Bilingual environments obviously are not confined to Quebec; in the United States, for example, it would seem worthwhile for designers to consider the merits of bilingual English and Spanish portal interfaces. Designers should be warned, however, that both at the development stage and in any subsequent interface modifications, minor or major, any changes will have to be replicated in all the language versions.

INTERFACES FOR THE FUTURE

Interface design continues to evolve, though not all developments will be as dramatic as the shift from text-based to graphical interfaces. In terms of children's Web portals it is possible to discern several areas of current research that offer new opportunities for interfaces to facilitate the task of information retrieval.

Researchers are now exploring interface designs that rely heavily upon visualization rather than linear text to present information. Children and young adults in particular tend to rely on visual information or visual cues rather than textual information (Fidel, et al., 1999; Hirsh, 1999; Large & Beheshti, 2000). Savage-Knepshield and Belkin (1999) predict that information visualization will be very much a part of the next information retrieval wave and will dramatically impact children's information retrieval. Our intergenerational design team did not respond positively when shown Web-based examples of visual displays such as WebBrain or PubMed. This might be explained, however, by the children's inability to appreciate the underlying possibilities of such visual displays when they were being applied to adult information resources that the children found difficult to understand.

Computer game enthusiasts are familiar with three-dimensional (3D) action games where players walk through virtual worlds and have the illusion of being themselves in those worlds. Christoffel and Schmitt (2002) discuss interfaces that use such real world metaphors. Their interface is based on an action game called Quake II, but instead of players killing their

enemies and ultimately saving the world, they can move around a library, browse its bookshelves, select books from them, and see their contents. Our intergenerational design team discussed such a 3D interface design for a Web portal, where users would move through a first-person 3D (or virtual, as the students called it) environment, browsing for information. In the 3D interface, as in a computer game, users would explore the Web by moving through virtual space. All but one of the students were extremely enthusiastic about such an approach so long as response times were not degraded, but they thought that such a 3D interface should complement rather than replace any conventional portal interfaces. We are currently designing such a 3D portal for eventual evaluation by elementary school students (Beheshti, Large, Nettet, & Bowler, 2004). According to Nielsen (2002), children like geographical navigational metaphors such as pictures of rooms, villages, and "other simulated environments that serve as an overview and entry point to various site or subsite features."

Another interesting area is the incorporation of active user assistance within a portal's interface. Abbas, Norris, and Soloway (2002) discuss the ARTEMIS Digital Library at the University of Michigan, which has been in use since 1997 by science students in grades six through twelve (approximately twelve to eighteen years old). ARTEMIS includes a practice area, called the Scavenger Hunt, where students learn how to use the various browse and search features of the interface. The interface also includes "scaffolding" features that help reduce the cognitive load for young users: for example, a workplace to save and organize search results and Web page links, a means to share with other students those resources that are of interest, the opportunity to view results of previous searches, and a dictionary that can be consulted as needed (several of these ideas were proposed by individual students in our intergenerational design team but were not incorporated into the prototype).

Shaw, LaBore, Chiu, and Johnson (2004) discuss the use of digital puppets that can interact with users through speech and gestures, modeling the kinds of dialog and interactions that occur during apprenticeship learning and one-to-one tutoring. These build upon the natural human tendency to interact socially with computers and can respond both to motivational and cognitive factors by increasing learner curiosity and interest and offering help. Although Shaw and her colleagues are interested in learning environments, such techniques offer interesting possibilities for children's Web portals, especially in providing the kind of interactive, context-sensitive help that children say they want.

A different kind of interface development is likely to be spurred by information technology advances. As the Web is accessed not just from computer display screens but, for example, from handheld devices such as cellular telephones, new interface challenges will be posed. The small

screen limitations will require of designers new approaches to information retrieval and display functions.

CONCLUDING THOUGHTS

Designing Web portals for children is a difficult and challenging task. By using unobtrusive observations, interviews, and focus group studies, researchers can obtain data and feedback for effective design criteria. It is only through intergenerational design teams, however, that Web portals can be constructed to meet the specific needs of children. Intergenerational teams consist of a number of adults and children who meet regularly over a period of time to tackle design and other issues for creating a Web portal. These teams should rely on a comprehensive framework as the basis for discussing design issues. In our case, we used a number of elements that were included in a design matrix from our previous research and modified them to suit our specific purpose in creating a Web portal for classroom projects on Canadian history for grade six students. These elements consist of the objectives of the portals (education, information, or entertainment), use of metaphors and icons, visual design of the interface, the name of the portal and its URL, characterization and personalization, consistent and appropriate terminology, retrieval capabilities, results display, interactivity in terms of email and chat rooms, online help facilities, advertisements, and multilingual capabilities. Extensive discussions of these elements within the intergenerational team allowed us to create a relatively sophisticated and yet usable Web portal for children. Preliminary tests through focus group studies indicate that the implementation of the portal is successful. In the near future we will test the portal in a real operational environment in a classroom. The results of the tests will help us to reassess the methodology of using intergenerational teams and to modify, if necessary, the guidelines for designing children's Web portals.

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