Elementary School Students, Information Retrieval, and the Web

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INTRODUCTION

In today's modern world, elementary school students (aged 5 to 12 years) use computers for a wide variety of tasks. These include communication (e-mail, instant messaging, and chatrooms), entertainment (games, video, music, etc.), leisure (such as information relating to hobbies and general interests), and information retrieval to support class-based learning. Internet access is now very widely available from home, school, and public library. A major reason for accessing the Internet is to find Web-based information relevant to classroom learning activities. Undoubtedly the Web represents an enormous and potentially rich source of multimedia information on topics within the elementary school curriculum, but accessing this information does pose a number of challenges. We identify in this article three major problem areas that currently impede effective exploitation by elementary school students of Web-based information resources: information systems are not necessarily intuitive or straightforward for children to use; basic information literacy skills too often are inadequate; and too little content appropriate for young users is available on the Web.

The first technology to gain popularity as a means for children to retrieve information was the CD-ROM. By the early 1990s, a wide variety of multimedia information resources targeted specifically at children were available in this medium. Many were children's encyclopedias, designed to facilitate rapid retrieval of discrete information "chunks," and often multimedia versions of an original print title. These CD-ROMs could offer an engaging, interactive experience for the young student. Although students were willing to explore and experiment with interfaces (Large, Beheshti, Breuleux, & Renaud, 1994; Large, Beheshti, & Breuleux, 1998), they were not necessarily effective at retrieving information from these CD-ROM titles (Marchionini, 1989; Oliver, 1996). In any event, regardless of its strengths and weaknesses as a classroom resource, CD-ROM technology proved transient and was quickly superseded by the expansion of the Internet and the rise of the Web. Yet the information retrieval problems revealed by CD-ROMs would continue to plague the Web.

COGNITIVE DEVELOPMENT IN CHILDREN

The past 50 years have witnessed considerable research concerning the cognitive development of children. Childhood is a time when a gap of only a few years can make an enormous difference in intellectual capability. For example, there is a huge difference in cognitive development between a 5-year-old kindergarten student and a 12-year-old grade-six student. Most researchers in children's cognitive development agree that there are age differences in how children represent their world and which are central to differences in thinking (Bjorklund, 2000). For example, Piaget, a pioneer of research into children's cognitive development, identifies four major stages of development: the sensorimotor stage (0 to 2 years), the preoperational stage (2 to 6 years), the concrete operational stage (7 to 11 years), and the formal operational stage (11 years and older) (Piaget & Inhelder, 1969). As children progress through the different stages, their cognitive processes and information needs change. Information processing theory also asserts that changes throughout childhood are rapid but argues that they are less demarcated than Piaget's stages would suggest (Kail, 2004). These rapid changes have two important consequences. Firstly, research results that have been generated from one

age group can only be applied with caution to another age group and secondly, that solutions to information retrieval problems encountered by children may have to differ according to the child's age.

INFORMATION SYSTEM DESIGN

Many studies (Bilal, 1998, 2000, 2001, 2002; Large, Beheshti, Nesset, & Bowler, 2004) have found that young students overwhelmingly turn to a relatively small number of search engines when seeking information on the Web: mainly Google, and to a lesser extent MSN, Yahoo, and Ask.Com (formerly, Ask Jeeves). All these retrieval tools, of course, were primarily designed to accommodate adult rather than young users who have very different cognitive abilities and affective responses when using information technologies as well as different information needs. Large, Beheshti, and Rahman (2002) identified four broad criteria by which Web search engines could be evaluated: goals, visual design, information architecture, and personalization.

The goal of most Web search engines is to find information as efficiently as possible by keyword searching or hierarchical subject browsing; there is no element of "fun" (games, quizzes, etc.) included that might provide the user with some diversion, if desired. Children themselves often point out, however, that motivation to use a search engine would be enhanced by such inclusions (Large, Beheshti, & Rahman, 2002), though there does not appear to be unanimity on this issue (Large, Nesset, Beheshti, & Bowler, 2004).

Children have many interesting comments to make about their preferred design characteristics when evaluating search engines relating to such matters as font sizes, graphics, animation, icons, vocabulary, layout, and color (Bilal, 2000; Large, Beheshti, & Rahman, 2002; Large, Nesset, Beheshti, & Bowler, 2004). Interestingly, young users, like their elderly counterparts, prefer large fonts that can be clearly read. The inclusion of graphics within the interface, and especially human or animal characters, tends to be popular, but the incorporation of animation effects is more controversial. Children like icons but only as long as they are meaningful to the concept being represented. The vocabulary employed throughout the search engine should be appropriate for the target age group. Screens should be clearly laid out so that the information can be readily identified. Neither the search nor the results display interfaces of most Web search engines reflect these young concerns. The former tend to be criticized for their dullness and the latter for their clutter.

At the heart of any Web search engine are its means of retrieving information, displaying results, and offering help when needed (its information architecture). A typical search engine provides keyword searching, and in many cases also the opportunity to browse hierarchically organized subject directories. Young people will avail themselves of both these approaches, but in addition may benefit from the opportunity to try other methods. For example, a team of grade-six students working with adult researchers designed a Web search engine to find information on Canadian history, and included alongside keyword searching and subject directories several other retrieval approaches: natural-language (full sentence) searches; alphabetical (A-Z) search on topics, and a scrolling timeline from which specific historical events could be located (Large, Beheshti, Nesset, & Bowler, 2004). The same students commented on the need to keep results displays short (no more than 10 results per screen) as well as meaningful in that they included a short description and subject headings from which relevance decisions could accurately be made. In terms of help features, the consensus among researchers is that the students want assistance but on the other hand they seldom or never, access any help provided (Large, Beheshti, & Moukdad, 1999). The explanation for this apparent contradiction is that the kind of help currently offered by search engines is, in fact, "unhelpful." Young people demand context-sensitive help that is clearly focused upon their specific problem and provides a solution to it. Ideally, of course, they would like a help facility that offers them the correct answer. Furthermore, given their often limited spelling and typing skills, any keyword-based information retrieval system that does not incorporate spell-checking routines is unlikely to serve well its young users.

The final evaluation criterion, personalization, appears to be as popular with elementary school students as it is absent from "adult" search engines. They would like the opportunity to personalize various aspects of the search engine's interface, including graphics, color, and icon design (Large, Beheshti, & Rahman, 2002). This design criterion, of course, is related to the first criterion discussed above in that personalization is one way of enhancing the fun and motivational aspects of a search engine.