

The International Children's Digital Library: Description and Analysis of First Use

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ABSTRACT

In this paper we describe the first version of the International Children's Digital Library (ICDL). As a five-year research project, its mission is to enable children to access and read an international collection of children's books through the development of new interface technologies. This paper will describe the need for such research, our work in the context of other digital libraries for children, and an initial analysis of the first seven weeks of the ICDL's public use on the web.

Categories and Subject Descriptors

H.3.7 [Information Storage and Retrieval]: Digital Libraries — Dissemination, User Issues; H.5.2 [Information Interfaces and Presentation]: User Interfaces — Graphical User Interfaces

General Terms

Design, Experimentation, Human Factors, Measurement

Keywords

Children, Digital Libraries, Books, Graphical User Interfaces, Zoomable User Interfaces.

1. INTRODUCTION

News media from around the world regularly report misunderstandings, intolerance and outright aggression among individuals and groups from different cultures. While research has shown that children absorb the ambiance, stereotypes and attitudes prevalent in their communities [19, 21], experts in intercultural communications have found that if young people have opportunities to share personal experiences and "stories," attitudes may change [12].

Books published in other countries can provide authentic accounts of the people, history, and traditions of other lands

and help to counteract stereotypes and the often more sensation-prone information provided through television or other media [17]. And yet, most libraries in the United States have inadequate foreign language collections. In 1995, the last time information was collected, librarians in fewer than 25% of schools nationwide rated their foreign language and/or English as a Second Language materials as excellent or adequate to support the curriculum [15].

Although library development is difficult in many areas of the United States, even more significant problems exist in many areas of the world. A 1997 survey in South Africa indicated that fewer than 30 percent of the schools had libraries, yet it was common to see computers [8]. In China, over 80 percent of the schools in large and medium-sized cities have established libraries in schools; however, in less developed areas of the vast country, fewer than 30% of the schools have libraries, yet approximately 50% have at least one computer [22].

Reports from librarians in Denmark, Russia, Kazakhstan, and the Netherlands indicate that libraries are important components in primary and secondary schools, and yet budget cuts have severely limited their abilities to provide the range of materials needed in today's global society. Most lack ready access to materials in a variety of languages [11].

Therefore the aim of our research is to leverage the power of the Internet to build cultural bridges by developing the International Children's Digital Library (ICDL) for young readers, ages 3-13 [9]. This five-year research project, supported by the National Science Foundation and the Institute of Museum and Library Services, focuses on developing and evaluating new interface technologies for children's information access, retrieval and use. Parallel to these efforts and spear-headed by our partners at the Internet Archive is the creation of a digital collection of approximately 10,000 classic and contemporary children's books, presented in their original languages, from at least 100 cultures from throughout the world.

This paper describes the ICDL and places it in the context of other digital libraries for children. We also present an

initial analysis of the first seven weeks of public use of the library by over 10,000 people. We conclude with a description of lessons learned thus far and suggestions for future directions.

2. CHILDREN'S DIGITAL LIBRARIES

Developing new technologies appropriate for children can be challenging, since young people can have difficulty reading, typing, spelling, and are continually changing in their interests and abilities [6, 9, 14, 18, 20]. While there is an emerging and significant research field devoted to digital libraries and information retrieval, we have found that the vast majority of content and interfaces are targeted at adults or older students.

Of the online digital libraries appropriate for children, there are a disappointing number of large-scale collections to explore. At the time that this paper was written (January 2003), the largest online freely available full text collection of children's books included only 83 titles. Out of 24 sites we found, a majority of these digital collections showed only titles, sometimes with summaries, reviews or associated activities (e.g., <http://www.bookadventure.com>, <http://www.bookchilde.org>, <http://fusion.sims.berkeley.edu/ReadingTree>, <http://www.twbookmark.com/children>).

Others offered only options to purchase books (e.g., <http://www.ebooks.com>, <http://www.ipicturebooks.com>, <http://www.tundrabooks.com>). Still other collections depended on out-of-copyright materials (e.g., <http://www.editec.net>, <http://etext.lib.virginia.edu/ebooks/subjects/subjects-young.html>).

The site that currently includes the most digitized books online outside of the ICDL is "Children's Books Online for Free" (<http://www.editec.net>). This collection now includes 83 fully digitized books online, with plans to increase the number to 1,200 out of copyright titles.

In evaluating the user interfaces of these sites for accessibility, it is clear that most were not designed primarily for use by children. Most sites depend on keyword searching and/or "point-and-click" interfaces that necessitate typing or reading long lists of titles. Some interfaces do offer a combination of book cover images with titles, but then depend on more limited methods of reading the actual book pages. Even the industry standard for book readers, *Microsoft Reader* and *Adobe Acrobat eBook Reader*, offer features primarily for adults reading long books or documents consisting mostly of text (Hourcade et al., In Press).

3. THE CURRENT ICDL SOFTWARE

The International Children's Digital Library (ICDL - www.icdlbooks.org) was launched on November 18, 2002 and currently includes 181 books from 14 countries (e.g., Egypt, Croatia, Singapore, South Africa, Australia, New Zealand, the United States and more) in 20 languages. The actual software technologies are based on previous NSF

DLI-2 funded research in children's interface development that was conducted at the University of Maryland [6, 16]. From 1999-2002, we researched and developed a visual interface that supports young children (ages 7-9 years) in querying, browsing, and organizing multimedia information. This initial project had multimedia resources focused on animal information donated by the Discovery Channel and the Patuxent Wildlife Research Center. It was used by children at Yorktown Elementary School in Bowie, Maryland to test and refine the interface. By building on this research foundation, and generalizing to a broader library collection and audience of children, ICDL research prototypes have been quickly deployed.

A unique aspect of this work is the process of collaboration and partnership that has been established [6]. Interdisciplinary researchers from computer science, information studies, education, art, and psychology work together with children (ages 7-11) to design this new library. Children's ideas are heard throughout the entire technology design process. To make this a reality, children work in the labs as researchers twice a week during the school year, and two intensive weeks over the summer. Together this interdisciplinary and intergenerational team brainstorms, sets project directions, tests new ideas, and implements technologies (video of team activities at: <http://www.cs.umd.edu/hcil/kiddesign/videos.shtml>).

In addition to this partnership for interface development, the ICDL has also established partnerships with national libraries, public library systems, professional associations, commercial publishers, authors, illustrators, and school districts around the world. Collection development guidelines are being jointly created, materials identified and digitized, and fair use models are being explored. Approximately one fourth of the books in the current collection are within copyright and were provided by contributors with specific restrictions. Some publishers or authors have agreed to donate their materials only if they are encrypted for book viewing, others have offered their books on a limited basis. All are interested in understanding the market potential for such a delivery mechanism.

The ICDL software is written in Java and relies upon Sun's freely available Java 2 platform, currently available for Windows, Solaris, Linux and Mac OS. It is built using the Jazz toolkit for Zoomable User Interfaces [3]. The software is deployed with Java Web Start technology that enables a user to download, install, and launch the software with a single click on a web page link (once Java is installed). The software may then be launched either from the web page, or a desktop icon.

Most books are stored unencrypted on a Web server in jpeg format and accessed directly through the Java client software. However, some books are encrypted according to publisher's requests and are served with Adobe Content Server. Those books are accessed through our application's

visual search system, but are read with the freely available commercial Adobe eBook Reader application.

The ICDL software application currently supports children with highly visual interface technologies to find and read books. A short description of the current interface functionality follows.

3.1 Finding Books

There are two ways to access and retrieve books. The first considers books by geography. There is a globe area that enables children to spin the globe and select a region (e.g., Africa, Europe, Asia, etc.). From this process, the search results provide a subset of the collection that is about the region, set in the region, or written by an author from the region (Figure 1).

A richer way to find books is through the visual search interface. Thirteen top-level search categories were chosen based on research with children and librarians concerning how children want to look for books (Figure 2). The categories include: the subject of the book; the types of characters in the book, if it is “true” or “make-believe”; how well it is rated by other children; how it makes children feel (e.g., “I want to find a book that makes me happy”); the shape; and the color of the book’s cover. Clicking on one of these icons zooms in to reveal the possible attributes of that field. Clicking on one those attributes performs a search on that attribute. The icon is smoothly moved to the “search caterpillar,” which represents the current search. If multiple attributes are chosen, a Boolean intersection is performed between those attributes. The search results are presented visually through book covers in the search result area (Figure 3). Clicking on the search results brings the child to that area where they can then use a “Zoomable User Interface” to visually explore those results.

The search results are shown using an embedded version of PhotoMesa [2]. PhotoMesa presents groups of images in rectangles which can then be examined more closely. Clicking on a group zooms into the group, and clicking again zooms in further to individual books. A complete search sequence is shown in Figure 4.

When a single book is clicked on, the “book preview” page is shown which includes metadata about the book, including title, author, date, language, publisher, contributor, page count and summary (Figure 5). From here, the book can be read with one of the four book readers.

3.2 Book Reader Prototypes

There are currently three book readers that we developed [9] and Adobe’s eBook Reader for books that the contributor required to be encrypted. Children may use the reader with which they are they most comfortable (except for encrypted books which currently requires Adobe eBook Reader). Our traditional reader is most similar to traditional commercial readers. It shows one page at a time with simple forward and backward navigation buttons. There

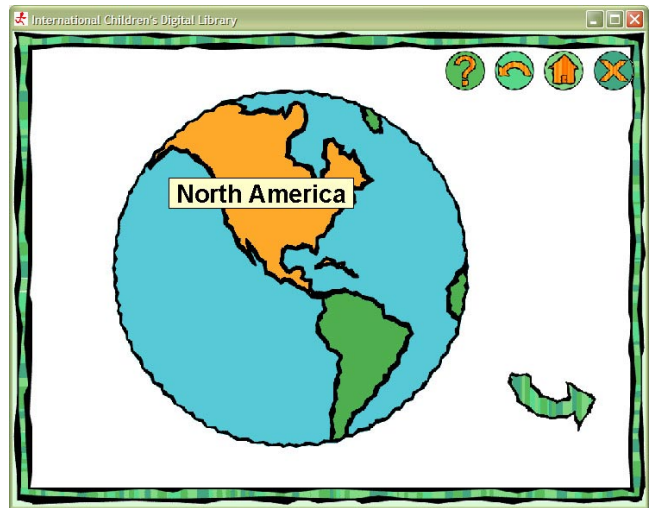


Figure 1: Searching for books using the globe interface



Figure 2: The Visual Search Categories



Figure 3: The Visual Search Results Area. This shows all books with animals grouped by subject.



Figure 4: Sample query in search area looking for books written in both English and Spanish that have an orange cover.

1. User clicks on Language icon from top search categories.
2. Language icons are shown. User clicks on English icon.
3. Results show books in English, some icons are disabled because there are no books written in both English and that language. Notice English icon is now on caterpillar. User clicks on Spanish icon.
4. Results show all books written in both English and Spanish. Notice both the English icon and the Spanish icon are now on the caterpillar. User clicks on “Top Search Categories” hypertext to go back to the top search categories.
5. User clicks on Color icon.
6. Color icons are shown; some are disabled because there are no books written in both English and Spanish that have those colors in their covers. User clicks on Orange icon.
7. Results show only book in library with text in both English and Spanish that has an orange cover. Notice all three selected icons are now on the caterpillar. User clicks on results area.
8. Results area shows book.

are controls for the visual “skin” of the controls. Users can also specify the orientation of the controls (horizontal or vertical) and whether the pages are shown one at a time, or in a two-page spread.

All pages are deployed with a 1024x768 jpeg image, but when zoomed in (with the magnifying glass icon), an image twice that resolution is downloaded in the background.

The “comic strip” book reader presents a zoomed out view of the visual book pages – oriented in horizontal strips like a comic strip (Figure 6). To read sequentially, a user simply presses the right arrow (or page down key). The interface smoothly zooms into the first page, and then animates to the next page in order upon subsequent arrow presses. At any time, the user may press the “zoom out” button to return to the starting overview page, and then click on any page to go directly to it, no matter what the page order of the book. The page borders are colored to indicate whether a page has been visited or not. The goal of this reader is to support simple overviews without getting in the way of traditional linear access.

On the other hand, the “spiral” reader is more dynamic. Its goal is to provide an experience like flipping through the pages of the book to quickly examine the book’s content. It presents the pages of the book in linear order with a

“focus” that is larger than the other pages, and a tail that shrinks (Figure 7). Like the comic strip reader, simple linear access is provided by the arrow buttons (or normal keyboard shortcuts) at which point the focus page is smoothly zoomed up to fill the screen. Going to the next page simultaneously shrinks the focus page down, rotates the spiral to focus the next page, and zooms up that next page. At any point, the zoom out button can be pressed to shrink the focus page, and then the user can click on any page in the spiral to spin the spiral so that page comes to the focus spot.

4. ANALYSIS OF USER LOG DATA

In an attempt to try and understand how the library is actually being used by the general web public, we have analyzed the log data. The results of this initial analysis are briefly presented here along with a discussion about what this information may mean regarding future web deployment of our digital library.

During the first seven weeks of public use, log data was collected that suggested who was accessing the software, what search methods were used, and what books were accessed. For a shorter period of time, log data was collected on the use of the book reader interfaces. The log data was analyzed and the results are summarized below.

We should note that a significant amount of international press accompanied the initial launch of the website. Based on the web logs and feedback we received by email, it is clear that there was broad use from people around the world including librarians, teachers, children, parents and others.

This log analysis was performed using the commercial Sawmill log analysis product (www.sawmill.net). We use the term “visitor” to mean web accesses from unique IP addresses over the period of the analysis and “page view” to mean a specific web page accessed by any client. Each “session” is defined to mean access from a unique IP address with no inactive period greater than 30 minutes. All numbers are rounded.

Over the first seven weeks of use, approximately 87,000 users accessed the general web site. Of those visitors, approximately 73,000 entered the library page that would give them access to our Java application deployed through Java Web Start which enables them to run the library. 47,000 visitors attempted to launch the library (by downloading the Java Web Start deployment file. 14,000 visitors attempted to download the actual Java application file, and 10,000 visitors successfully ran the ICDL software.

Of those users, the majority were from the United States (6,000 visitors) followed by Canada (430 visitors) and Taiwan (340 visitors). See Figure 8 for a full description of use by country. Aggregated by continent, use comes from:

North America:	7,000 visitors (67%)
Europe:	1,700 visitors (17%)
Asia:	1,200 visitors (12%)
Oceania:	300 visitors (2%)
South America:	100 visitors (1%)
Africa:	15 visitors (<1%)

Most visitors (79%) used the software just once. Visitors returned to the software (as defined by a gap in usage of 30 minutes or more) as follows:

1 time visitor:	8,200 visitors (79%)
2 time visitor:	1,300 visitors 12%
3 time visitor:	400 visitors (4%)
4 time visitor:	200 visitors (2%)
5 time visitor:	100 visitors (1%)
6+ time visitor:	200 visitors (2%)

The ICDL users came from a diverse set of places. 69% of visitors came from .net or .com domains associated with ISPs. 6% came from .edu domains associated with universities. 3% came from .us domains which were mostly associated with K-12 schools or libraries. 1% came from .org domains associated with non-profit organizations. The rest came from non-US countries or domains that we could not attribute meaning to. Based on this analysis we infer that most of our users were coming from home computers on broadband networks.

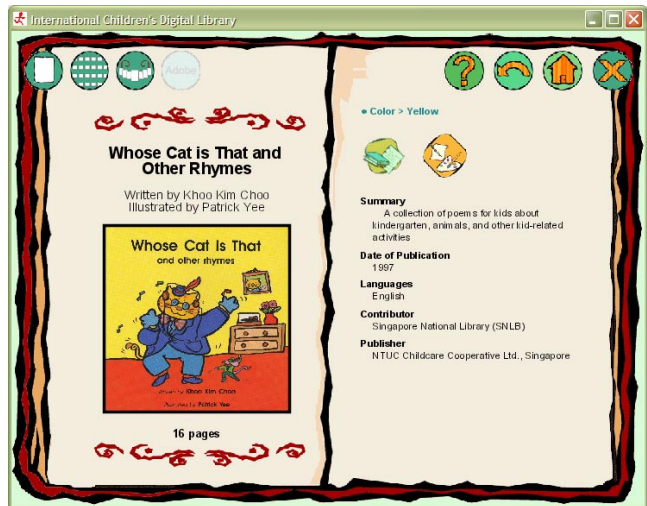


Figure 5: Book Preview. This shows metadata about the book including an available summary.



Figure 6: The Comic Strip Book Reader

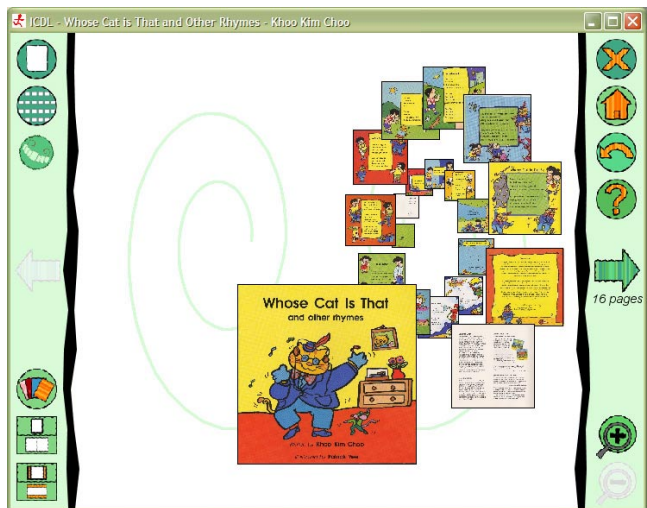


Figure 7: The Spiral Book Reader

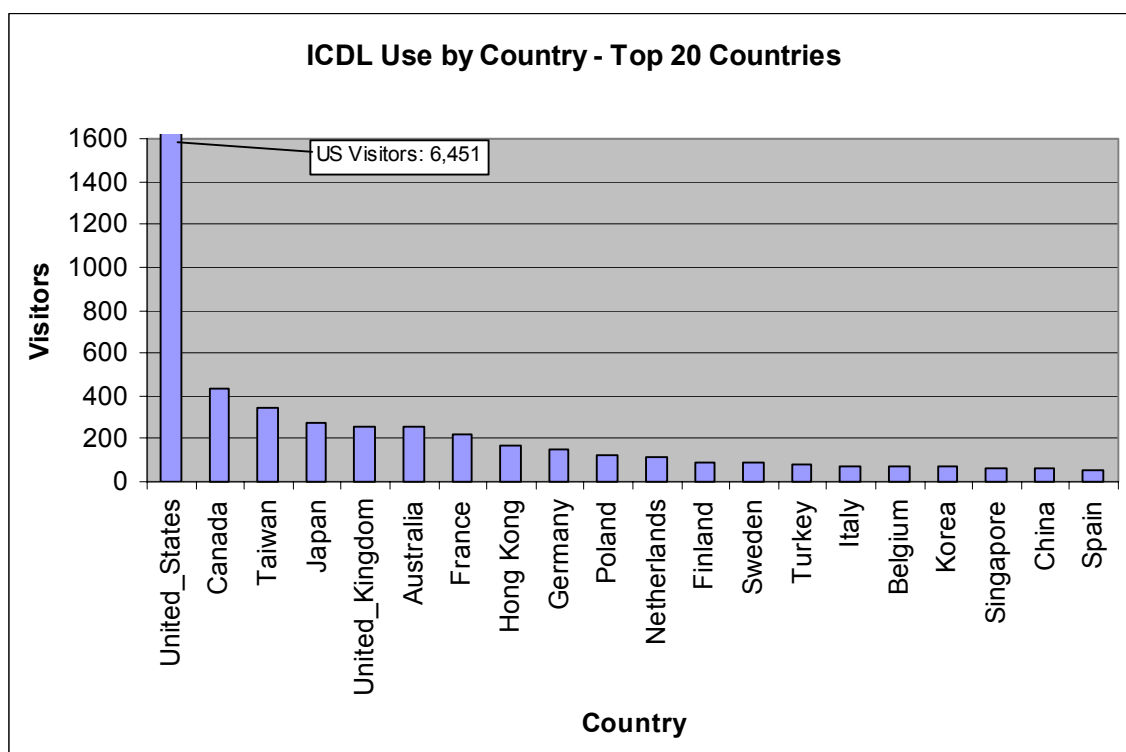


Figure 8: Use of the ICDL by country

We found that 79% of users looked for books by using the visual search (Category) interface, while 21% used the Globe interface. 68% of category searches were on a single category with 32% on two or more categories. The top five single category searches were:

- Books for three to five year olds
- Books in English
- Books for six to nine year olds
- Books about imaginary beasts and creatures
- Books rated with five stars

When we aggregate all the single item searches by top level category, we find the most frequent searches were accomplished with:

- Age (child target age) 18%
- Subject (the content of the book) 17%
- Language (language of book) 13%
- Genre (type of book) 10%
- Characters (kids, animals, etc.) 9%
- Setting (when and where) 8%
- Color (color of book cover) 7%
- Rating (how the book was rated) 4%
- Feeling (how the book makes readers feel) 3%

For the users that searched by geographic area with the globe interface, they searched for books by continent as follows:

- North America: 29%
- Asia: 24%
- Europe: 23%
- South America: 10%
- Oceania: 8%
- Africa: 6%

During the initial seven week period, 36,000 total books were accessed (not including books that were read multiple times once they were downloaded. We are unable to track this information.) The most popular book was *Axel the Freeway Cat* [10]. The popularity of this title may have been due to the fact that it was mentioned in numerous articles that appeared in press coverage of the ICDL launch. The next most popular books were *Sun Flight* [13], an in-copyright book contributed to the collection by Caldecott-Award winning author, Gerald McDermott; *Where's the Bear?* [4], a simple story in multiple languages donated by the Getty Publications; and *Going Downtown and other Rhymes* [5], a book about life in Singapore, contributed by the National Library of Singapore. See Figure 9 for the frequency of books accessed.

As for the books that were requested by publishers to be encrypted, the total number of books accessed was 1075 (again, not including locally cached accesses). The most popular book accessed through the Adobe Book Reader was *How Do Dinosaurs Say Good Night?* [23] followed by *Is Your Mama A Llama?* [7] and *When Sophie Gets Angry-Really, Really Angry* [1]. All of these books were contributed to the ICDL by Scholastic, Inc. The total number of books accessed through the Adobe Book Reader

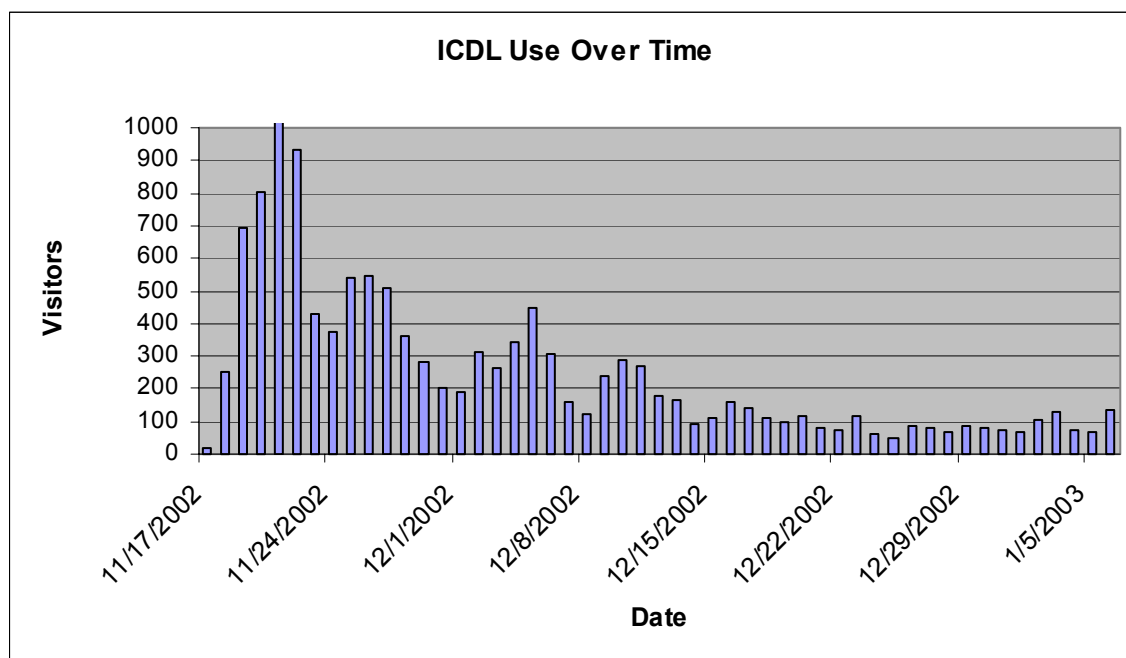


Figure 9: Number of books accessed

was considerably less (19%) than those accessed through the other three readers.

During a three week analysis of the other book readers, it was determined that the Standard Book Reader was used 69% of the time, the Comic Book Reader was used 16%, and the Spiral Book Reader was used 15%. Using these readers, 431,000 pages were accessed by all users. On average, each visitor looked at 1.5 books, and this number stayed relatively constant throughout this period. Most visitors viewed only one book, but more than 100 visitors read ten or more books (Figure 10).

4.1 Discussion

Based on this initial data analysis we have seen that an application with high-end technical requirements can serve only a small percentage of users on the web. Just 12% of visitors to the ICDL during the initial seven-week period were able to run the library software successfully.

We believe that this number is so low because of the high system requirements needed to run the application (e.g., a fast Internet connection, 250 Meg of memory, and Java and Java Web Start installed). In response to the outpouring of email requests asking for access to the site with lower system requirements, we have begun to develop an html-only interface. We expect this interface to be deployed by Summer 2003 and we intend to compare usage patterns between the Java interactive version of the interface and the more static html version. We will be most interested in learning how much (if anything) is “lost” to the user without the smooth animation and zooming. We expect that on-site empirical testing will be needed to fully understand this issue.

Our initial analysis indicates that most users of the ICDL are from North America or from primarily English-speaking countries. This finding is not surprising because the interface, though quite visual, includes text that currently is only in English. In addition, most initial media coverage about the project came out in the US press. We also believe that the high-end system requirements may be a barrier to use in many other countries. Therefore, we are interested in studying whether the make-up of users will change when the html-only interface is deployed and when we add explicit support for other languages.

We also found that the search strategies used by visitors to be quite interesting. Most users searched by “standard” metadata categories. Based upon the preponderance of searches by “age” and by “subject”, we believe that most users were adults or adults working with children. When we have observed children in our lab and on-site in schools and libraries, children seemed to search using the more novel categories. We intend on conducting more targeted on-site testing of how children search (without adult suggestion) and will compare this to the public access logs of the website. This comparison should provide additional information about who is using the ICDL and how it is being used.

In regards to book readers, we found that the more novel book readers (e.g., the comic strip book reader and the spiral reader) were accessed almost an equal number of times. This perhaps suggests that there is no clear favorite interface between the two; something we found to be the case in our own pilot studies in the lab with children [9]. While the standard book reader was accessed more than the other readers, this may be due to the fact that it is the default book reader. We intend in the future to vary the

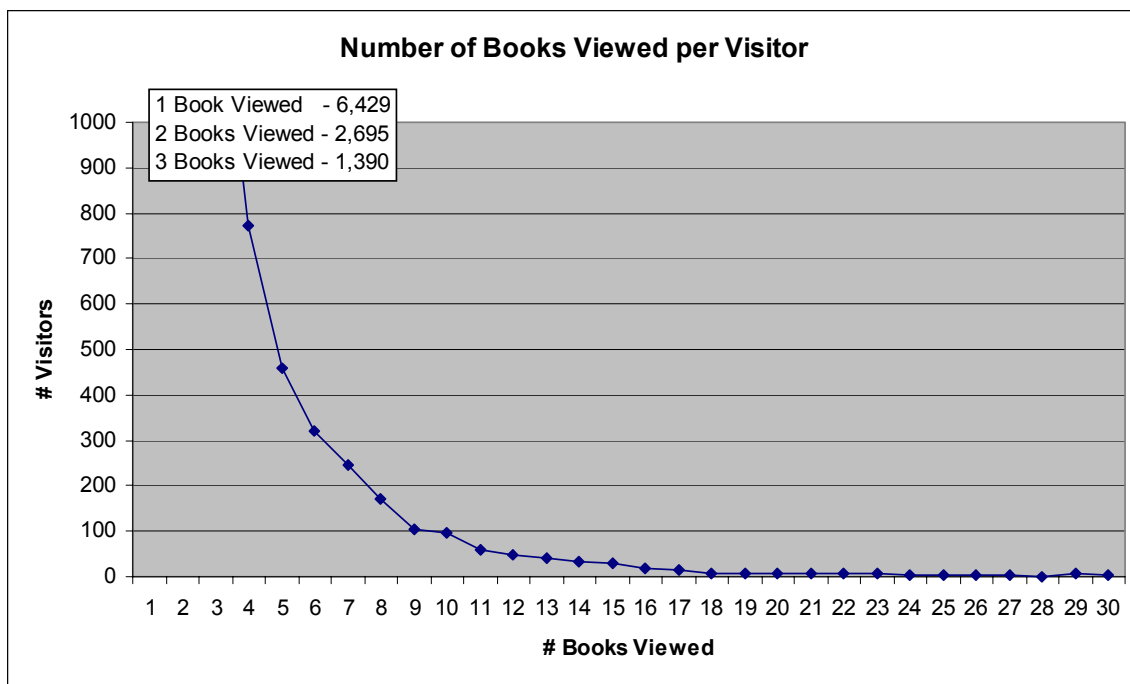


Figure 10: Number of books viewed per visitor

default settings among the book readers to see if usage patterns change significantly.

In examining the books that were accessed most frequently, we were not surprised to find that contemporary books were the most popular. However, we also found that *Where's the Bear?*, the book that had text in five languages on each page, was also quite popular. We were somewhat surprised by the popularity of one of the books contributed by the National Library of Singapore because we assume that most users of the library had little familiarity with the country. These findings encourage us to continue to work to identify bilingual and multilingual titles to include in the collection as well as to continue our emphasis on collecting books from as many cultures as possible. We have seen in our own lab, children's fascination with languages they have never seen and places they have never gone. It was quite common to see children in our lab browsing through the pages of a book written in Arabic or Croatian to look at the pictures or to see the "fancy words" as one 6-year old put it.

One area of interest about which we have not yet been able to develop an understanding of is how many queries users made before deciding to read a particular book. While we know that the average number of books accessed by each user was 1.5, it would be interesting to know if users spent a much longer time searching and browsing. To fully explore this question, again we will have to more deeply observe users on-site to understand their search patterns.

In this initial study, it was not possible to determine how many of the users were children and how many were adults; how many children visited the library independently

and how many visited with parents, teachers, librarians, or other adults; how many users were teachers, librarians, or researchers; or why the users visited the library. Therefore, we intend to conduct more focused empirical studies in the future with a cross section of users in schools, libraries, and home where we can be more positive of the demographics of our users. With the use of web surveys and interviews as well as log data we hope to gain a better understanding of who our users are and what their needs are for the future. We also expect to continue to track the general public's use of the ICDL to gain a better understanding of the use patterns over time.

5. LESSONS LEARNED

While it has only been a short time since our initial deployment of the ICDL, the public use of our research has taught us a great deal. While we had tested the interface extensively before deployment, our biggest challenges turned out to be related other issues and we have learned a great deal. To summarize, these lessons include:

Balance innovation with public access: The enormous drop-off in users who were unable to download the Java Web Start application, spoke to us quite loudly. If we are going to offer our research to the general public, we now know it is not enough to state the system requirements. We received many emails from frustrated users who felt it was "shameful" "unfair to children" "not supportive of schools and libraries" that such high-end system requirements would be needed to have access to children's books. At the same time, we received emails from many "excited" users impressed with the "interface innovations" and the relatively "bug-free experience". We had, in fact, weighed

this issue before our initial release. On one hand, we knew that our research grants and partners expected far-reaching research, yet we wondered if the general public would become frustrated. We opted to release the research prototype as opposed to waiting almost a year for the low-end solution. We felt that the general public (though limited in who could access the library) could contribute to our research directions.

Speed matters: We have always known that speed is an important factor in any interface we develop, however we have learned just how critical it is in web deployment. Users are somewhat forgiving when a static web page takes several seconds to load. But if that same slow speed is evident in an interactive Java application, people simply have no patience. If the users are children, this is even truer. What adds to this challenge is the need for bandwidth on our servers as ICDL users continues to increase. That coupled with users who try the application despite not having the system requirements, makes it that much more critical that we explore a dual development strategy in the future.

There is interest in various countries and languages: Users throughout the world are interested in children's books from many cultures and in many languages. *Sun Flight*, *Where's the Bear*, *Going Downtown and other Rhymes*, were the books most frequently accessed, other than the title that received the most coverage. Each of these books offer a look into other cultures and in the instance of *Where's the Bear* other languages. This suggests there is great promise in pursuing the development of an international collection of children's books.

Web logs can only say so much: We have found that while the analysis of web logs gave us a good first understanding of users' activities with the ICDL, we need to know more. In particular, we need to know more about who is really using the computer. Before our initial release, we wrestled with how much information we can ask from users. This concern was particularly important because the site was designed to be used by children. We have come to realize that a combination of onsite empirical study and web logs will help our research progress.

6. FUTURE WORK

We continue to develop and refine new prototypes of the ICDL which we expect will soon be tested in the labs and publicly deployed in the next six months. We also expect to have a simple version of the library that will not require Java Web Start or a high speed internet connection. Based on our initial insights from this analysis we see the need for testing and comparing new versions of the ICDL with various empirical methods. A research goal we also intend on pursuing in the coming year is the development of a "book community." We hope this on-line community for children will motivate them to become more involved with the library (e.g., increase the number of books accessed); keep children coming back to the ICDL; help them interact with each other (e.g., through online discussions and

games); and give us a way of communicating with them when it is time to update the software.

We also have come to understand that we need to balance our research priorities with our responsibility for serving the public's interests. It has been made very clear to us that there is an enormous interest and a pressing need for a collection of children's materials in multiple languages, from multiple cultures that is freely available over the internet. As we move forward, balancing these two foci may be our biggest challenge.

7. ACKNOWLEDGEMENTS

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