

Children as Design Partners and Testers for a Children's Digital Library

Yin Leng Theng, Norliza Mohd Nasir, Harold Thimbleby, George Buchanan,
Matt Jones, *David Bainbridge, and **Noel Cassidy

School of Computing Science, Middlesex University, U.K.
{y.theng, n.mohd-nasir, h.thimbleby, g.buchanan and m.jones}@mdx.ac.uk

*Department of Computer Science, University of Waikato, Hamilton,
New Zealand, davidb@cs.waikato.ac.nz; **St.Albans School, U.K.,
NJCASSIDY@st-albans.herts.sch.uk

Abstract. Most of today's digital libraries (DLs) are not designed for children. To produce usable and useful DLs, designers need to ensure that good design features are incorporated, taking into consideration users' needs. We describe our experience working with children as *design partners* and *testers* in building a children's DL of stories and poems for 11-14 year olds, using a concrete example to demonstrate our design philosophy and research approach. The study provides insights on useful design features children's DLs should have, and their importance to children. The initial work we have done highlights issues and provides a basis for the building of usable and useful digital libraries for children.

1 Digital Library Technology and Children

Historically, the creation of public libraries in the early 1900s was to support education by providing free access to information. With the introduction of the World Wide Web (also known as the Web) in the mid 1990s, we were presented with a powerful alternative to traditional libraries. The Web makes it "very easy" for anyone to publish and retrieve information. To cope with what is now becoming an information glut on the Web, subject-based digital libraries (DLs) are beginning to emerge on the Web. However, most of today's DLs are not designed for children [1].

Children have their own likes, dislikes, curiosities and needs that are different from adults. Designers of this new DL technology, therefore, should regard them as an entirely different user population with their culture, norms and complexities.

Using a concrete example to demonstrate our design philosophy and research approach, we describe our work in the design of a DL of stories and poems for children aged 11-14 years old. This work was carried out as part of a project funded by the UK's Engineering and Physical Sciences Research Council (EPSRC). Our DL illustrates two objectives:

- To engage children as *design partners* to ensure that the DL is designed with and for children (see Sections 2 and 3); and
- To engage children as *testers* to evaluate three different interface designs to the DL and to rate in order of importance design features crucial to the success of the DL (see Section 4).

2 Participatory Design - Engaging Children as Design Partners

In recent years, we see more research focusing on understanding the role of children in the technology design process as users, testers, informants and design partners [e.g. 2, 4, 6, 7, *etc.*]. From the start, we wanted our project to be a thoroughly collaborative endeavour as we wanted to design a DL with and for children. Hence, we invited a class of twenty-three 12-year old boys and their English teacher at a secondary school to be our design partners. These children were selected because they were competent web users and would be able to give more informed comments on the efficiency and effectiveness of DLs, compared to say, novice users. (Also, one of this paper's authors is a Governor of the school).

Two sessions were conducted during a one-hour-ten-minute English lesson between November and December 1999. The objectives of the first two sessions were to carry out *participatory design, engaging children as design partners* to:

- investigate useful design features for a children's DL of stories and poems; and
- propose and implement basic design features for the children's DL that will encourage active engagement and participation, taking into account children's needs.

Protocol of first session

We wanted to create the trust required to have a truly participatory design process and that takes time and effort [7].

In the first session, the children were introduced to the concept of DLs. We explained our research project and objectives. The students felt important at being invited to be design partners. We wanted the children to work in teams to brainstorm design ideas for the DL environment with as little input from us as possible. Teams of five or six children were formed. The teams had two weeks to think about the design features. To help them with the assignment, they were provided with URLs to browse sample DLs and children's websites. The children were to submit their design ideas before the second session.

Protocol of second session

The second session took place three weeks after the first session. Each team presented the design ideas proposed for the DL environment, which they had discussed in their groups after the first session.

Results and Analyses

What the children wanted in the DL was entertainment and fun. One suggestion was that the library could be divided into different areas: (a) study area to allow reading or browsing; (b) librarian area to make enquiries; (c) games area to play games; (d) dictionary area to search for meanings of words; and (e) actual library to search for books. Another suggestion was to provide different forms of help such as having a librarian at the "front desk", a search box and a random book selector. The children also suggested that the DL environment to include a display of the top ten stories/poems, information about authors and a message board to post and discuss ideas.

Table 1 summarises the ideas submitted by the four teams (see <http://www.cs.mdx.ac.uk/dl/St.Albans/> for work done by the children). At the end of the second session, a list of design features the children liked to be included in the collaborative writing environment was formed (see Table 1). These features were implemented in the three different interfaces to our DL prototype, described in more detail in Section 4.

Table 1. Ideas proposed by the children, and list of design features implemented in the three interfaces to our DL prototype.

Team	Ideas proposed by the teams	List of design features implemented in our DL prototype (see Section 4)
A	<ul style="list-style-type: none"> - Bookshelf organised in different sections (e.g. science fiction, fantasy, etc.) - Facility to write and submit stories - List of top 10 books/authors - Good index feature - Provide interesting and fun activities such as a picture of man falling over, books falling off the bookshelves, etc. - Provide a random book selector with the relevant book opened to be read 	Design DL to be: <ul style="list-style-type: none"> - like "traditional" library - more game-like - efficient in searching for relevant materials Offer children opportunities to submit to the DL.
B	<ul style="list-style-type: none"> - Facility to write/submit story - List of books with reviews and comments from readers - Search for relevant materials giving either information on "title" or "author" - Facility to contact the author via email to give feedback 	Give recognition of good stories submitted by listing the top 10 books/authors. Offer children with fun features to search for relevant books, etc.
C	<ul style="list-style-type: none"> - Provide games - List of top 10 books, authors - Links to other relevant sites and writing aids such as dictionary, thesaurus - Facility to chat with other users 	Provide opportunities to chat with and to get feedback from other readers.
D	<ul style="list-style-type: none"> - Create a virtual library with study area, librarian area, dictionary area, search area and games area - Select a weekly winning book - Provide audio feature for the story to be read - Provide a random book selector 	

3 Design Choices

Using inputs from the children as well as drawing upon design guidelines highlighted by other researchers working with children [e.g., 2, 4, 5, 6, 7, *etc.*], we describe our DL environment with distinctive features to provide opportunity: (1) to create and submit stories/poems to the DL, collaborate with other users in writing stories/poems

and actively engaging users in the use of the DL; and (2) for flexibility and manipulation of search results.

3.1 Provide Opportunity for Creation, Collaboration and Engagement

Although subject-based DLs are beginning to emerge on the Web, and promise us opportunities we never had with traditional libraries or even the Web, DLs in general have not taken off in a "big" way compared to, say the Web. One reason for the Web becoming popular overnight is the introduction of Mosaic, the graphical user interface to the Internet, making it "very easy" for anyone to publish and retrieve information. In contrast, the majority of the current DLs is mainly repositories of information, hence users' experience in DLs is passive and less engaging compared to the Web. Therefore, if the DLs are to be popular with children, they need to be fun, easy-to-use and empowering them — both as readers and authors.

Here, in our prototype, we provide the children opportunity for *creation* of their own stories/poems and uploading them into the temporary DL space for reviews from their teachers and peers, before submitting to the permanent DL (see Figure 1). Only stories and poems approved by the teachers can be submitted to the DL, thus ensuring the quality of the documents.

Figure 1. Children can create their own stories/poems and upload into temporary DL space

The screenshot shows a Netscape Communicator browser window with a document creation template. The template includes a list of instructions and a form with fields for title, author name, class name, year, and story/poem content. A separate section shows a submission form with fields for author's name, year, class, collection type, title, and categories, along with an upload document button and a 'Browse...' button.

Instructions to create a new story/poem

- Choose *File>Edit page* on the browser
- Delete the "*Enter title*" text and type your title at that section
- Delete the "*Enter author name*" text and type your name at that section
- Delete the "*Enter class name, enter year*" text and type your class name and year at that section
- Delete the "*Start typing story/poem here*" text and type your story/poem at that section
- Note: Before saving your work, delete these text
- To save your work, choose *File>Save As... Enter your filename.html*

Template for creating a new story/poem

(To create a document:

[Enter title]

[Enter author name]

[Enter class name, enter year]

[Start typing story/poem here]

Attributes for users to enter to describe story/poem for submission to the library

All collections search

Author's name: []

Year: [] Class: []

Collection type: []

Title: []

Categories:

Action & Adventure Historical Myth

Classic Horror Others

Fairy tales Humorous Science fiction

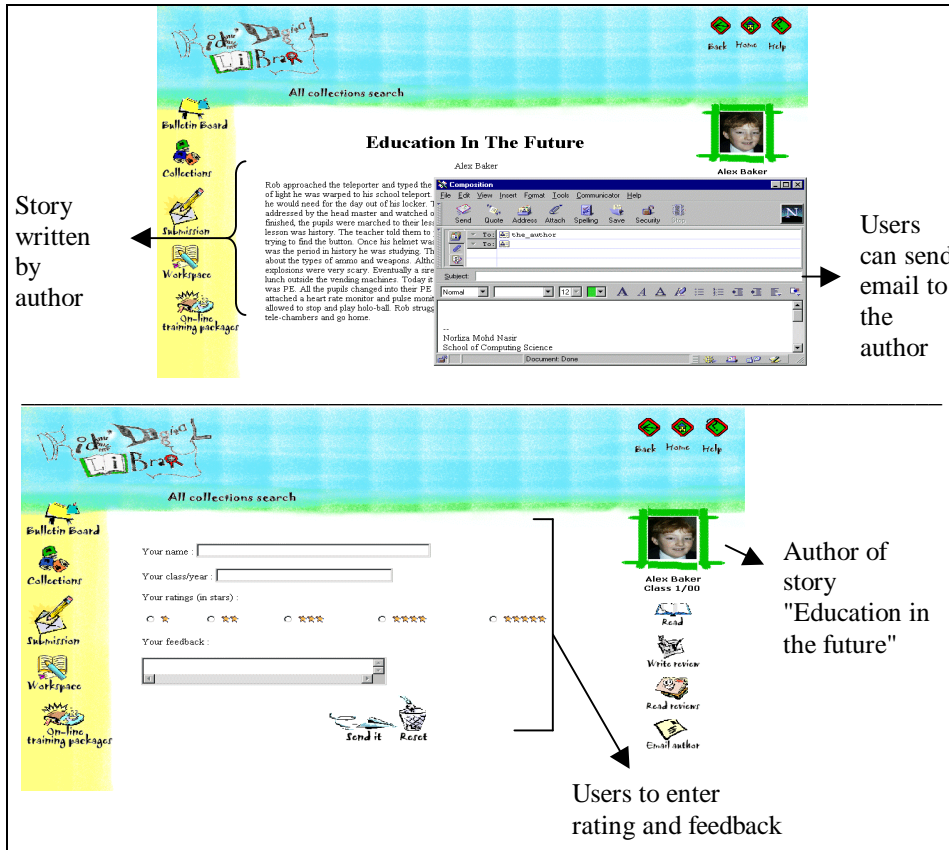
Folk tales Mystery

Upload document: [] Browse...

Send it Recd

Figure 2 shows one of the stories in the permanent DL. To encourage collaboration, children can read stories, give reviews, read other children's reviews on stories and email authors for other comments.

Figure 2. Children can submit review, give feedback and rank story read.



To promote active *engagement* of the children in using the DL, we apply Ellington *et. al.*'s four basic factors to match the natural learning processes of humans by [3]: (F1) making materials stimulating and interesting enough to make learners *want to learn*; (F2) incorporating sufficient activities to help learners experience *learning by doing*; (F3) providing sufficient channels of *feedback to learners*; and (F4) enabling learners to *digest and relate* what they have learned to the real world.

In our DL environment, children can query and browse stories and poems written by other children (applying F2). The distinctive feature is that it also allows children to create and submit their stories and poems to a temporary workspace permitting others such as their teachers and peers to read and give feedback by sending their comments via email to the children authors (applying F2, F3, F4).

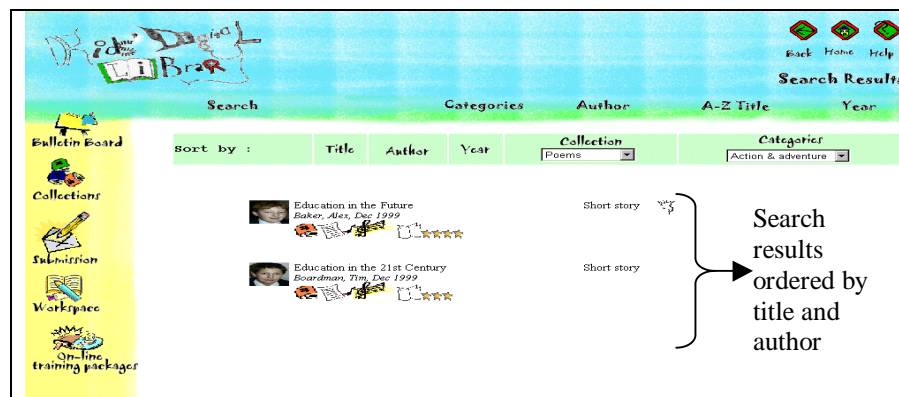
The DL environment also provides: (1) a display of the top ten stories/poems (applying F1); (2) information about the authors (applying F1); and (3) message board to post and discuss ideas (applying F3, F4). Resources to help the children authors include links to: (a) other related DLs; (b) helpful on-line dictionary, thesaurus and spell checker; and (c) relevant computer-based training packages to teach them skills on, for example, how to write better (applying F2).

3.2 Provide Workspace and Equal Opportunity for Flexibility and Manipulation of Search Results

We introduce to the DL facilities a "desk" for interaction on the basis of Equal Opportunity, a heuristic introduced for human-computer interaction [11]. Here, the user can exploit the prior output of the computer as input to a further stage in interaction, with or without modification. It may be useful to compare this to the opportunity of activity in a traditional library. Readers are able to get a list of possible items of interest, and retrieve them for further inspection. Those that prove of cursory interest can be set aside or returned to their usual place quickly, and those of greater use can be gathered together for deeper investigation.

Search items can be ordered and prioritised according to either title or author. We are in the process of extending our DL prototype the possibility of allowing search items to be ordered and prioritised according to either the year of publication or by the collection or categories within the library space (see Figure 3).

Figure 3. Search items can presently be ordered/prioritised according to either title or author



4 Participatory Evaluation $\frac{3}{4}$ Engaging Children as Testers

At the end of the second session, we were certain we wanted the DL to be fun as suggested by the children. This is in agreement with approach encouraged by [4] that designers when designing technologies for children can also make things that ask laughter, excitement and creativity. We were, however, uncertain as to what the children meant by making the DL useful and fun. The children's concept of fun was to include games such as having books falling from shelves and only the relevant books would be opened and "caught" to be read. Other suggestions seem somewhat violent which include "beating up the librarians" or "drawing graffiti in the library" that have no relation to the functionality of the DL (at least to adults!).

Hence, we decided to have a third session with the children to give them something more concrete to comment on their likes and dislikes of DLs, as some children may have a more difficult time verbalising their thoughts, especially when it concerns abstract concepts and actions [12]. The third session was held in February 2000. The children were given three different, paper-based versions of interface designs of the

DL but each with similar basic design activities and screen layouts suggested by them (see Section 3). The three different interface designs are:

- *Interface A* using the New Zealand School Journal¹ interface with only the images and icons changed to something more brightly coloured to appeal to a younger user group;
- *Interface B* uses a library metaphor with children moving among book shelves looking for relevant books, articles, etc.; and
- *Interface C* uses a game-like metaphor of an adventure story engaging children in a treasure hunt for books.

Due to constraint of space in this paper, only the design features implemented in Interface A are shown in Figures 1-3. Please see <http://www.cs.mdx.ac.uk/dl/DLinterfaces> for designs of Interfaces B and C.

The aim of the third session was to carry out *participatory evaluation, engaging children as testers* to:

- conduct an initial evaluation of the three different interface designs to investigate useful design features for DLs for children; and
- rate in order of importance design features crucial to the success of children's DLs.

4.1 Initial Evaluation of Three Interface Designs

Protocol of third session (Activity One)

The session began with Activity One showing the children a web-based, mock-up of the three interface designs of the children's DL. The children were then divided into three groups of six to eight with an adult to ensure that the children understood what needed to be done as well as to facilitate discussions if necessary. The groups were given a paper-based version of the three interface designs, allowing the children to examine more closely the different interface designs of the DL. The children were each given a worksheet to write down three things they liked about the interfaces and three things they wished the interfaces would provide.

Results and Analyses

The aim of the third session was to get a quick impression of the children's responses to the "look-and-feel" of the three different interface designs. Table 2 shows things children generally liked about the three different interface designs.

With regard to screen display, the children loved the use of bright colours, good graphics and audio. The simple design with easy access to help in the form of a helpdesk/librarian was well-considered. To them, good navigation involves ease of use to get information and help. Links to other relevant sources and writing aids are welcomed. Interface B with a library metaphor seemed to appeal to the children because it was more "realistic, easy to use since most people have been to traditional libraries".

Although the children liked the use of colours as reflected in Table 2, they were not keen on having too much of one colour, for example, Interface A having too much

¹ URL for New Zealand School Journal is <http://www.nzdl.org/>

blue or Interface B having too much brown. Simple layout is important with appropriately sized text and labelled buttons. Navigation should be kept simple with not too many clicks to find the relevant information.

When we started with this project, we were uncertain as to the likes and dislikes of this age group (11-14 years old) as most research does not work with children of this age group. What was surprising in their comments was that they wanted the interfaces to be "less babyish" and "more adult". It would seem that they preferred interfaces that were fun and interesting to use as well as functional.

Table 2. Things children liked about the three interface designs.

Design Categories	Interface A (conventional DL interface)	Interface B (library metaphor)	Interface C (game metaphor)
<i>screen display</i>	<ul style="list-style-type: none"> - bright colours - good graphics/icons - simple design - audio - easy access to help - easy to understand 	<ul style="list-style-type: none"> - bright, bold colours - simple terms and presentation - books on shelves - signs on the wall - notes on the noticeboard - helpdesk/librarian 	<ul style="list-style-type: none"> - good colours - good graphics - good idea with message popping up and animation
<i>navigation</i>	<ul style="list-style-type: none"> - easy to use - easy to get info - links to other sources 	<ul style="list-style-type: none"> - quick access to other items - feedback system 	<ul style="list-style-type: none"> - easy to use - links to other writing aids
<i>overall comments</i>	<ul style="list-style-type: none"> - creative writing 	<ul style="list-style-type: none"> - colourful and interesting - very realistic, very easy to use because it's like a normal library which most people have been to 	<ul style="list-style-type: none"> - treasure map makes things easier for us to use

4.2 Ranking Design Features for Children's Digital Libraries

Protocol of third session (Activity Two)

Activity Two was to get the children to rate a list of fifteen design features on a scale of 1-4, with number 1 being "not important" and number 4 being "very important". The aim of this activity was to rank in order of importance the design features considered as crucial in the DL by the children in Activity One.

Results and Analyses

Table 3 shows the percentage of children who rated the features as either "important" or "very important". Top of the list is the "ease of use to find information" (96%) followed closely with the need to make the DLs "fun/interesting/attractive/appealing to use" (91%). The provision of some kind of "librarian-like" help features (for example, guided tours) did not seem to appeal to them, scoring a low 17%.

Although the division between usability and usefulness is blurred as evidenced by differing views held by researchers [e.g. 8, 10, *etc.*], in this paper, we define

"usability" of DLs to be measured by established usability dimensions covering usability defects such as screen design, terminology and system information, system capabilities and user control, navigation and task completion [9]. In contrast, "usefulness" of DLs is measured in reference to system specifications and not on user performance testing [9]. From children's feedback (see Table 3), there seems to be an equal emphasis for the children's DL to be usable (53%) as well as useful (47%).

Table 3. List of design features for children's DLs ranked by children in percentages

Criteria	Category	Percentage
1. Easy to use to find information	Usable	96%
2. Fun to use	Useful	91%
3. Interesting to use	Useful	91%
4. Attractive/appealing to use	Useful	91%
5. Easy to retrieve/download materials	Usable	87%
6. Easy to use search facilities	Usable	78%
7. Easy to learn how to use	Usable	74%
8. Simple language, easy to understand	Usable	70%
9. Help feature provided	Useful	65%
10. Relevant to what you are doing	Useful	65%
11. Flexible to use	Usable	61%
12. Links to relevant materials	Useful	61%
13. Feedback given on what you have asked the computer to do	Useful	52%
14. Feedback/hints on what to do next	Usable	48%
15. "Librarian-like" help features (e.g. guided tours)	Usable	17%

5 Design Lessons, Conclusions and On-going Work

To ensure we design a children's DL with and for children, we carried out a study to investigate useful design features children's DLs should have by engaging children as *design partners*. While children can be extremely honest in their feedback and comments, much of what they say needs to be interpreted within the context of concrete experiences [2]. Therefore, in our study, we also involved the children as *testers* providing them with three different interface designs based on what they suggested in the first two sessions. The children gave us useful suggestions congruent to other research findings with younger children [e.g. 2, 4, 5, *etc.*] that children prefer systems that are fun to use, interesting and appealing. As a result, we implemented in our prototypes features for children to create stories/poems to the DL, write reviews, give feedback and to collaborate with other children. In contrast to current DLs, our DL provides a dynamic environment to encourage active engagement of children in using the DL. Unlike the younger children, this age group, however, seemed to want systems that are more functional and "adult in appearance".

In our study, we also wanted to investigate which design features in DLs were considered more important to the children. Contrary to popular belief and other research findings [e.g. 2, 4, *etc.*], although our children prefer systems to be fun, interesting and appealing, usability of DLs is considered even more important. When we designed the three different interfaces, we thought the children would be more satisfied with the game-like interface. However, results from our study showed

otherwise. It will be interesting to repeat our work with other age groups and control for other factors such as web skills and gender.

This is on-going work for us. The initial work we have done suggests useful work with children and DLs. Next, we will be carrying out more in-depth, one-to-one sessions with the twenty-three children to evaluate the usability and usefulness of the three prototypes. The design features discussed in this paper need to be further refined and tested with different types and numbers of children before they can emerge as guidelines for the design and evaluation of digital libraries for children.

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