

**BUILDING AN ENHANCED BROWSING/
READING ENVIRONMENT BY THE
INSTALLATION OF THE BROWSREADER IN
THE CHILDREN'S ROOM OF A LIBRARY OR
KINDERGARTEN**

DECEMBER, 2012

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Preface

Reading together draws much attention as a societal concern for children not only to yield emotional reaction but also to gradually advance intellectual thinking. We here aim to build a new environment, in which children's activity in browsing/reading picture books together with families and/or friends is steadily enhanced, by installing the BrowsReader in the children's room of a public library or kindergarten. The BrowsReader is a system to assist children in finding and reading a large number and wide variety of picture books. Its basic ideas involve the processing of the primary and secondary information seamlessly and the assisting children in browsing/reading together the printed, digitized, and web picture books. The children, by gathering around the BrowsReader, can browse picture books and then choose and read a book by flipping pages on it.

We introduces three notions to realize the BrowsReader: a surrogate picture book, which consists of the front-cover image followed by the page images of a printed, digitized or web picture book; an abstracted bookshelf, which presents the front-cover images and the titles of many surrogate picture books in the form where all are linearly arranged, with some of the images bundled in places and some of the titles superimposed in string; and a unified view, which presents each page of any surrogate picture book in a form that seems like a printed picture book's page. We then specifies, the BrowsReader which can be installed in each children's room so that children together with families and/or friends can easily browse a large number of surrogate picture books as if they are browsing in the physical bookshelves of the children's room without noticing the difference between the primary and secondary information, and can read any found surrogate picture book as if they are reading an ordinary printed picture book on a table.

The evaluation about whether children's activity in browsing/reading together was enhanced in a new environment by installing the BrowsReader has been carried out in a step by step process through two phases; in the temporary children's rooms realized in children's events 2007, 2008, and 2009, and in the actual children's rooms of four public libraries and one kindergarten. In the former phase, we certified that children constantly enjoyed using the BrowsReader together and confirmed the BrowsReader could be used in an actual situation. In the latter phase, we further clarified that the children's activity in browsing/reading together was steadily enhanced when using the BrowsReader by analyzing the data of the employed logging system and questioning the librarians and kindergarten teachers.

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1. Introduction

Picture books play an important role as textbooks for children. Children's activity in reading together draws much attention as a societal concern. For enhancing children's activity in browsing/reading picture books together with their families and/or friends, we aim to build a new reading environment in the children's room of a library or kindergarten. This chapter overviews the background of the study and describes how to build the new environment.

1.1 Background

Reading picture books together with peers or adults motivates children to become active participants in a reading community [34]. By reading-to-children and also reading picture books together mainly with families, younger children experience a range of emotions - e.g. joy, happiness, and sad - by being affected in their cerebral limbic systems [60]. These experiences and the experience in reading picture books together with families and/or friends, which accompanies reading-aloud, in succeeding years largely help older children to acquire literacy skills, broaden communication ability, and advance intellectual thinking by developing the frontal association areas within their cerebrums [4] [25] [41] [60].

The children's room of a public library or kindergarten is one of the best places for children to find and read picture books of interest together with their families and/or friends [59]. It can be noted that if the collection in a children's room is not biased in content and not limited in number, it becomes more attractive and enhances the reading together activity. Unfortunately, mainly due to finance, many small public libraries are unable to collect a large number and/or wide variety of picture books. It also can be noted that children should be able to find picture

books of interest by browsing in through the entire collection. In the children's room of a large public library, however, children face the challenge of finding these books; i.e. they either have to physically browse through multiple bookshelves or search a bibliographic database for keywords.

The problem in the children's room of a small library described above could be solved by bringing digitized picture books into the existing printed picture book collection (in this case digitized picture books refer to the picture books that have received permission for digitizing and copying from the copyright owners), in addition to web picture books that are the picture books in Digital Ehon [15], Digital Okayama Encyclopedia [16] [44], the International Children's Digital Library [27] [31], etc., freely accessed via the Web. The problem that exists in the children's room of a large library can be potentially solved by building an environment in which children together can easily browse through a bookshelf that conveniently keeps the entire collection. Note that the adoption of off-the-shelf digital picture books provided by the web stores, e.g. Kindle Store [36] and Barnes & Noble [6], exerts a significant influence on the execution of a library budget.

1.2 Objective

We here try to solve the problems described above, by building a new children's reading environment in the children's room of a library or kindergarten, where the BrowsReader is installed, and children's activity in browsing/reading together with their families and/or friends is steadily enhanced. Most of these children are kindergartners and the rest are mainly lower graders. The BrowsReader [38] [39] [40] is a system designed so that children can gather around it and engage in picture bookshelf browsing and picture book reading. Its basic ideas involve the processing of the primary and secondary information seamlessly, and the assisting children in browsing/reading together the printed, digitized, and web picture books. For the former, it is designed to display the virtual bookshelf storing many picture books and the index listing the titles, and show the results in the bookshelf and index promptly while browsing in them, for helping children to make connection between the two kinds of information. For the latter, it is designed to utilize the digitized/web picture books as if they were the real printed

books, for assisting children in reading the found picture book together by moving around, rotating, and enlarging the book without noticing the differences between the real printed books and digital ones.

The children in such a room can easily browse a large number of picture books as if they are browsing in the physical bookshelves, and can read a wide variety of picture books as if they are reading ordinary printed picture books. The hardware setting of the environment is just a computer with a display. A touch-display relatively large in screen size is preferable so that the children together can operate the BrowsReader. Figure 1.1, shows an environment built in the children's room of Oita University library to enhance children's activity in browsing/reading together, which is open to the public.



Fig. 1.1 An enhanced children's room of Oita University library.

To realize the BrowsReader in an actual children's room with a large collection, we introduce three notions: a *surrogate picture book*, which presents a front-cover image followed by the page images of a printed, digitized, or web picture book, an *abstracted bookshelf*, which presents the front-cover images and the titles of many picture books in the form where all are linearly arranged, with some of the images bundled in places and some of the titles superimposed in string, and a *unified view*, which presents every page of any picture book in a form that seems like a printed picture book's page.

The features of the BrowsReader realized involve:

- (1) A large number and wide variety of printed, digitized, and web picture books are reproduced as surrogate picture books.
- (2) Children, together with their families and/or friends, can easily browse in an abstracted bookshelf storing surrogate picture books and have a similar experience to browsing in the physical bookshelves of a children's room, without noticing the difference between the primary and secondary information.
- (3) Children, together with their families and/or friends, can read any found surrogate picture book in a unified view that allows each surrogate picture book to be viewed as if it is an ordinary printed picture book.
- (4) The browsing/reading activity for the surrogate picture books would not infringe upon copyright protection.

We consider that children together with their families and/or friends have read picture books using the BrowsReader in a children's room when they together spend 2 to 5 minutes for flipping the pages of each of these picture books, by supposing that during this time period many kindergartners have enjoyed looking around the pictures and/or hearing the stories, and many lower graders, in addition, have become intellectually activated through reading-aloud of the texts. The estimation of the time period is based on the observation of the kindergartners' reading activity in the children's room of a kindergarten.

By gathering around the BrowsReader children can easily browse in an abstracted bookshelf and then find surrogate picture books which are of interest. Any found surrogate picture book, which can be moved around, rotated, and enlarged, is read by flipping the pages with the same convenience as with a familiar printed picture book. The children are also free to browse while reading. The BrowsReader is different from an ordinary bibliographic search engine in which the information about the desired picture books is searched for by inputting the keywords or category symbols and is presented on a display. In the BrowsReader all the front-cover images are linearly arranged and then presented in such a way that some of them, which will be of particular interest, are enlarged and the rest are reduced. Further the presence of all the front-cover images is shown all of the time. The BrowsReader is relatively easily

customized so that it can be installed in any children's room, where the main task of the customization is to generate the surrogate picture books for the collection there.

The effect upon the installation of the BrowsReader has been evaluated along with its step by step improvement through eight case studies; three of the case studies were conducted in the temporary children's rooms built in Oita University campus and five in the actual children's rooms of Oita Prefectural library [48], Oita City library [47], Beppu City library [8], Yufu City library [63], and Beppu University's attached kindergarten [9]. A free-style evaluation study, where children freely used the BrowsReader, was employed so as not to have any long lasting influence on the children's browsing/reading activity in the future. In the initial three studies, where hundreds of digitized and non-flash-based web picture books and also printed picture books became available, the children's behavior was observed, and then the children were questioned and interviewed to evaluate the effect of the installation. Through the observation and the answers we confirmed the BrowsReader was able to work in enhancing the activity in browsing/reading together. In the latter five studies, a relatively large number of digitized, non-flash-based/flash-based web picture books and a fairly large number of printed picture books collected in a children's room became available on the BrowsReader. The printed, digitized, and web picture books, which were arranged so that they reflected the scheme used to classify the printed picture books, were able to be browsed all together, and any digitized/web picture book be read as if it was an ordinary printed picture book. By analyzing the data of the employed logging system, and questioning and interviewing the librarians and kindergarten teachers who observed the children's behavior, we collected the evidence showing that the children's activity in browsing/reading together was steadily enhanced in the actual children's rooms.

1.3 Outline of the Dissertation

The rest of this dissertation is organized as follows: Chapter 2 overviews previous studies, which have focused on enhancing the browsing/reading activity. There are three main streams in recent studies; the first stream involves some ideas and activities; the second stream pro-

vides digital children's books via the Web; the third involves devising new large-scale digital devices in libraries.

Chapter 3 states the basic ideas, which involve the processing of the primary and secondary information seamlessly, and the assisting the children in browsing/reading together the printed, digitized, and web picture books. To realize the BrowsReader, we mainly introduce three notions named surrogate picture book, abstracted bookshelf and unified view. Following that, the details about how to organize an abstracted bookshelf and provide a unified view in the BrowsReader are described. The end of this chapter depicts a scenario when children utilize the BrowsReader with their families and/or friends.

Chapter 4 shows a description about how the BrowsReader is customized so that it can be installed in an actual children's room, where the main task of the customization is to generate the surrogate picture books for the collection.

Chapter 5 describes the details of the case studies that were conducted to evaluate the BrowsReader in enhancing children's activity in browsing/reading in temporary children's rooms built in Oita University campus and in actual children's rooms of four public libraries and one kindergarten. We confirmed the BrowsReader was able to work in enhancing children's browsing/reading together from the observation and the answers in the case studies in the temporary children's rooms, and we collected the evidence showing that the children's activity in browsing/reading together was steadily enhanced in the actual children's rooms from analyzing the data of the employed logging system, and questioning and interviewing the librarians and kindergarten teachers.

Chapter 6 finally summarizes our proposition, and discusses a future research direction to further investigate the effect of the BrowsReader in children's activity in browsing/reading together, and gradually establish the collaboration of the BrowsReader in various libraries for assisting children in a children's room in browsing/reading picture books collected in all the libraries.

2. Related work

Recent studies have suggested that the environments for enhancing the children's activity in browsing/reading together are built along three main streams. The first stream involves ideas which encourage children to read the printed children's books¹ in the children's room of a public library. The second stream provides a large collection of digital children's books in a server system and encourages children to read and discuss via client computers. The third involves devising new large-scale digital devices that intensify the children's physical activity.

The reading-to-children programs of public libraries in the promotion of children's reading activity in Japan [20] and Storytime programs in USA [43] have been very effective in attracting children (mainly aged 0 to 3) for reading together with their families. The effort of Carnegie and Kate Greenaway Awards [51] [61] in UK organizes children into different groups, and each group reads the books in a library chosen from a shortlist of the nominated children's books. Afterwards, they communicate via the Internet across the country to choose the best books. In another effort, Statewide Summer Reading Program [26] [57] in New York State in USA, 1,100 local public libraries across the states organize children aged 0 to 5 as well as older children during summer to read various children's books together with their families in a series of events. The main benefit there is to provide fun to the children through reading together, which is an important part of learning [4]. All the efforts described above, however, involve the creation of special plans valid for a limited period of time. Further the collection in each library is limited in number and biased in content, and in addition, out-of-print books could not be read there either.

¹ A picture book here is a kind of children's book.

Providing digitized picture books through the Web is one way of alleviating those problems. The free website, Old Picture Book [49], produces the web based digitized versions of the great Old Picture Books written by authors such as Kate Greenaway, a popular nineteenth century writer for children, through the Web. Although reading these picture books together can provide an excellent opportunity to teach children many things, supporting children's browsing to find books of interest is crucial in increasing the amount of reading they do [54]. Oxford Owl [52], the website built by Oxford University Press, has claimed that encouraging younger children, mostly preschoolers, to read picture books together with their parents can effectively help them to develop early reading skills. When the parents draw attention to letters and sounds, their children begin to notice them as well. Thus children's early reading can be seen to greatly benefit from reading picture books with families and developing initial awareness of pictures, sound, and letters relationship.

The adoption of off-the-shelf digital picture books available from web stores, e.g. Kindle Store and Barnes & Noble, can be another way of providing a number of picture books for children. The available collection from which picture books are chosen as a part of the collection of a public library, however, is still not so large. Though more than 1,100 public and school libraries in USA have introduced the digital book distribution system of OverDrive Inc. [50], through which children can read the digital picture books, the introduction of such a system also becomes a burden financially [12]. Further it should be noted that off-the-shelf digital picture books are usually read on dedicated devices each of which is not well suited for children to use by gathering around.

In order to provide a large collection to children researchers [17] [28] [30] have tried to address the problems by building a children's digital library, named ICDL, on the Web. There are many other experimental, public, and commercial digital libraries. Two studies related to ICDL have investigated how to help children from grade schools or junior high schools to find the digital information about children's books and read them through verbal communication [18] or through internet communication [35]. The former study has designed and developed an interface in which children (the major targets are children aged around 8) can use multiple mice collaboratively on a single computer to access multimedia information. As the children get into the search section, they are required to click category symbols and forced to engage in

conversation to agree upon how to use two mice. The latter study has been carried out at Baltimore University, where children in the higher grades or from junior high schools have used the Internet to exchanged and shared ideas about the children's books in ICDL with their reading group by making digital notes and/or marks. Although the effectiveness of ICDL in reading children's books has been certificated in a four-country study [19], the focus is on the reading together activity to some extent and does not support the combining of the physical spaces and artifacts in a library. In [24] [42] it is said that children desire for physical spaces in a library for social communication.

The stream for building new large-scale digital devices includes a number of projects. The researchers in the projects have tried to realize new children's libraries to meet various children's needs [22] including a new design of physical spaces for old as well as new media. The project conducted by Aarhus University and Aarhus School of Architecture in Denmark [24] has studied an interactive children's library that can engage the children's physical activity in finding printed children's books through the digital system. The prototype system, StorySurfer, has an interactive browsing device set up in a public library. The system has category buttons on the floor of the library that display the front-covers of categorized books, and the children (the major targets are children aged around 8) together select a category by stepping on the appropriate category buttons. The children are able to walk among the front-covers to choose books of interest, and the information then is sent to an interface module displaying the book locations. This system motivates the children for mutual interactions and then they can have an enjoyable time when reading as usual, but to do this they are required to know the categories beforehand. The device seems to be too large to be suitable for ordinary libraries. The study has also revealed that the children do not prefer to search for books through the available systems; however they do like to browse in physical bookshelves to find books of interest, and prefer the front-covers instead of the backs of the books. Shelf-Slider, which is shown in the study [24], is a proposal to assist children aged around 8 in browsing the front-covers. By touching the digital slider attached to the sidewall of a physical bookshelf, the children together are able to browse the front-covers in this bookshelf. When the children stop the slider on a particular front-cover, the location of its corresponding book is displayed. The slider interface

meets the children's preference, but when the size of the book collection becomes too large, they can easily lose their way to browse, making browsing difficult.

Another project, Search Wall [14], aims to realize a tangible interface which searches for interesting information in a public library. It provides a large vertical wall display, a small table in front of it, and 10 categories/keyword-cubes surrounding them. Children aged 5 to 11 have access to digital data, such as titles, front-covers, etc., about printed children's books from the wall display by narrowing down the search area in the collection. The children can enjoy searching, but they are required to use the categories/keyword-cubes. Although they together can browse in the large wall display, the number of books presented is limited, and they have to change the presentation frequently to find the desired books.

When supporting the children's activity in a library by reflecting the results of those studies or implementing those kinds of systems, there is an unavoidable issue related to copyright protection [13]. To increase the number of digital books in the collection the library has to negotiate with the copyrights holders. This negotiation becomes a heavy burden financially as the number of newly collected digital books increases. And if we collect only books which are allowed to be copied and/or whose copyrights have expired, we will lose a great way to give the children a further opportunity to read. Note that we can find a variety of places, i.e. websites, where the children can freely read digital picture books.

The approach taken here is different from the studies described above. The installation of the BrowsReader in the children's room of a library or kindergarten, offers an easy way to build a new environment for enhancing the children's activity in browsing/reading together. In this environment, children, gathering around the BrowsReader, become able to easily browse a large number and wide variety of picture books in harmony with the ordinary browsing in physical bookshelves, and to read any found picture book with the same interface as that provided in an ordinary printed one. The hardware setting is just a computer with a display. Also on the BrowsReader many and various digitized/web picture books become available at little expense and without infringing copyright protection.

3. The BrowsReader

The BrowsReader, which is different from the models in the related work described above, takes important roles in the approach taken here to build a new reading environment in the children's room of a library or kindergarten for enhancing the children's activity in browsing/reading together. This chapter states the basic ideas of the BrowsReader, and three notions to realize the BrowsReader; surrogate picture book, abstracted bookshelf and unified view. The details in how to organize an abstracted bookshelf and to provide a unified view are also described in this chapter.

3.1 Basic Ideas

The basic ideas of the BrowsReader come from the children's activity in browsing and reading printed picture books in the children's room of a physical library or kindergarten. The BrowsReader is designed for processing the primary and secondary information seamlessly to better help children to understand the relationship between the former and the latter, and for flipping the pages to read any printed, digitized, and web picture book [39]. In order to enforce the children's activity in browsing/reading picture books together, the BrowsReader was settled on a digital table. The digital table is an ordinary reading table except a computer and a display. Around the table, children are allowed to browse in a large virtual bookshelf and read the found picture books with a face-to-face communication, and touch the bookshelf and handle the picture books as if they were the physical ones [40].

3.1.1 Primary and Secondary Information

The primary information here is about the printed, digitized, and web picture books themselves, and the secondary information here is extracted from the primary information as to the bibliographic attributes “title” and “author.” The secondary information functions as an index to the primary information for managing a large number of picture books. For adults there would be no problem in distinguishing and making use of the two kinds of information. For children, however, it would be difficult to make connections between the two [37].

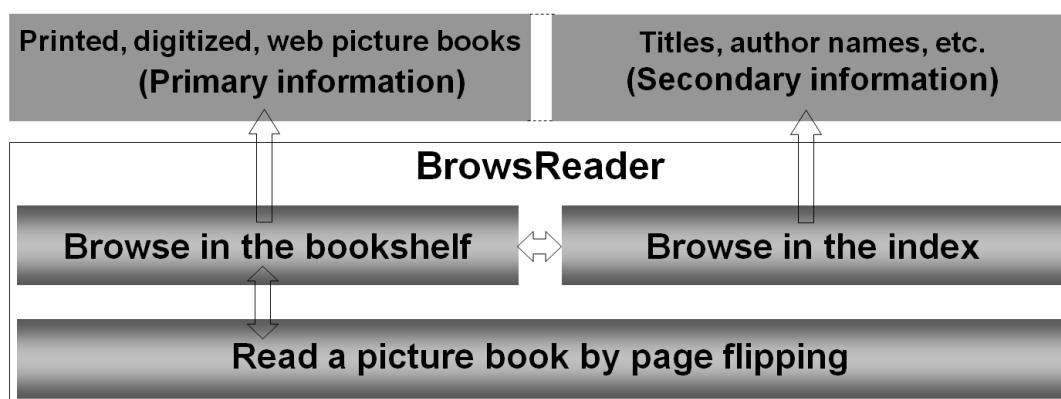


Fig. 3.1 Information processing in the BrowsReader.

Figure 3.1 illustrates the processing of the information in the BrowsReader. With the BrowsReader children can find books of their interest by browsing in the virtual bookshelf and/or the index. The virtual bookshelf showing the front-cover images of printed, digitized, and web picture books in the form of arranged bookcases is browsed in as seen in the real bookshelf browsing, and the index listing the titles and author-names as seen in the Keyword-in-Context index browsing. For easy browsing the bookshelf can be enlarged by touching a bookcase and the index by dragging-in or dragging-out a character icon. To better help children understand the relationship between the primary information and the secondary information, the visual bookshelf and the index of the BrowsReader in Figure 3.1 should be processed seamlessly, and the results be displayed promptly.

The front-cover images of the books in the virtual bookshelf are intended to be treated as the part of the primary information. The found picture books can be read by just touching their front-cover images and flipping the following page images as if they were printed versions. When the touched image is for a printed book, children can find the book quickly from the real bookshelf based on the information from the BrowsReader. On the table they can read both digital and printed picture books together by page flipping.

The way of processing the information in a conventional children's reading room can be seen in the left part of Figure 3.1, where the primary information is fully utilized. Children find the printed picture books by browsing in the bookshelves, pick them up, and then read them by flipping through the pages on a table. When the entire collection increases in size, children will have difficulty in searching it just by the primary information. A search system for processing the secondary information may help them in this case. This system, however, requires children to input keywords, a not easy task for younger children to do. Children who find books of their interest also need to go to the bookshelves to check the front-covers to be certain they got the right ones. In this environment, the primary information and the secondary information are processed separately, rendering it hard for children to make connections between the two.

In children's digital libraries, the processing of the two kinds of information is still separated even though the primary information is digitized. Children have to know and input keywords or category symbols before starting any search. The accesses to the primary information and the secondary information are independent. Besides, only the digitized picture books are available to read, no printed versions.

3.1.2 Browse/Read Together

For the activities in reading picture books together the communication through gesture/chatter and characters/figures is important. To enhance children's activity in browsing/reading together, we should not only process seamlessly the primary and secondary information, but also build an environment where they can browse/read together by exchanging opinions and handing the interested books over to each other. In the environment we set a digi-

tal table in the children’s room of a library or kindergarten. Sitting around the digital table, children can browse/read the printed, digitized, and web picture books together with their friends and/or families.

Figure 3.2 illustrates the basic concept of a framework about placing a digital table with the BrowsReader to enhance children’s activity in browsing/reading together in the children’s room of a library or kindergarten. A digital table has a tabletop touch display controlled by a personal computer with the BrowsReader. The digitized and web picture books are also stored in the PC. The major roles of the digital table are for the children to handle easily the picture books together, and to enforce the face-to-face communication among the children who are browsing/reading the picture books.

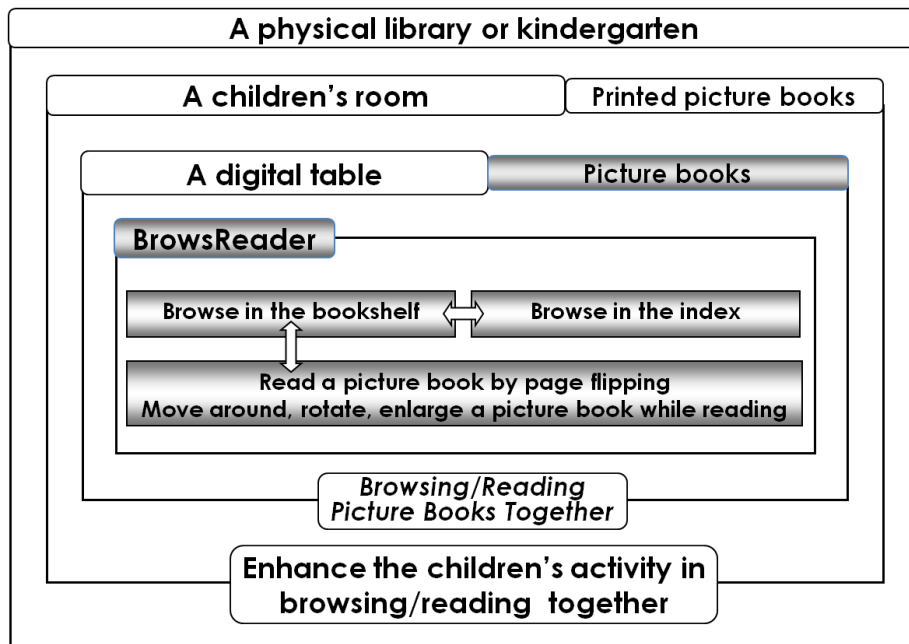


Fig. 3.2 A framework for enhancing children’s activity in browsing/reading together.

By getting around the digital table to use the BrowsReader, children together with their families and/or friends can more actively browse/read the picture books. For example, a pair of children sitting around a corner of a digital table, or sitting in the opposite sides of the table, or sitting side-by-side, can browse in the same virtual bookshelf by dragging-in or dragging-out characters one after the other with the face-to-face communication, and can collaboratively

read a picture book by freely moving around, rotating, and enlarging the book on the digital table, and following each other's page flipping while reading aloud.

A children's reading room in a physical library furnished with some wooden tables and physical bookshelves would be the best place for the activity in browsing/reading together. We foresee the new environment replacing some wooden tables with digital tables would enhance the activity in browsing/reading together. The benefits of such enhanced activity in browsing/reading together can be summarized below as:

- (i) Children can easily browse in a large virtual bookshelf to find the desired picture books together with their families and/or friends.
- (ii) Children can have great fun in reading together with their families and/or friends as they can exchange information about the books through gesture/chatter and hand any picture book over freely to each other.

By gathering around the digital table children can easily browse in the virtual bookshelf and then find picture books which are of interest. Any found picture book, which can be moved around, rotated, and enlarged, is read by flipping the pages with the same convenience as with a printed picture book. The children are also free to browse in the bookshelf while reading the picture books.

For realizing the BrowsReader to build an enhanced environment in a children's room of a library or kindergarten as stated in Section 1.2, with a large number and wide variety of picture books, three notions of surrogate picture book, abstracted bookshelf and unified view are, respectively, organized and provided in the BrowsReader. Next section describes them in details.

3.2 Surrogate Picture book, Abstracted Bookshelf and Unified View

According to the basic ideas we introduce surrogate picture books, abstracted bookshelf, and unified view to realize the BrowsReader in an actual children's room. The BrowsReader reproduces printed, digitized, and web picture books as surrogate picture books, and then pre-

sents surrogate picture books in the form of an abstracted bookshelf² arranging linearly their front-cover images so that children can easily browse in this bookshelf just as when browsing in physical bookshelves. The BrowsReader also presents the found surrogate picture books in the form of the ones providing a unified view³ so that they can be read in a similar way to the ordinary printed picture books. Here a surrogate picture book consists of the front-cover image followed by the page images of a printed, digitized, or web picture book. Figure 3.3 depicts the sources of organizing an abstracted bookshelf and of producing the surrogate picture books.

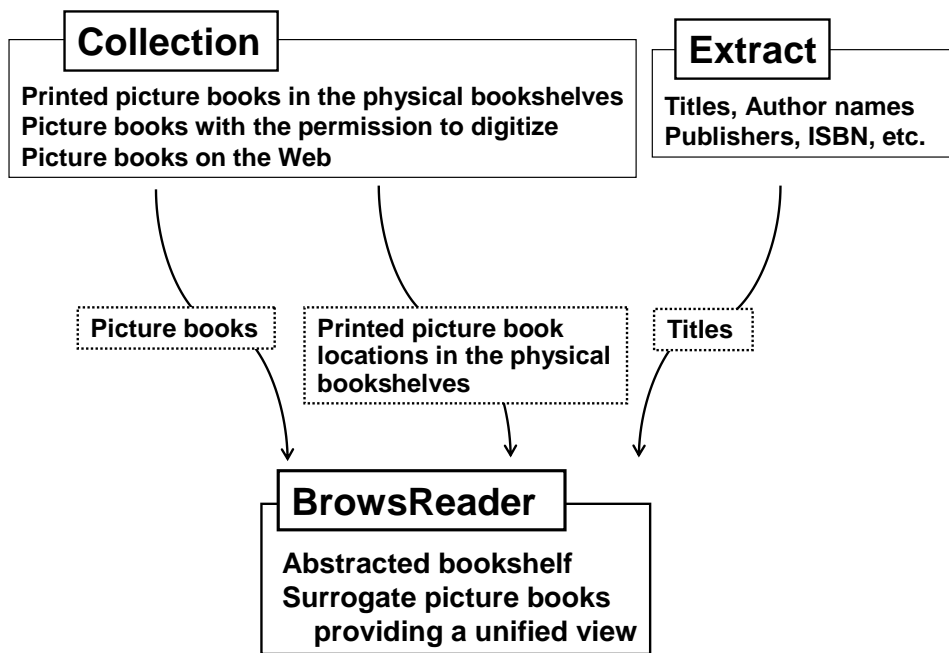


Fig. 3.3 Organizing an abstracted bookshelf and producing the surrogate picture books.

An abstracted bookshelf is organized as the presentation of the *linearly arranged* front-cover images of surrogate picture books both for the printed picture books in a collection and for the digitized/web picture books being collected. Some front-cover images in places will be bundled to make an abstracted bookshelf compact in form. Any front-cover image accompanies its surrogate title, which is a schematization of the title of this front-cover image for

² The word ‘abstracted’ is used to reproduce the physical objects as the items in a PC and to bundle multiple items into one that can be presented in a compact form on a display with limited space.

³ The word ‘unified’ is used in the sense that all the surrogate picture books for various picture books are the same in vision and page flipping.

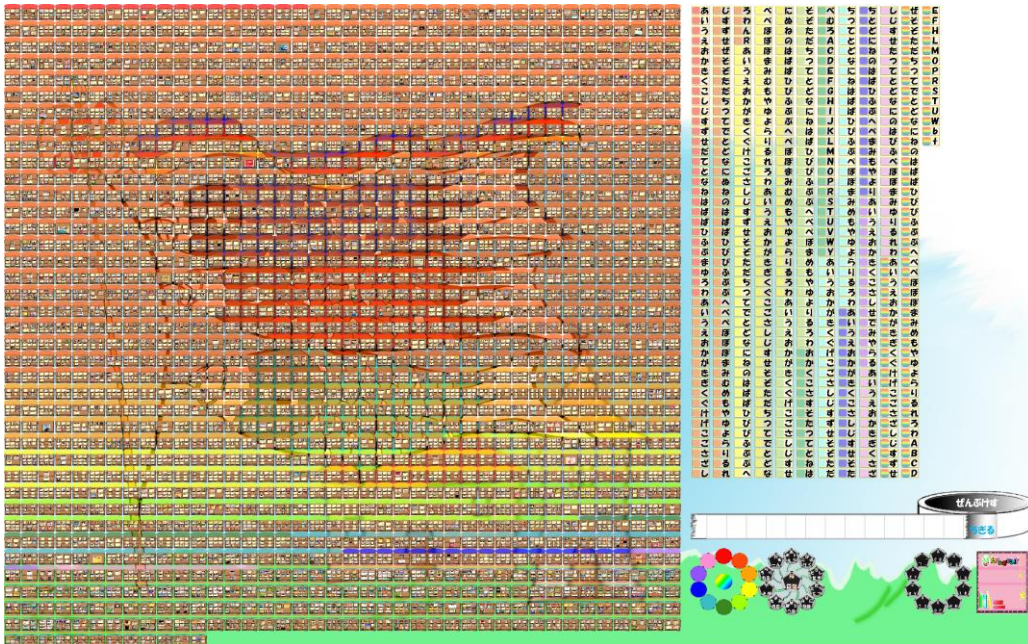
presentation. Some surrogate titles will be superimposed when they are similar in string and then one or more front-cover images can accompany the same surrogate title.

The arrangement of the front-cover images is conducted in the same manner employed to linearly arrange the printed picture books in physical bookshelves. As the arranging schemes in many libraries are based on the colored spine labels for major classification followed by the titles for minor classification (author names sometimes are employed instead), we put, at the heads of the surrogate titles, the color symbols whose arranged order is the same as that of the spine label's colors. We then arrange all the front-cover images according to the color symbols in their corresponding titles. When the front-cover images have the same color symbol, we further arrange them based on the lexicographical order of titles. Note that the color symbols are not for categorizing the picture books but for arranging the front-cover images. Any front-cover image thus has its own relative location in an abstracted bookshelf, which is quite similar to any printed picture book given the fact that it has its own relative location in physical bookshelves. The surrogate titles themselves are also arranged similarly. One of the specific features of an abstracted bookshelf is that it always presents the presence of all the front-cover images. When the images are small in size, many of them can be enlarged by reducing the rest while keeping the relative locations unchanged.

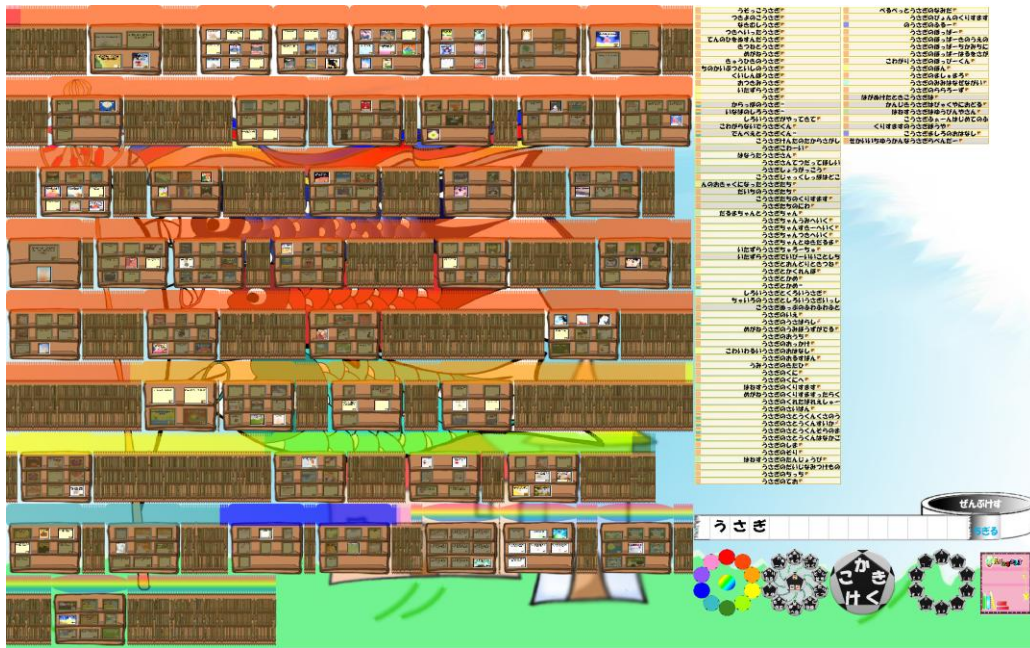
The surrogate picture book for a printed picture book is in fact composed of the image of its front-cover photo followed by the page image showing the physical bookshelf photo (as seen in Figure 3.9(d)), in which this book is placed. For a digitized picture book the surrogate picture book is composed of its scanned front-cover image followed by the scanned images of the rest of the pages, and for a web picture book the web page with its front-cover image followed by the web pages along with the rest of the pages. Unfortunately, by using these basic compositions the surrogate picture books themselves could have different views. We prepare a sophisticated mechanism of trimming the front-cover/page images and of transferring the page flipping operations into some specific mouse events by employing the CollaboTray technology in [1] so that any surrogate picture book can provide a unified view. In the following we present an overview of some abstracted bookshelves and some such surrogate picture books.

Figure 3.4(a) shows an initial abstracted bookshelf, where the left side presents the front-cover images of in total 10,540 surrogate picture books for 9,459 printed, 79 digitized and

1,002 web picture books, and the right side their surrogate titles. For dealing with a large number of surrogate picture books and easy browsing in an abstracted bookshelf some adjacent front-cover images are grouped to form a surrogate bookcase in fix size n (The adoption of a surrogate bookcase makes it possible that about n times as many front-cover images as the case when not employed can be presented on a display). Accordingly the surrogate bookcases in an abstracted bookshelf are arranged by reflecting the order of color symbols from the top row to the bottom row and from the left side to the right side in each row. The surrogate titles are also arranged from the left column to the right column and from the top end to the bottom end in each column. Figure 3.4(b), changed over from Figure 3.4(a) by inputting Japanese hiragana characters ‘う,’ ‘さ,’ and ‘ぎ,’ shows an abstracted bookshelf in which the front-cover images and the surrogate titles with these characters in the corresponding titles are enlarged and the rest reduced. Note that the Japanese hiragana consists of 46 basic characters and 30 additional ones, where the basic characters can be grouped into 10 classes. A hiragana character in Japanese seems like an alphabetic character in English.



(a)



(b)

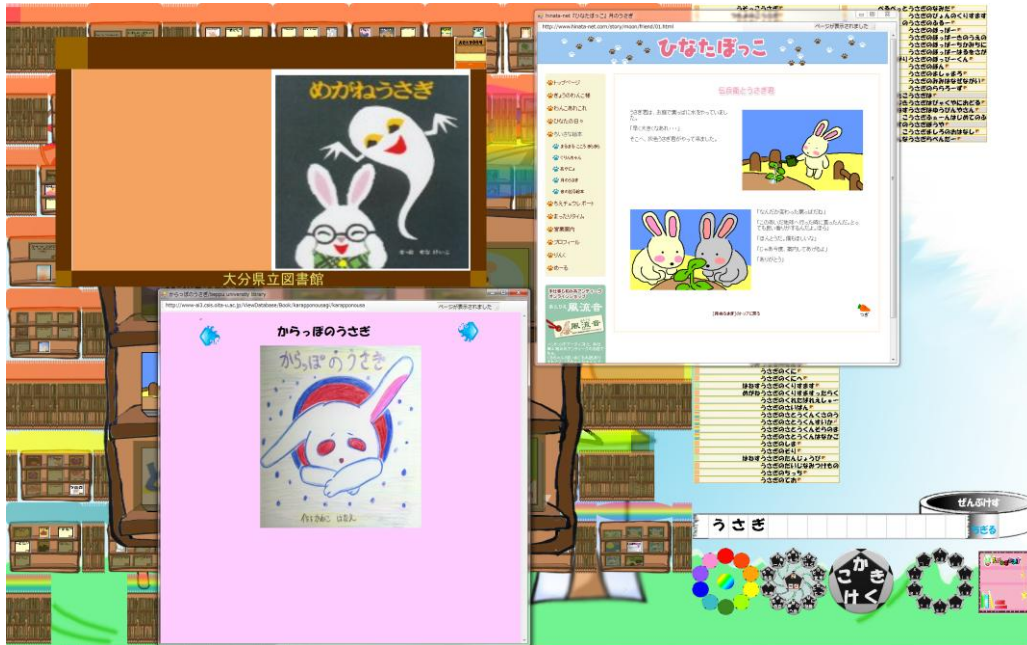
Fig. 3.4 An initial abstracted bookshelf and a changed over one.

The front-cover images of the surrogate picture books for three printed, digitized, and web picture books in the enlarged bookcases are presented, after further enlargement, in the top left, bottom center, and top right in Figure 3.5(a), respectively, where these books are to be read using the sophisticated off-the-shelf book viewers. They are, however, different in presentation and in page flipping operation. Figure 3.5(b) presents three front-cover images providing a unified view⁴ for which no copyright protection infringement occurs. Children together can read any of them through ordinary page flipping, and if necessary can move around, rotate, and enlarge it.

Children can freely go into reading from browsing, and vice versa. Also the children are able to browse in an abstracted bookshelf while others glance through it. Since an abstracted bookshelf matches physical bookshelves and any surrogate picture book can be read in a similar way to read a printed picture book, the children together can browse/read with the same feeling as when they are in an ordinary children's room even on the BrowsReader. The instal-

⁴ The superiority of a unified view was certified by asking 11 kindergarten teachers and children's parents to use the BrowsReader with the presentation like Figure 3.5(a) and the one with Figure 3.5(b), where all of whom prefer the latter presentation to the former one.

lation of the BrowsReader thus will make a children's room more attractive in enhancing the activity in browsing/reading together.



(a)



(b)

Fig. 3.5 Surrogate picture books providing a unified view.

3.3 Organizing an Abstracted Bookshelf

The efforts for steadily enhancing children's activity in browsing/reading together in the children's room are to let the BrowsReader have four features denoted above. The processes about an abstracted bookshelf are described in more detail in how to organize in the BrowsReader. Hereafter a surrogate bookcase and a surrogate title, respectively, are written as a bookcase and a title for simplicity unless otherwise noted.

After observing the collection sizes of various public libraries it becomes clear that the BrowsReader should be able to deal with at least 10,000 printed picture books in addition to many digitized/web ones. It also can be noted that the relative locations of the printed picture books in the physical bookshelves of a children's room would be basically unchanged even when the collection sizes are increased or decreased.

3.3.1 The Left Side

On the left side of an abstracted bookshelf the bookcases (each of which several front-cover images are clustered into according to the method [32]) are linearly arranged [32] and then presented. To make the arrangement understandable we put a color bar on the top of each bookcase. This color bar matches the color symbols at the heads of the titles whose corresponding front-cover images are in this bookcase. All the bookcases are color-segmented and arranged according to the color bars. Each printed picture book thus is considered to have its relative location in an abstracted bookshelf that matches its relative location in physical bookshelves.

Children together can change over from one abstracted bookshelf to another one with more enlarged bookcases, if they want to examine in more detail some bookcases or some front-cover images that are small in size. The character icons are prepared to enlarge multiple bookcases containing at least one front-cover image whose corresponding title includes the character(s) that has been dragged-in (The detail of dragging-in the character(s) is given in Section 3.3.3). No enlarged bookcases are reduced, and if the reduced ones are adjacent and given the same color bar, they are bundled to make room for better enlargement. Each bookcase also can be enlarged by touching it, and each front-cover image there, when it corresponding sur-

rogate picture book is to be read, can also be further enlarged by touching it. The presence of all the bookcases is shown all of the time with their arranged order unchanged so that each of the children can notice the present state of an abstracted bookshelf in order to easily browse in it together with others. An abstracted bookshelf then works as a simultaneous menu [29].

Children could become confused about the arrangement of bookcases when there is a sudden changeover on an abstracted bookshelf, so an animation procedure for the changeover when dragging-in a character is employed. A zooming technique is utilized to formalize an animation procedure. The procedure when dragging-out can be similarly formalized. As all the linearly arranged bookcases in an abstracted bookshelf are two-dimensionally allocated on a display for presentation and the bookcases to be enlarged/reduced would be scattered around there, some need to be moved upward while others downward in order to make room as large as possible. This complication makes it difficult to employ the previous zooming techniques [2] [7] [62].

We solve this difficulty by devising a new zooming technique that consists of spiraling-up and -down steps. The spiraling-up steps begin, for each bookcase from the headmost to the dead-end in an abstracted bookshelf, with repeatedly moving this bookcase while it can be moved toward the leftmost position in its own row; and further, if possible, toward the rightmost position in the row above, by considering the final bookcase allocation. When moving, reduce the size of the moving bookcase if it includes no front-cover image of the surrogate picture book containing the dragged-in character in its title. After the spiraling-up, each of the bookcases is spiraled-down by reversing the steps and enlarging the size of each bookcase.⁵

With this procedure all the bookcase-images are spiraled-up or spiraled-down uniformly, and then the linear arrangement of the bookcase-images are clearly visualized all the time. The spiraling-up step can be speeded up by (i) grouping the bookcase-images that are adjacent in a row and will be moved upward, and (ii) moving them together toward the final locations after moving them concurrently toward the leftmost in this row. Each bookcase-image that will be moved upward but is not grouped is processed similarly. The spiraling-down step can also be

⁵ The effect of the spiraling-up and spiraling-down steps was examined by seeing that the surrogate picture books that had been found in an initial abstracted bookshelf with 1,000 front-cover images could easily be found in a next step abstracted bookshelf when the animation procedure was employed. They were found statistically much faster than the case when the animation procedure was not employed. Ten university students participated in this examination.

speeded up in the same way. The speeded up steps can be proved that the linear arrangement is unchanged at any time of zooming. Figure 3.6 depicts example zooming steps when some character icon is dragged-in. The left, middle, and right figures, respectively, show the abstracted bookshelves before, during, and after the changeover. The spiraling-up and -down steps, respectively, are depicted in the upper- and lower-middle figures.

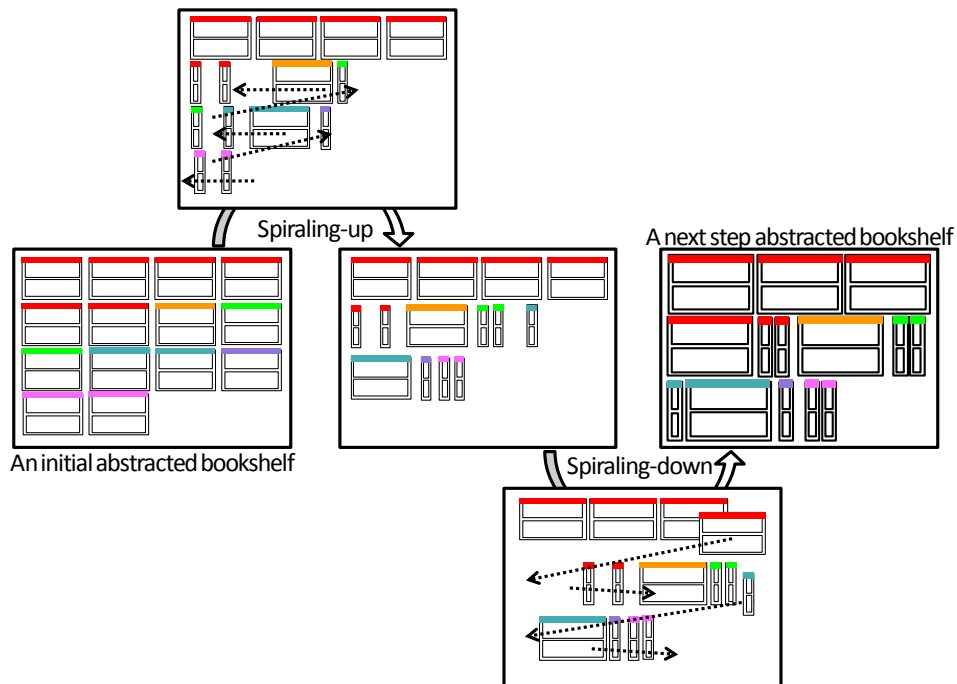


Fig. 3.6 Enlargement/reduction of the bookcases.

3.3.2 The Right Side

The titles on the right side of an abstracted bookshelf become useful, especially when the front-cover images to be browsed are too small in size. By noting that even kindergartners together with their families and/or friends can deal with a character [39], the function for children to drag-in a character to have the more enlarged front-cover images is prepared. The dragged-in character is centered in the titles, the titles with this character are selected and rearranged like in the KWIC index [58], and the adjacent titles with common substring are superimposed as much as possible for better presentation. Accordingly the front-cover images whose titles are included in the presented titles are enlarged.

Figure 3.7(a) presenting the titles (including two superimposed titles) is changed over to Figure 3.7(b) presenting the rearranged titles with the dragging-in character in their centers. The width of each title is adjusted to make room for the dragged-in character and its predecessor/successors, and each title is presented as large as possible so that children can see if the inputted character constitutes a part of the title. When the number of dragged-in characters increases, the number of presented titles drastically decreases and the size of each title increases. This also helps the children to correctly spell the words, as seen in the utilization of an incremental search [56]. It is indicated in [46] [55] children could not correctly spell words until 11, though they start to become interested in characters from around 3 years old. No zooming technique is employed since the titles with the dragged-in characters are the only objects that would be enlarged and presented. The color symbols attached at the heads of the titles match the color bars on the bookcases. Any color symbol can be dragged to browse the color-segmented bookcases in sequence.

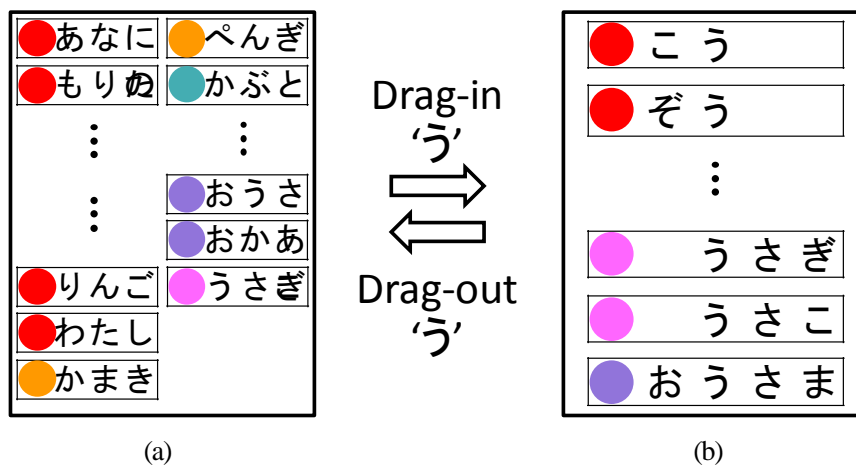


Fig. 3.7 Enlargement of the titles.

A touch on a title corresponds to the input of the characters in this title. Since the enlargements/reductions of the left and right sides of an abstracted bookshelf are fully synchronized, as a character is dragged-in, the matched bookcases and the associated titles are enlarged simultaneously. Such synchronization guarantees the left and right sides, as they should be seen in one mechanism.

3.3.3 Dragging-in or Dragging-out a Character

Children are able to easily browse in an abstracted bookshelf with many small front-cover images by dragging-in or dragging-out a character. The dragging-in or dragging-out of a Japanese character which is done by using the character input panel located in the lower-right of a display (see Figures 3.4 or 3.5), is especially effective in such a case. The Japanese hiragana consists of 46 basic characters and 30 additional ones expressing dull sound, nasal sound, etc., and the basic characters are grouped into 10 classes most of which consist of 5 characters. In the second-left division of the input panel almost all the hiragana characters are shown in 10 dark soccer-ball shaped icons; the rest of the hiragana characters are shown in the middle division when needed. In the left-most division 11 colored soccer-ball shaped icons reflecting the spine label's colors are presented in a circle, where the colored soccer-ball shaped icon in the center is for digitized/web picture books (The number of the colored soccer-ball shaped icons will vary depending on the major classification taken in each children's room). When one of the colored soccer-ball shaped icons is dragged, its corresponding color symbol is inputted and all the bookcases with the corresponding color bar are presented after being enlarged. When one of the dark soccer-balls is touched, it is enlarged and presented in the middle division, and then children are able to drag-in a character. By dragging a character icon, the presented bookshelf is promptly refashioned. Children one after the other can drag the character icons in succession. In Figures 3.4 and 3.5 the other 10 soccer-ball shaped icons located at the second-right division are prepared to drag-in alphabetic characters. The soccer-ball shaped icons could be replaced so that characters for some other languages can be inputted.

The characters that have been dragged-in are displayed on the white-ribbon just above the soccer-ball shaped icons. The children one after the other can drag-out or exchange any characters on it to have an imaginable arrangement of characters. These convenient features help the children without knowledge about keywords to easily operate on the BrowsReader. The characters on the white-ribbon can be cleared out to set an abstracted bookshelf to the initial presentation. When a non-superimposed title is touched, its corresponding title is displayed on the white-ribbon. The children together then can update it by adding or removing characters as

they please. The bookcase icon at the bottom-right division is for bringing back the surrogate picture books under reading into an abstracted bookshelf.

3.4 Providing a Unified View

In the BrowsReader printed, digitized, and web picture books are reproduced as the surrogate picture books that can provide a unified view. The surrogate picture books also should be dealt with in a manner that doesn't infringe upon copyright protection when presented to the public. In the following we first discuss about copyright protection and then a unified view.

3.4.1 Keeping Copyright Protection Intact

Any surrogate picture book consists of a front-cover image followed by the page images or the page image with a physical bookshelf photo. No copyright protection issue occurs on the images but for the front-cover images of printed and web picture books, and for the page images of web picture books. This issue on those front-cover images can be solved by taking the obscured front-cover photos or by referring to the web pages with the URL addresses displaying them. It should be noted that the web pages are referred to every time when the front-cover images there are required to be presented. For the page images of web picture books we could take a similar approach to the front-cover images. Since, however, for some sort of web picture books, e.g. flash-based web picture books, no URL addresses for the page images can be known, we take another approach to using off-the-shelf book viewers (or internet explorers) stating at the URL addresses for the front-cover images.

To speed up the presentation, the obscured front-cover images in the web pages are registered and then presented when they are in small bookcases. Eventually the BrowsReader stores (i) for a printed picture book the obscured front-cover image (and the URL address in which the non-obscured front-cover image will be displayed, if available) followed by the page image displaying a physical bookshelf photo, (ii) for a digitized picture book the front-cover image and the rest of the page images, and (iii) for a web picture book the obscured

front-cover image and the URL address in which the non-obscured front-cover image will be displayed.

3.4.2 The Mechanism

The surrogate picture books on off-the-shelf book viewers would be variously presented as seen in Figure 3.5(a). To alleviate this defect the BrowsReader has been developed in such a way that the surrogate picture books can provide a unified view. The mechanism to do so is depicted in Figure 3.8, where the CollaboTray technology devised in [1] is employed. The mechanism takes a three-layer structure. The bottom layer is for a web page with a front-cover/page image of some picture book on an off-the-shelf book viewer, and the top layer for just the front-cover/page image. Though on the bottom layer the specific buttons in places should be pressed for page flipping, on the top layer dragging (or touching) of the page images is sufficient for this purpose. The middle layer shows a CollaboTray technology based filter for trimming the bottom layer image so as to be seen on the top layer, for moving around, rotating, and enlarging the trimmed image by the affine transformation [33], and for transferring the dragging (or touching) performance to the corresponding button operation. The moving around, rotating, enlarging, and dragging performances encourage children to read surrogate picture books together. No infringement of copyright protection occurs since the BrowsReader stores no original images on the web pages (and of the printed picture books).

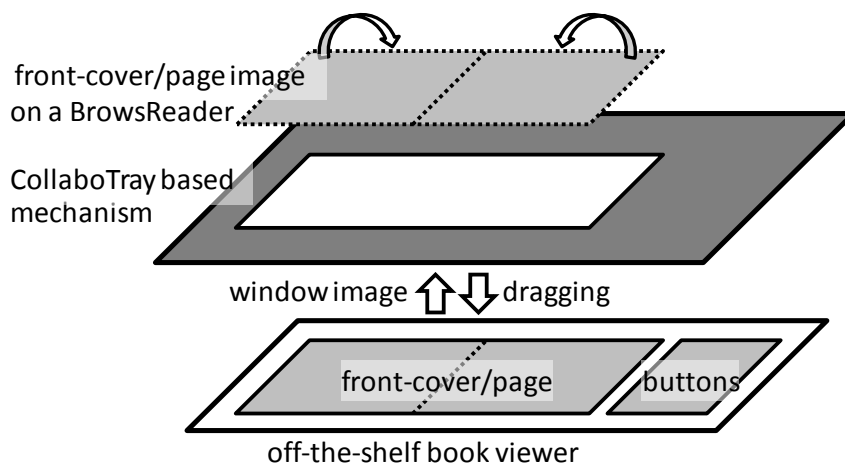


Fig. 3.8 Mechanism of obtaining a surrogate picture book providing a unified view.

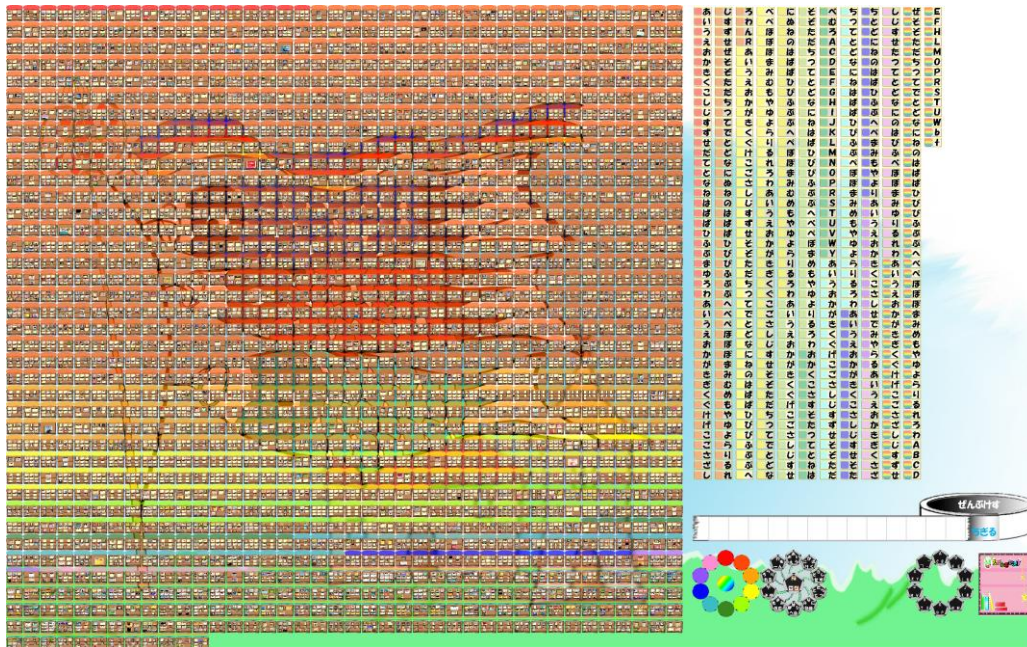
3.5 Reading a Surrogate Picture Book

Children together can read a surrogate picture book with a unified view having the feeling that it is an ordinary printed picture book. When a front-cover image in some bookcase is touched, its corresponding surrogate picture book is presented in readable size. This design mimics the book reading activity in a children's room. When the presented surrogate picture book is for a digitized or a web picture book, children can read it by flipping one after the other the front-cover image and then the page images on the BrowsReader as if they are reading a printed picture book on a table. When the presented surrogate picture book is for a printed one, the children can read it by flipping the front-cover image, finding its location in an abstracted bookshelf and also in physical bookshelves, taking it out from there, and then flipping the pages on a table. More than one surrogate picture book can be read simultaneously.

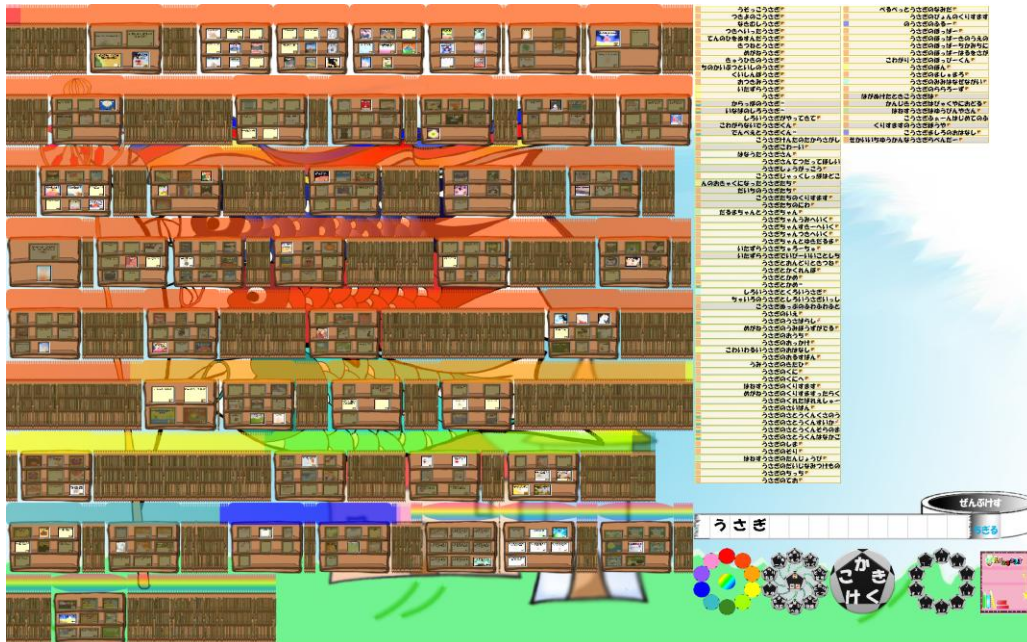
3.6 A Scenario of Utilizing the BrowsReader

Let us see a scenario in which we assume that two siblings are sitting and gathering around the lower-right corner of the BrowsReader and use it to find some picture book of their interest in the children's room of a library. At first the young boy inputs the character 'う' by dragging a character for finding a picture book about 'うさぎ (rabbit).' Then he, unfortunately, can not recognize which one is character 'さ' from the characters, because he just began to learn Japanese characters in his kindergarten. His older sister teaches him the new character by pointing and dragging it instead of him. By their above dragging-in characters 'う,' 'さ,' and 'ぎ' one after the other, they together can change over from the initial abstracted bookshelf (see Figure 3.9(a), where the left side presents the front-cover images of in total 10,540 surrogate picture books for 9,459 printed, 79 digitized and 1,002 web picture books) to a further enlarged one (see Figure 3.9(b)), and examine the further enlarged front-cover images of three surrogate picture books about 'うさぎ (rabbit)' as seen in Figure 3.9(c). He finally become able to select the surrogate picture book entitled 'からっぽのうさぎ(A rabbit in lonesome heart)' whose page image is shown in Figure 3.9(d). He can read it by himself, or more interestingly with his sister sitting at side and helping him flipping the pages. He and his sister can even

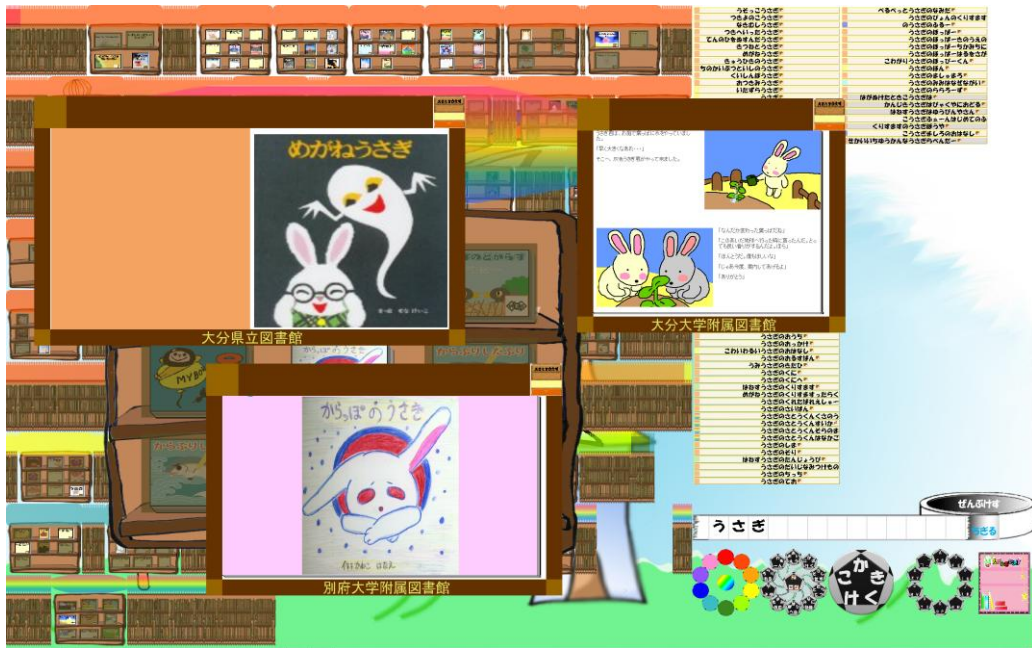
read out the book in turn, while orienting, enlarging, and flipping the page images freely at their pace.



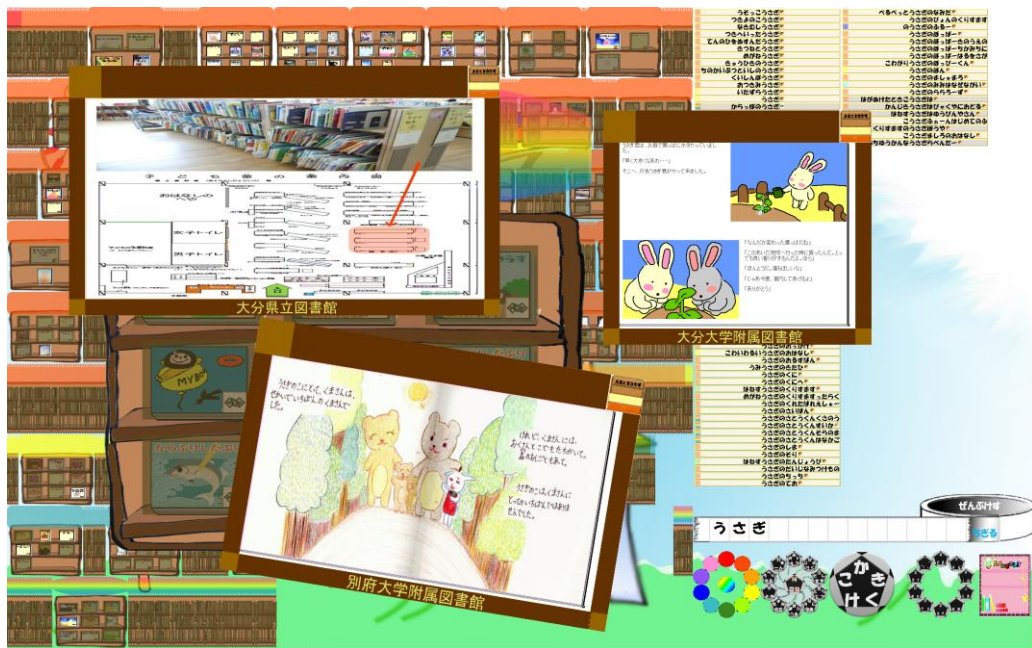
(a)



(b)



(c)



(d)

Fig. 3.9 Use of the BrowsReader.

4. Customization of the BrowsReader to be Installed in a Library or Kindergarten

The BrowsReader is designed to be relatively easily customized so that it can be installed in any children's room of a library or kindergarten, where the main task of the customization is to generate the surrogate picture books for the collection there. This chapter describes the procedures about the generation of surrogate picture books of printed, digitized and web picture books.

In the customization process librarians are requested to collect the picture books that have the permission to be digitized and/or to qualify the picture books on the Web. The former could be the product of the library's course in creative writing open to citizens, and the latter could be found by some citizens e.g. parents when navigating websites.

The generation of surrogate picture books for digitized picture books is rather easy, i.e. it can be by scanning their front-covers and pages. When they are originally digitized the task becomes much easier. The generation of surrogate picture books for web picture books is the registration of the URL addresses of their websites and the preparation of the data to provide a unified view. For digitized/web picture books their titles and dedicated color symbols should be registered. The generation of surrogate picture books for printed picture books includes: collecting the titles and the codes for the arranging scheme, finding the front-cover images on the Web, and taking the photos of physical bookshelves. The titles and codes can be found in a library's bibliographic database. Many of the front-cover images can be found on the Web by employing a search engine with ISBN numbers, though some inadequate ones still need to be filtered out manually. When the front-cover images are not available on the Web, they are

manually obtained by taking their obscured photos. The location of each printed picture book is registered in the form of the page image with the photo of the physical bookshelf (as seen in Figure 3.9(d)) in which this book is placed.

The most laborious work in the customization process is the preparation of the data used for providing a unified view for the web picture books (i.e. the preparation of the location coordinates of the page images and the buttons on the web pages) and of the obscured front-cover photos of the printed picture books. The organization of a database, storing the data and photos (as well as the images of digitized picture books if they are open to the public), makes the customization much easier when newly installing the BrowsReader in another children's room.

5. Case Studies

The evaluation about whether children's activity in browsing/reading picture books together was enhanced in a new environment by installing the BrowsReader, was conducted by employing a free-style study of allowing children to use the BrowsReader without control or direction from the researchers, as this kind of study would minimize any unexpected influence on the children's browsing/reading activity in the future. This allowed us to certify the effect of installing the BrowsReader by noticing that the children's activity in browsing/reading together was steadily enhanced.

The BrowsReader was improved and evaluated in a step by step process through two phases; (i) in temporary children's rooms realized during the children's events in 2007, 2008, and 2009, and (ii) in the actual children's rooms realized in a prefectural library, a kindergarten, and three medium public libraries. In the former phase, we not only directly observed the children's behavior, and questioned and interviewed the children but also employed a logging system to record the children's operations on the BrowsReader. In the latter phase, since we were not allowed to directly observe, question, and interview, we analyzed in some detail the data of the reformed logging system to figure out the children's activity in reading together, and questioned and interviewed the librarians/kindergarten teachers who observed the children's behavior.

The digitized and non-flash-based web picture book collection in the former phase was gradually increased in number, although the total number was up to around 700. We further set up the makeshift physical bookshelves arranging 500 printed picture books to see whether the BrowsReader could really work in an actual situation. In the latter phase the further improvement was achieved so as to manage, in a unified view, the complete collection of printed pic-

ture books in an actual children's room in addition to the digitized and non-flash-based/flash-based web picture books. Some color symbols were also prepared for suitably presenting special bookcases which collected the front-cover images of seasonable picture books, with the reflection of the arranging scheme taken in each children's room. The design of several icons was somewhat changed by hearing the opinions of the children. We also checked that the children steadily enjoyed the use of the BrowsReader and became more active when browsing/reading on it.

The hardware setting for the BrowsReader was basically the same in all case studies, though each was customized to manage the collection available in each setting. A 30-inch touch-display was utilized to encourage the children together to operate the BrowsReader by gathering around it as shown in the figures in Tables 5.1, 5.4, 5.8 and 5.11.

5.1 In the Temporary Children's Rooms

This section describes parameter settings of the BrowsReader before the case studies, experimental settings, and results and discussions of the studies in the temporary children's rooms.

5.1.1 Parameter Settings

We fixed several parameters of the BrowsReader before conducting the case studies. For the visualization of the right side of the abstracted bookshelf, the size of any character of the title was set to be at least 15pt (This font size was obtained by examining the texts of randomly selected 20 printed picture books). For easy dragging-in or dragging-out a character, the size of a soccer-ball shaped icon and a character icon was set to be at least 96×96 pixels on a 30-inch display [29]. When the soccer-ball icon was touched it would be enlarged so that each character in the icon was displayed at least with 96×96 pixels. When a bookcase-image was enlarged by a touch, the size of each of its book-image would be enlarged to a size no less than 96×96 pixels. About the unified view, for smooth reading of the surrogate picture books, the speed of page flipping was set at one page-shot per second for medium size books. A faster speed was set for smaller books.







5.1.2 Experimental Settings

Table 5.1 describes the environmental settings for the three case studies in the temporary children's rooms. Each study in the three events in 2007, 2008, and 2009 hosted at Oita University was performed from 10:00 a.m. to 3:00 p.m. by building a temporary children's room in the university campus, where a total of 111, 146 and 126 children aged 3 to 12 with their families and/or friends participated in using the BrowsReader, respectively. Children got together when browsing/reading as they pleased.

In the 2007 event we focused on browsing/reading the surrogate picture books for the digitized versions of 162 printed picture books (the digitization here was performed solely for the case study use because of copyright protection) and on confirming that the children could use the BrowsReader [39]. The children were briefly introduced to the BrowsReader and encouraged to freely use it. In the 2008 event we added the surrogate picture books for another 70 digitized and 228 non-flash-based web picture books to see whether the children could browse/read the web picture books [40]. In this event a display was set horizontally on a table and we checked the effect of such setting. In the 2009 event the collection was enriched by adding other 259 non-flash-based web picture books⁶ and further enriched by preparing the surrogate picture books for relatively new 500 printed picture books. We temporarily put, at the heads of the titles, the color symbols that reflect grouping of the Japanese hiragana characters. These printed picture books also were provided in the makeshift physical bookshelves placed in a temporary children's room. The front-cover images of about 94% of the printed picture books were found in the websites such as Books.or.jp [10] and EhonNavi [21]. By using this setting we were able to see whether the children together read the printed picture books in the physical bookshelves after finding their surrogate picture books on the BrowsReader. A display in the 2009 event also was set horizontally.

⁶ In the 2008 and 2009 events we collected only non-flash-based web picture books whose front-cover and pages images could be accessed via their URL addresses, and employed the simple method of tracing the addresses for yielding a unified view.

Table 5.1 Environmental settings for the case studies in the temporary children’s rooms.

Event year	2007	2008	2009
Place	A temporary children’s room build in a lecture room during the events		
Activity time	(10:00 a.m. ~ 3:00 p.m.)		
Hardware setting	Two tables with two 30-inch (2560×1600 pixel resolution) touch displays and two PCs each of which has an Intel® Core™2 Duo CPU working under an MS Windows XP		
Software setting	 <p>BrowsReader2007</p>	 <p>BrowsReader2008</p>	 <p>BrowsReader2009</p>
Room setting	 <p>Children’s room2007</p>	 <p>Children’s room2008</p>	 <p>Children’s room2009</p>
Collection setting	162 digitized picture books	232 digitized picture books 228 web picture books	232 digitized picture books 487 web picture books 500 printed picture books
Tasks	The children were asked to utilize the BrowsReader as they pleased. After utilizing the BrowsReader, every child was interviewed, requested to fill in the questionnaire.		
Number of the participated children	Total 111 children 16 kindergartners (aged 2-5) 68 lower graders (aged 6-9) 27 higher graders (aged 10-13)	Total 146 children 27 kindergartners (aged 2-5) 99 lower graders (aged 6-9) 20 higher graders (aged 10-13)	Total 126 children 24 kindergartners (aged 3-5) 79 lower graders (aged 6-9) 23 higher graders (aged 10-14)

5.1.3 Results and Discussions

The same logging system to record the children’s dragging and touching operations was utilized in all three studies for the statistical survey. We further observed the children’s behavior, and requested that the children (along with their families and/or friends) filled in the questionnaire shown in Table 5.2. The questions were prepared to see whether the use of the BrowsReader was enjoyable and whether the activity in browsing/reading together there could be enhanced from the viewpoint of the children. We also collected information on the ages and grades by interviewing the children.

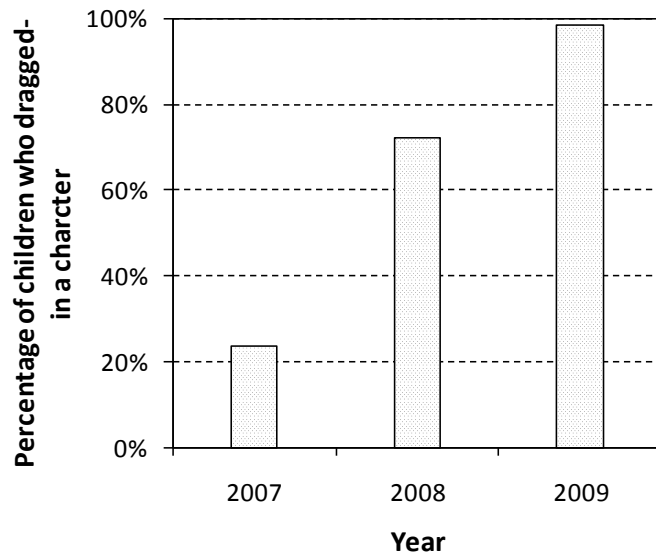
Table 5.2 Questions in the questionnaires for the 2007, 2008, and 2009 events.

Questions	2007	2008	2009
Q1 Were you happy when you used it (i.e. the BrowsReader)?	✓	✓	✓
Q2 Did you use it with others?	✓	✓	✓
Q3 Did you find a digitized/web or printed picture book when you used it?	-	-	✓
Q4 Did you read a digitized/web picture book when you used it?	✓	✓	✓
Q5 Did you read a printed picture book near the bookshelf?	-	-	✓
Q6 Did you read a digitized/web or printed picture book together with others?	-	-	✓
Q7 Would you like to use it again?	✓	✓	✓
Q8 Do you often go to a library?	✓	✓	✓

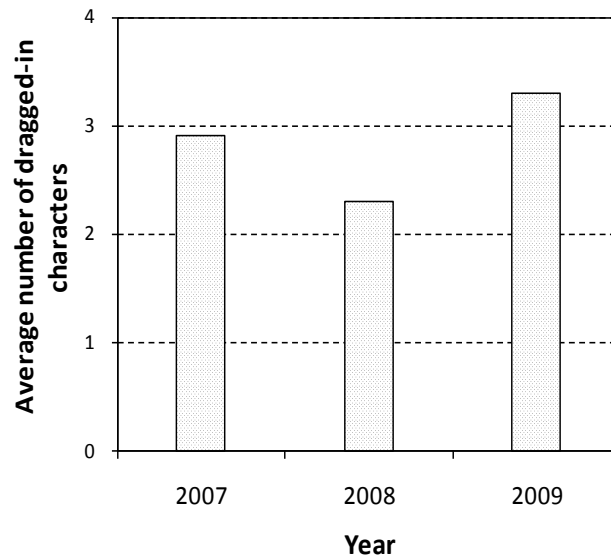
(a) Results about browsing

Figures 5.1(a) and (b) show the percentage of the children who dragged-in at least one character and the average number of dragged-in characters, respectively. We noticed that even kindergartners could drag a character icon [39]. In the 2009 event 98.4% of the children dragged the character icons. This rate was larger than 71.9% and much larger than 23.5% in the 2008 and 2007 events, respectively. We believed that this was a result of the front-cover images being small. The children would like to see the front-cover images; and this fact was the main cause of dragging-in more characters when the front-cover images presented were small. We concluded that the BrowsReader was able to work in enhancing the browsing together activity even for a large collection. Most children could freely change over the abstracted bookshelves

and then find the surrogate picture book(s) for reading. Even kindergartners and lower graders dragged-in characters, and some children dragged-in multiple characters as seen in Figure 5.1. From the answer to Q5, many children read the printed picture books after using the BrowsReader.



(a)



(b)

Fig. 5.1 Statistics as to dragging-in at least one character in the 2007, 2008, and 2009 events.

In the 2009 event, where a display was horizontally set and the makeshift physical bookshelves were set up, we observed that about 80% of the children gathered around the

BrowsReader for browsing. The percentage was larger compared to that in each of the previous events. After browsing, many children were able to easily locate although not knowing the structure of an abstracted bookshelf and to read the found printed picture books without getting lost in the physical bookshelves, by seeing their locations in the abstracted bookshelf and the page images with their photos (as shown in the BrowsReader2009 on the top of Table 5.1). By this fact we can say that the children could browse in surrogate picture books like usually.

(b) Results about reading

Figure 5.2 shows the average numbers of surrogate picture books for the digitized/web or the printed picture books read by the children getting together. After touching a front-cover image the children began to flip its page images on the BrowsReader or the pages in front of the physical bookshelves. When many page images for a digitized/web picture book or many pages for a printed picture book were observed being flipped one after the other at an easy pace, we decided that this book had been read together. Two to four children getting together read 1 to 2 picture books on average; however with more time they would have been able to read more. In the 2009 event the children read in total 44 printed picture books after finding their surrogate picture books. In the event about a half of the children liked to read printed picture books better than digitized/web ones. Similar results to this one have been found in other research [19]. The children were not bewildered when reading the digitized/web picture books. We thus can conclude that the BrowsReader worked well in allowing the children together to read the digitized/web picture books as if they were reading ordinary printed ones.

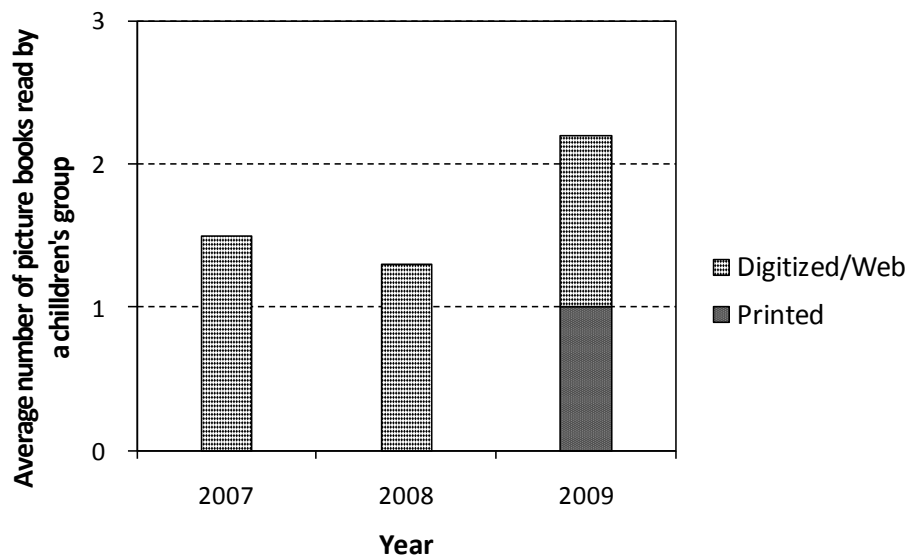


Fig. 5.2 Statistics as to reading digitized/web or printed picture books in the 2007, 2008, and 2009 events.

Many children shared the surrogate picture books they found with their families and/or friends when they found something interesting there. Several children, who learned how to orient the front-cover and page images toward them by mimicking the other children’s behavior, read the surrogate picture books as if they were the ordinary printed ones. Some of the children still tried to find the printed picture books in the physical bookshelves nearby after reading their digitized versions. The graffiti tool prepared to virtually paint on digitized/web picture books contributed a great deal to motivate the children in reading, although this tool was excluded in the following studies since the graffiti on printed picture books would be prohibited in a library.

(c) Discussions based on the questionnaire and interview

The statistics about the answers to the questions in Table 5.3 are shown in Table 5.2. When comparing the data for the common questions, the results for the years were almost the same except for Q2 and Q4. The average percentage of positive answers to Q2 drastically increased from 38.8 in 2007 to 63.0 in 2008, and then to 83.7 in 2009. This certifies that the activity in browsing/reading together could be enhanced by laying down a display and furthermore by building an environment in which many printed picture books as well as digitized/web ones

were collected. Positive answers to Q4 in the 2009 event indicates the built environment was suitable for kindergartners and lower graders. Some higher graders had a clearer purpose of their own, if the book(s) they were looking for could not be found, they would no longer use the BrowsReader. From the answers to Q1, Q7, and Q8 it can be seen that the children who rarely go to libraries enjoyed the use of the BrowsReader.

From the answers to Q3 and Q5, we can see that most children could easily find the surrogate picture books and not a few children read the printed picture books after finding their locations in the makeshift physical bookshelves. The average percentage (61.1%) of positive answers to Q6 correlates well with our observation that a large portion of the children joined in the activity in browsing/reading together.

Table 5.3 Percentages of positive answers to the questions in the 2007, 2008, and 2009 events.

	2007			2008			2009		
	kinder	lower	higher	kinder	lower	higher	kinder	lower	higher
Q1	100	98.5	100	96.3	99.0	100	100	98.5	100
Q2	81.3	32.4	29.6	81.5	61.6	45.0	100	75.4	95.0
Q3	---	---	---	---	---	---	95.2	98.5	90.0
Q4	81.3	89.7	96.3	77.8	88.9	95.0	95.2	98.5	80.0
Q5	---	---	---	---	---	---	34.8	43.2	42.9
Q6	---	---	---	---	---	---	71.4	55.4	70.0
Q7	93.8	94.1	100	88.9	96.0	100	85.7	93.8	100
Q8	75.0	75.0	66.7	77.8	84.8	55.0	81.0	84.6	75.0

* Here, kinder: kindergartners aged 3-6, lower: lower graders aged 6-9, higher: higher graders aged 9-12.

Some comments from the interviews with the children were: “We like to read the picture books together with others.” “If the same one is in our school library, I will use it every day.” Many parents told us that they hoped the BrowsReader would be set in a public space not just in the event.

Based on the studies in the temporary children’s rooms we believed that the BrowsReader could be used in the actual children’s rooms providing it could manage many more and

various picture books. We also noticed that the BrowsReader should be able to flexibly color-segment the bookcases according to the arranging scheme taken in each actual children's room.

5.2 In the Actual Children's Rooms

Before the case studies in the actual children's rooms, some improvement of the BrowsReader was performed. The further improvement was achieved so as to manage, in a unified view, the complete collection of printed picture books in an actual children's room in addition to the digitized and non-flash-based/flash-based web picture books. The other main improvement was to have a surrogate picture book providing a unified view even for a web picture book with no URL addresses for the page images without infringing copyright protection. Also the bookcases in an abstracted bookshelf were made to be flexibly color-segmented.

Case studies in the actual children's rooms were successively carried out in five children's rooms of Oita Prefectural library, a fairly large public library playing the central role on public library services in Oita prefecture; Beppu University's attached kindergarten, a medium kindergarten; Beppu City library, a medium public library for providing library services in Beppu city; Oita City library, a medium public library for providing library services in Oita city; and Yufu City library, a medium public library for providing library services in Yufu city from October, 2010. The BrowsReader in the five children's rooms was, respectively, named KENTO, BEPPU-KND, SENTO, COMPAL, and YUFU when customized for the prefectural library, the kindergarten, three City libraries in Beppu, Oita, and Yufu city. The details about the customization process in each children's room are described in this section.

We know that many children prefer reading printed picture books to digitized/web ones [19] and most children and parents in Japan have known little about the digitized/web books by the investigation [5]. Using this knowledge and the results in Section 5.1.3, we made suppositions before the following studies (i) that the BrowsReader in each of the children's rooms would work well to enhance the activity of children in reading the printed picture books together as

one positive effect of enhanced browsing together, but (ii) that its work to enhance the activity of children in reading the digitized/web picture books together would be limited.

This section details the environmental settings, results and discussions of the children's rooms in the four public libraries and one kindergarten. These descriptions are divided into three parts considering the scale of the libraries and the order of building the children's room: case studies about KENTO; BEPPU-KND; and the other three. The former one was a case study in a prefectural library; the middle one was a case study in a kindergarten; the latter one was case studies in the city libraries.

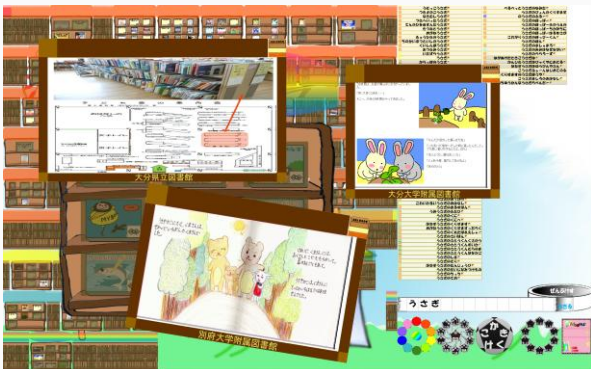

5.2.1 In the Children's Room of Oita Prefectural Library

The case study about KENTO in Oita Prefectural library has lasted for about 21 months from October 27th, 2010 to June 28th, 2012. During the period, KENTO was very useful for children's activity in browsing/reading together, and has become a necessary part of the children's room by the words of the librarians of the library.

5.2.1.1 Environmental Settings

Table 5.4 summarizes the environmental settings of KENTO, in which the photo was taken while a girl was dragging-in a character icon to find the picture books of interest with her friends. As shown in the photo, KENTO was set in a side of the counter, and near the entrance/exit of the children's room. The hardware setting was basically the same as the ones in the temporary children's rooms, and the ones in all the actual children's rooms in four libraries and one kindergarten, though each was customized to manage the collection available in each setting. The large touch display was used to encourage the children together to operate KENTO by gathering around it. The display for each was vertically set and bound on a table to prevent possible accidents, although the horizontal setting was shown in the above case studies to be effective as a way of allowing children to get together.

Table 5.4 Environmental settings for the case study in Oita Prefectural library.

	In Oita Prefectural library
Study period & Activity time period	October 27 th , 2010 ~ June 28 th , 2012 (264 weekdays, 153 holidays) At any time during 9:00 a.m.-5:00 p.m.
Arranging order	Category of the picture books (without the colored spine label)
Software customized	 <p style="text-align: center;">KENTO</p>
Room setting	
Children's ages	Kindergartners and lower graders aged 3-9 visited with their families and/or friends.

The customization for KENTO was performed as follows: The digitized picture books were the product of the librarian course opened in Beppu University. The web picture books were found in a varied selection of 20 to 60 websites, e.g. Digital Ehon, Digital Okayama Encyclopedia for Japanese picture books, and ICDL for English picture books, and qualified by the librarians of Beppu University and Oita University libraries. The URL addresses of their websites and the data for providing a unified view were stored in a server of Oita University library, where the front-cover/page images of the digitized picture books also were stored. This server also could be accessed by the kindergarten and the other three libraries via the Web. The surrogate picture books for the printed picture books were generated in the manner described in Chapter 4, where about 67% of the front-cover images were found on the Web by employ-

ing a search engine with ISBN numbers. Only their obscured images were stored in KENTO. The rest of the front-cover images in this study were automatically produced and stored as the ones with the titles for simplicity. The picture books in the children’s room are arranged by the order of the categories of the books, and there are not the colored spine labels on the books. The bibliographic data and the codes for the arranging scheme were obtained by the manner stated in Chapter 4. Since the number of surrogate picture books in KENTO was very large, we set each bookcase size to 9.

The numbers of surrogate picture books in KENTO were gradually increased as shown in Table 5.5. The additions on KENTO were (i) caused by the updating of the bibliographic data for the printed picture books and (ii) planned to see the effect of the increase in the number of web picture books.

Table 5.5 Number of picture books in KENTO.

Type	October 27 th , 2010	November 26 th , 2010	December 3 rd , 2010	February 25 th , 2011
Printed picture books	7,745	7,745	9,459	9,459
Digitized picture books	53	51	46	79
Web picture books (flash-based)	293 (146)	946 (312)	1,061 (324)	1,002 (324)
Total	8,091	8,742	10,566	10,540

5.2.1.2 Results and Discussions

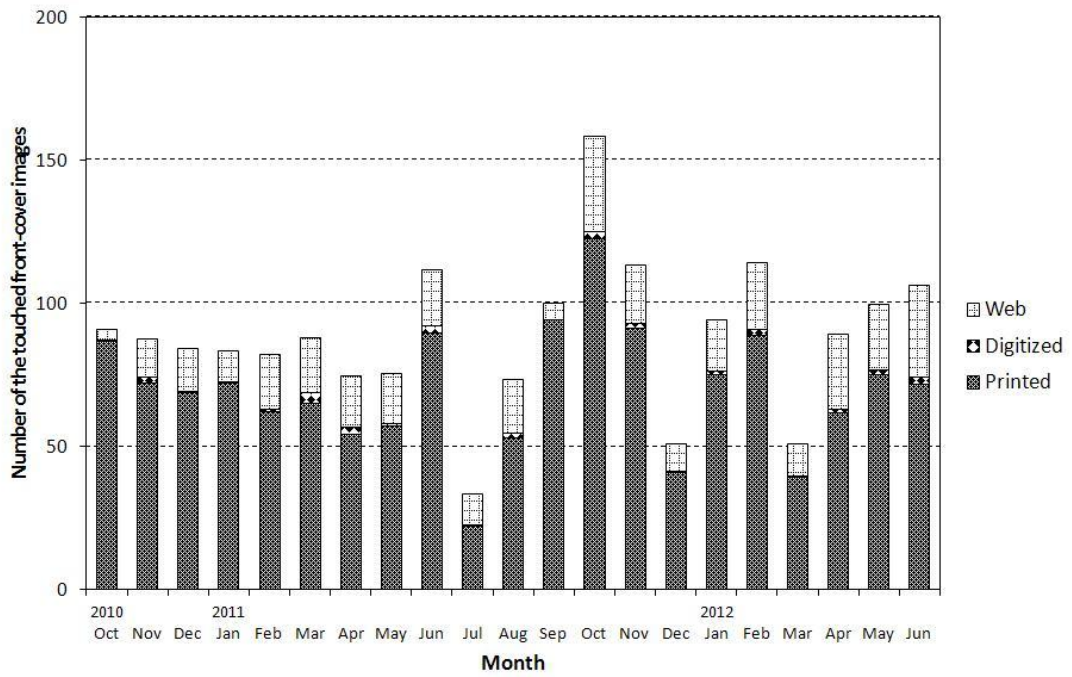
The reformed logging system, which enables us to check whether the children visited the children’s rooms were more active in reading together, was utilized in the case studies in the libraries and the kindergarten, since we could not observe the children’s behavior there and also could not record the personal data. The logging system recorded the operations on abstracted bookshelves and surrogate picture books with the time stamps. We questioned the librarians as shown in Table 5.6. The questions were prepared to see whether the built environment could enhance children’s activity in browsing/reading together from the viewpoint of the librarians. To see the effect from the viewpoint of the children we checked whether KENTO was actively used by analyzing the logged data.

Table 5.6 Questions for the librarians about KENTO.

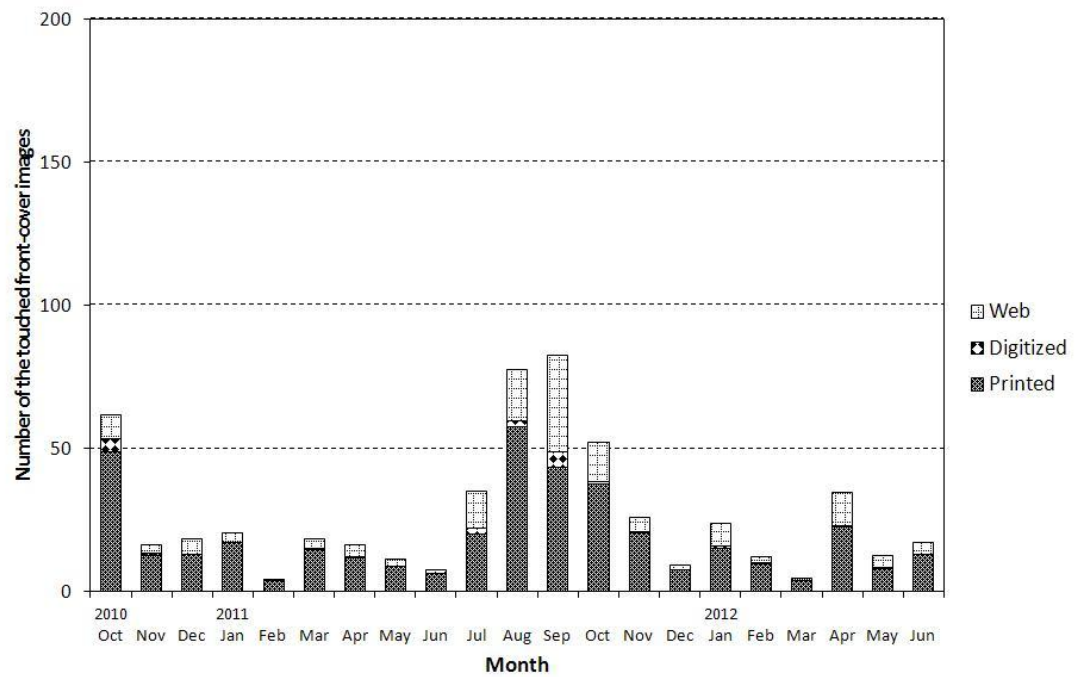
Questions
Q1 What were the supposed children's major ages?
Q2 Did you see children use KENTO together with others?
Q3 Did you see children go to the physical bookshelves after using KENTO?
Q4 Did you see children read together with others on KENTO?

Figures 5.3(a), (b) and (c), respectively, show the average numbers of touched front-cover images in KENTO per holiday (including Saturdays, Sundays and national holidays), weekday, and open day in each month. Total 20,476 front-cover images were touched during 21 months. The number of touched front-cover images per holiday was much larger than the one per weekday; this meant that on holidays the children visited the children's room and operated KENTO with their families in addition to their friends (with whom they might visit on weekdays). On weekdays the grade-schoolers had insufficient time and the kindergartners had no means of transportation to come to the prefectural library. By seeing Figure 5.3(a) that KENTO worked fairly well in steadily enhancing the children's activity in browsing together, where the average numbers of touched front-cover images on holidays were highly stable during 21 months. The largest one was in October, 2011, about 160. In August, 2011, the numbers were not so much changeable between holidays and weekdays.

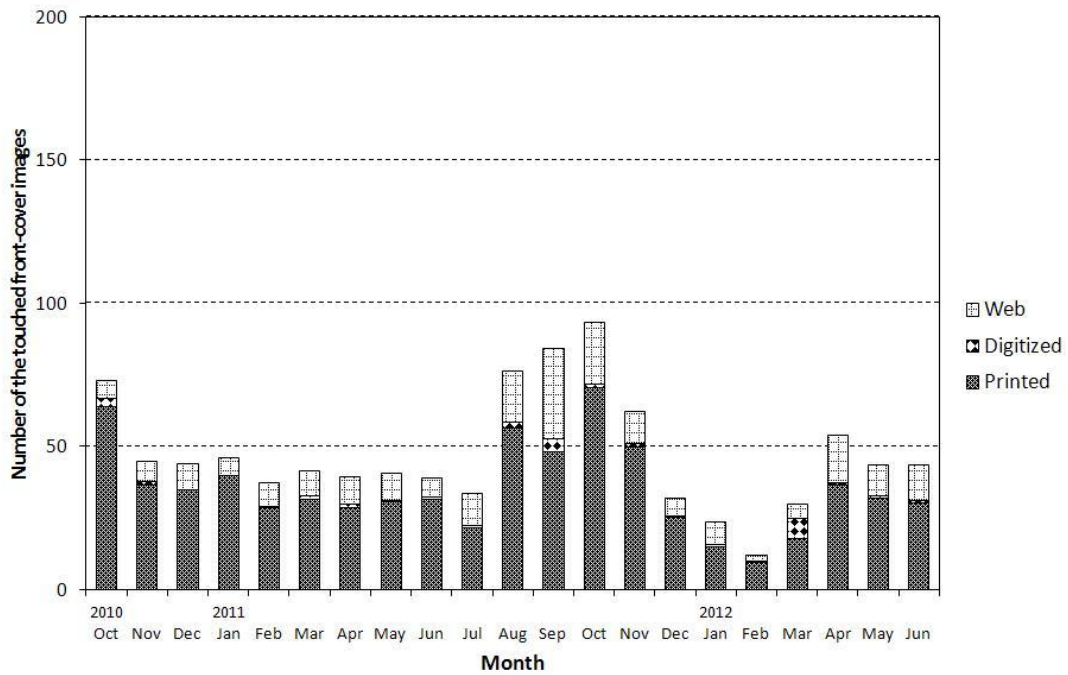
When comparing the relative number ratios of printed, digitized, and web picture books in the collection, the number ratio of touched front-cover images of digitized/web picture books appeared to be increasing, though that of printed picture books was consistently high. We reconsidered that the children from the beginning had an interest in reading the digitized/web picture books together.



(a) On holidays



(b) On weekdays



(c) On open days

Fig. 5.3 Average numbers of touched front-cover images on KENTO.

Figure 5.4 shows the relative average number ratios for touched/dragged bookcases, character icons, and titles on holidays in each month, where the ratio for bookcase was very high. By seeing this figure we can say that the children tended to browse the front-cover images even when their sizes were very small. A similar observation to this was made in research [23] which indicated that children liked to browse in the physical bookshelves with front-covers. From the analyses the presentation of front-cover images would be necessary to enhance children's activity in browsing/reading together. It also could be noticed that the children rather frequently dragged-in the characters to enlarge the front-cover images, and sometimes touched the titles. As to the dragged-in characters about 20% of them were for the strings with not less than 4 characters in length. The relative number ratio for touched/dragged character icons and titles in every month was gradually increasing, as seen in Figure 5.4.

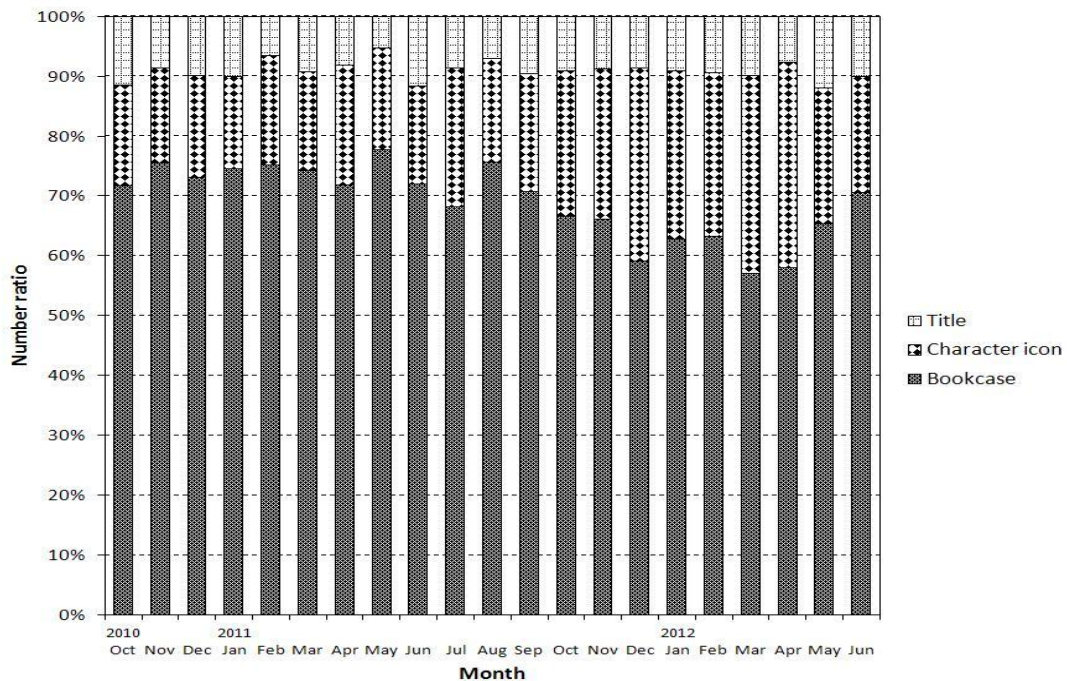


Fig.5.4 Average number ratios for touched/dragged bookcases, character icons, and titles on KENTO.

The logged data was analyzed to estimate how many surrogate picture books for the digitized/web picture books had been read together on KENTO. Since in the children’s room the direct observation of the children’s activity was not feasible, we considered that the children together with their families and/or friends had read a surrogate picture book when they together spent, for page flipping, 2 to 5 minutes from the opening to the closing of this picture book. This time period was estimated by observing the reading activity of the kindergartners of Beppu University’s attached kindergarten (The details are given in Section 5.2.2.2). We could not estimate such time period for a printed picture book. In total 200 surrogate picture books were considered to have been read together within a period of 153 holidays, and this number, i.e. 1.3 surrogate picture books per holiday, seemed rather small.

The fact that on KENTO the number of touched front-cover images was large and the number of surrogate picture books read was small seems to coincide with our suppositions denoted above. By hearing comments from the librarians, however, we came to the conclusion that, if the number of digitized/web picture books in a collection is comparable to that of the printed picture books, the children together are sure to read many more digitized/web ones. This tendency can be seen in Figure 5.3(a).

Although no user’s manual for browsing was prepared for KENTO, the children liked to touch the bookcases even in a large abstracted bookshelf, as seen in Figure 5.4. Thus we can note that the children browsed in a large number of surrogate picture books in the same manner as if they were browsing printed picture books in the physical bookshelves. There was also no manual for reading the surrogate picture books. The answers for Q3 shown in Table 5.7 show that when the picture books found by using KENTO were non-digitized/web ones, many children often went to the physical bookshelves to read them. This leads us to note that the children would not clearly differentiate the digitized/web picture books with the printed ones for reading.

Table 5.7 Answers to the questions about KENTO for the librarians.

Questions	Answers
Q1 What were supposed children’s major ages?	About 3 to 9 (on weekdays: 6 to 9, holidays: 3 to 6)
Q2 Did you see children use it together?	Yes, children mostly with the mothers.
Q3 Did you see children go to the physical bookshelves after using it?	Yes, many children often.
Q4 Did you see children read together on it?	Yes, rather frequently.

*Here ‘it’ means KENTO.

Table 5.7 shows the answers to the questionnaire featured in Table 5.6. From the answers to Q1 and Q3, we can say the children’s room of a public library will be one of the best places for lower graders and/or kindergartners to use the BrowsReader. From the positive answers to Q2, Q3 and Q4 we can say that KENTO worked fairly well to enhance the children’s activity when seen from the perspective of the librarians. Since KENTO was actively used together with others over 21 months, we can say that they worked well even when seen from the children’s perspective.

We outline some interesting comments on KENTO from the librarians. Some of the comments from the librarians are as follows: “The children used KENTO with no help from a librarian.” “We saw that the children were sometimes waiting in line in front of KENTO.” “The grade-schoolers were positive about dragging-in the characters and some of them were the repeaters.” “The children would have read more digitized/web picture books if many more

digitized/web picture books that could be clearly identified were collected.” Further we noticed that some adults used KENTO to find picture books for reading-to-children.

5.2.2 In the Children’s Room of Beppu University’s Attached Kindergarten



The children’s room of the kindergarten is used by children during the school time and free time almost every day. After KENTO was successfully set in the prefectural library, we further wanted to conduct a case study in a kindergarten for mainly use from the kindergarteners. In the case study during almost 2 months from February 9th, 2011 to March 26th, 2011, BEPPU-KND was showed to be liked by the kindergarteners by the words of the teachers there.

5.2.2.1 Environmental Settings

The environmental settings in the children’s room of Beppu University attached kindergarten is summarized in Table 5.8, in which the photo is took while two girl were reading a surrogate picture book together. As shown in the photo, BEPPU-KND was set next to the physical bookshelves in the children’s room. The hardware setting about BEPPU-KND was same as the one about KENTO.

The customization for BEPPU-KND was as follows: The digitized/web picture books were collected in a similar manner to KENTO. This work was rather easy since we fully utilized the data stored in the server of Oita University library. English picture books were excluded because of the language problem for the kindergatners. The surrogate picture books for the printed picture books (published relatively earlier) were generated similarly. About 51% of the front-cover images there were found on the Web. Their obscured images were stored in BEPPU-KND. The rest of the front-cover images were produced and stored by taking their obscured photos. The picture books are arranged in the order of the category of picture books, and there are colored spine labels on the books. The bibliographic data and the codes for the arranging scheme were set in a similar way to the above. Since the number of surrogate picture books on BEPPU-KND was not so large, we set each bookcase size to 4.

Table 5.8 Environmental settings for the case study in Beppu University’s attached kindergarten.

	In Beppu University’s attached kindergarten
Study period & Activity time period	February 9 th , 2011~ March 26 th , 2011 (27 room-open days) At free time during 9:00 a.m.-12:00 noon (mainly 9:00 a.m.-10:00 a.m.)
Arranging order	Category of the picture books (with the colored spine label)
Software customized	 <p>BEPPU-KND</p>
Room setting	
Children’s ages	Kindergartners aged 3-6 visited with their friends and/or kindergarten teachers.

The numbers of surrogate picture books in BEPPU-KND was gradually increased as shown in Table 5.9. The additions on BEPPU-KND were caused because we started the free time use following to the school time use.

Table 5.9 Number of picture books in BEPPU-KND.

Type	February 8 th , 2011	February 9 th , 2011
Printed picture books	1,111	1,111
Digitized picture books	79	79
Web picture books (flash-based)	75 (13)	779 (324)
Total	1,265	1,969

5.2.2.2 Results and Discussions

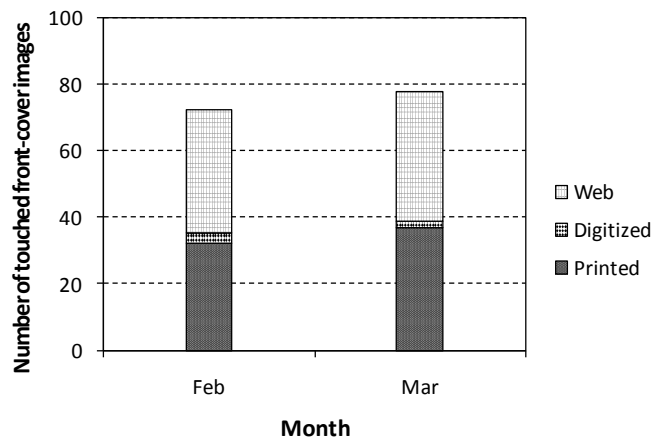
We had two sub-phases for the case study in a kindergarten when using BEPPU-KND: the school time use followed by the free time one. The school time use was set on February 8th, 2011 between 9:30 a.m. and 12:00 noon to introduce BEPPU-KND to the children who were in one of three classes Y (15 children aged 3 - 4), M (21 aged 4 - 5), and E (22 aged 5 - 6). The children in every class were put into 24 subclasses, where every class was 2 to 4 members. We installed two BEPPU-KND's, each of which stored the collection shown in the middle column of Table 5.9, in the children's room. In each abstracted bookshelf the front-cover images of all the printed picture books were reduced in size, since the purpose of this sub-phase was for the children to have the first experience to use BEPPU-KND in both browsing together and reading together. The children's subclasses were to read the digitized or web picture books. There was no difficulty in reading them using BEPPU-KND even for class Y children, since all the children had much experience in reading the printed picture book together.

When many page images of a surrogate picture book were observed being flipped one after the other at an easy pace, we decided it had been read together. Almost all subclasses read the surrogate picture books, and each subclass spent around 10 minutes or more to browse in an abstracted bookshelf and to read 2-3 found surrogate picture books. In total 64 surrogate picture books (26 and 38 for digitized and web picture books, respectively) had been read on two BEPPU-KND's in almost 2 hours. Each subclass spent about 3.5 minutes on average for reading a surrogate picture book. After observing the children's behavior, we asked the children to comment on the enjoyment of using BEPPU-KND, the activity in reading digitized/web picture books, and the experience of utilizing computers. About 85.5% and 76.5% of the answers, respectively, were positive for the former two (there was no noticeable statistical difference among the children's classes), though the percentages of the children in classes Y, M, and E giving positive answer to the last one were 38.0%, 50.0% and 63.6%, respectively. We also asked the kindergarten teachers and children's parents to use BEPPU-KND and questioned whether BEPPU-KND was useful to enhance the children's activity in reading together when installed in the children's room. The answers received were positive.

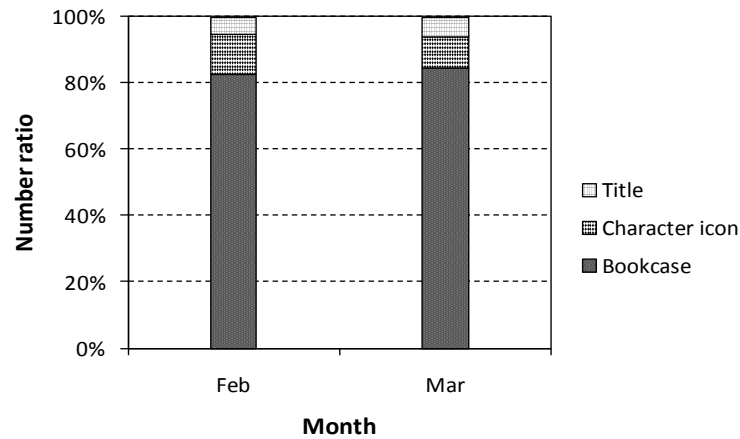
On February 9th, 2011 we installed one BEPPU-KND in the same room as in the above with the collection shown in the right column of Table 5.9. In the free time use BEPPU-KND

was set so that the front-cover images of not only the digitized/web picture books but also the printed picture books were presented. When the surrogate picture book for a printed picture book was found the printed picture book could be read in this room after being taken from the physical bookshelves. The same logging system as described above was set in BEPPU-KND.

Figure 5.5(a) shows the average number of touched front-cover images in BEPPU-KND per room-open day in each of two months. Total 2,036 front-cover images were touched. The children browsed in an abstracted bookshelf of BEPPU-KND around 75 times per day. This result shows that the children in the kindergarten were active in browsing together. The distributions of the average numbers of touched front-cover images for printed, digitized, and web picture books in the kindergarten and prefectural library were different. This could come from the different number ratios for those picture books in BEPPU-KND and KENTO. As a consequence we can say that BEPPU-KND well matched this room and that the children enjoyed the use of it.



(a)



(b)

Fig.5.5 Average numbers of touched front-cover images and average number ratios for touched/dragged bookcases, character icons and titles on BEPPU-KND.

Figure 5.5(b) shows the relative average number ratios for touched/dragged bookcases, character icons, and titles on a room-open day in each month. The children tended to browse the front-cover images similar to the above. From this figure we can again say that the presentation of the front-cover images of the printed picture books that were collected in the kindergarten would be beneficial to enhance the children’s browsing together activity. As to the dragged-in characters about 19% of them were for the strings with not less than 4 characters in length.

We estimated how many surrogate picture books for the digitized/web picture books had been read together on BEPPU-KND on the same base for KENTO. In total 89 surrogate picture books (53 different ones) were considered to have been read together within a period of 27 room-open days. The number, i.e. 3.2 surrogate picture books per room-open day, was relatively large compared to the one in the study in the prefectural library, though the activity time period per day was short. Some of the same surrogate picture books had been read by the same child at different times or by different children. We propose that BEPPU-KND could work well to enhance reading together in addition to browsing together.

The fact that the number of touched front-cover images on BEPPU-KND was large during a period of almost 2 months coincides with the suppositions denoted above; however the number of surrogate picture books read on BEPPU-KND was relatively high, which seems to contradict some of these suppositions. The reasons are that the number of digitized/web

picture books and that of printed ones were almost equal, and that the published date of the printed picture books were relatively old. Another reason is that the children would like to read the digitized/web picture books as well as the printed ones; which can be confirmed by the comments of the kindergarten teachers described in the following. The children in the children's room with BEPPU-KND were highly active in the activity in browsing/reading together.

The similar notices about browsing in an abstracted bookshelf and reading the surrogate picture books shown in the above for KENTO can hold for BEPPU-KND. Since the children could use BEPPU-KND without the assistance of the kindergarten teachers, the browsing/reading activity on BEPPU-KND is said to be seamlessly combined with the accustomed activity in the children's room of the kindergarten.

We questioned the kindergarten teachers about using BEPPU-KND similarly with KENTO as shown in Table 5.6. Table 5.10 shows the answers to the questionnaire featured in Table 5.6. From the answers to Q1 and Q3, we can say the children's room of a kindergarten will be one of the best places for kindergartners to use the BrowsReader. From the positive answers to Q2, Q3 and Q4 we can say that BEPPU-KND worked fairly well to enhance the children's activity when seen from the perspective of the kindergarten teachers. Since BEPPU-KND were actively used together with others almost 2 months, we can say that they worked well even when seen from the children's perspective.

Table 5.10 Answers to the questions about BEPPU-KND for the teachers.

Questions	Answers
Q1 What were the supposed children's major ages?	3 to 6
Q2 Did you see children use it together with others?	Yes, usually with the friends.
Q3 Did you see children go to the physical bookshelves after using it?	Yes, some children when saw.
Q4 Did you see children read together with others on it?	Yes, they usually read together with others.

*Here 'it' means BEPPU-KND.

We outline some interesting comments on BEPPU-KND from three kindergarten teachers. Comments from the kindergarten teachers are: “The kindergartners in classes Y and M enjoyed browsing and the ones in class E reading too.” “The children really liked the digitized/web picture books to read together.” We also were informed that KND-Beppu has continued to be used by some children’s parents for reading-to-children once a week.

5.2.3 In the Children’s Rooms of Oita, Beppu, and Yufu City Libraries

Based on the studies in the actual children’s rooms of Oita Prefectural library and Beppu University attached kindergarten, we found that the children’s activity in browsing/reading together was steadily enhanced by the installation of the BrowsReader. From September 10th, 2011, we have additionally installed the BrowsReader in three city libraries in local cities in Oita prefecture. They are Oita, Beppu, and Yufu City libraries. The environmental settings, results and discussions of the three case studies are described as follows.







5.2.3.1 Environmental Settings

Table 5.11 summarizes the environmental settings in the Oita, Beppu, and Yufu City libraries. Most environmental settings were similar to the ones in Oita Prefecture library. The study about COMPAL during almost 7 months from October 12th, 2011 to April 22th, 2012; about SENTO was carried out during almost 10 months from September 10th, 2011 to June 26th, 2012; and about YUFU during almost 5 months from December 8th, 2011 to April 22th, 2012. The photos in the bottom column of Table 5.11 were taken while children were browsing/reading picture books with their friends. As shown in the photo, COMPAL, SENTO, and YUFU were set near the physical bookshelves arranging printed picture books.

The customizations for COMPAL, SENTO, and YUFU were performed in a similar manner to KENTO and BEPPU-KND. These works were, however, much easier than KENTO, because during the customization process on KENTO, the data used for providing a unified view of web picture books (as well as the images of digitized picture books), and of the obscured front-cover photos of the printed picture books have been stored in the database on the server of Oita University library. On average about 50% obscured photos of the printed picture

books in each children's room of the three city libraries were found from the server. About color symbols the settings on YUFU were a little different from others, because the printed picture books in the children's room of Yufu City library were arranged by two-way classification; top is category, sub is lexicographical order. The color bars and color symbols on YUFU were then designed to be with two-way color.

Table 5.11 Environmental settings for the case studies in Oita, Beppu, and Yufu City libraries.

	In Oita City library	In Beppu City library	In Yufu City library
Study period & Activity time period	October 12 th , 2011~ July 31 th , 2012 (148 weekdays, 86 holidays) At any time during 9:00 a.m.-7:00 p.m.	September 10 th , 2011 ~ June 26 th , 2012 (148 weekdays, 76 holidays) At any time during 9:00 a.m.-7:00 p.m.	December 8 th , 2011 ~ July 31 th , 2012 (115 weekdays, 57 holidays) At any time during 10:00a.m.-6:00 p.m.
Arranging order	Lexicographical order of titles (with the colored spine label)	Lexicographical order of titles (without the colored spine label)	Two-way classification of picture books; top is category, sub is lexicographical order (with the colored spine label)
Software customized	 COMPAL	 SENTO	 YUFU
Room setting			
Number of children aged 3-9 in the city	About 32,000*	About 6,000*	About 2,000*

* The data is obtained with reference to the population census report in 2005 [53].

Table 5.12 shows the number of surrogate picture books in COMPAL, SENTO, and YUFU. Referring to the data about the number of children aged 3-9 in each city, as shown in the last column of Table 5.11, we could find that no matter how many children aged 3-9 are lived in the city, the number of the printed picture books in the city library was almost the

same. The total number of surrogate picture books was around or less than ten thousand, similar to the number in KENTO. So the BrowsReader with ten thousand of surrogate picture books would be fit for the children's rooms of different scale public libraries.

Table 5.12 Number of picture books in COMPAL, SENTO, and YUFU.

Type	COMPAL	SENTO	YUFU
Printed picture books	8,356	8,951	7,973
Digitized picture books	79	79	75
Web picture books (flash-based)	796 (342)	796 (342)	815 (342)
Total	9,241	9,836	8,863

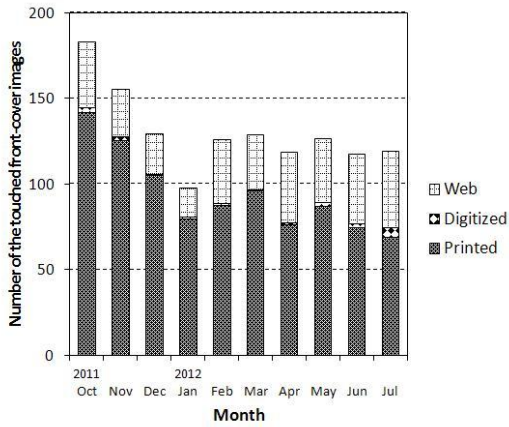
5.2.3.2 Results and Comparative Discussions

The logging system same as the one on KENTO was utilized on COMPAL, SENTO, and YUFU. By analyzing the logged data we checked whether COMPAL, SENTO, and YUFU were actively used. Figure 5.6(a) to (f), respectively, shows the average numbers of touched front-cover images in COMPAL, SENTO, and YUFU per holiday and weekday in each month. The former was much larger than the latter except in YUFU.

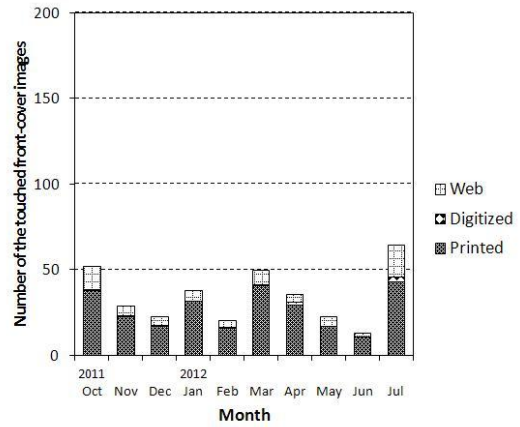
According to the results, we found that COMPAL worked fairly well, especially on holidays, in the children's room. The largest number of touched front-cover images per holiday in COMPAL went up to about 190 and the average numbers were highly stable during 10 months. In SENTO and YUFU the changing tendency of the average number of touched front-cover images per holiday in each month was also upward, although the numbers in some months among the whole period were not so high. The number per weekday in YUFU was a little higher than the one per holiday. The differences among the results in the three city libraries could be related to the number ratio of the children aged 3-9 lived in each city.

The number ratio of touched front-cover images of digitized/web picture books appeared to be increasing in COMPAL, SENTO, and YUFU. We confirmed that the children had an interest in reading the digitized/web picture books together.

Average numbers of touched front-cover images on COMPAL

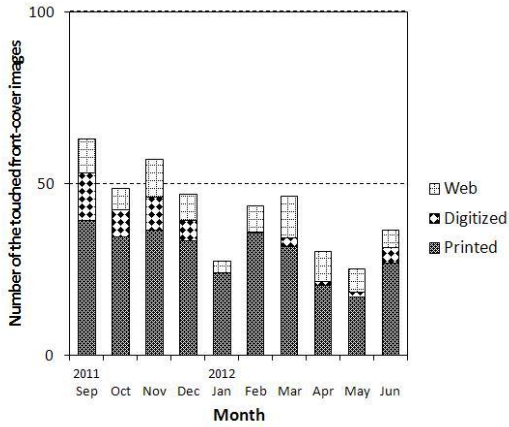


(a) On holidays

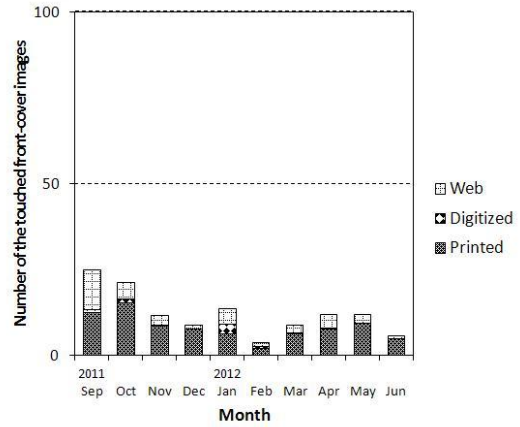


(b) On weekdays

Average numbers of touched front-cover images on SENTO

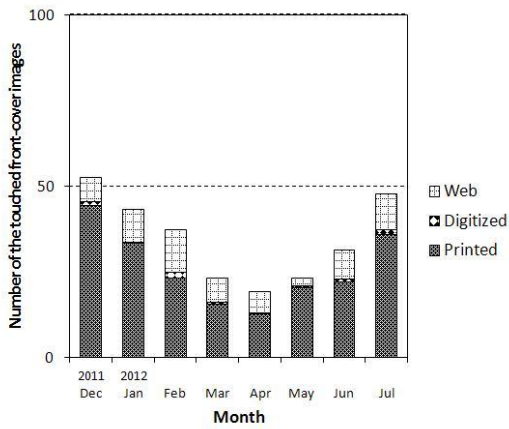


(c) On holidays

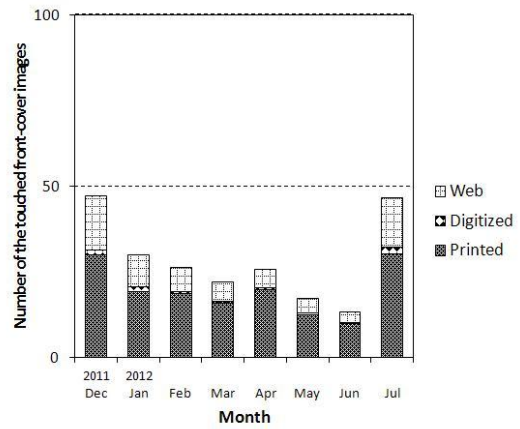


(d) On weekdays

Average numbers of touched front-cover images on YUFU



(e) On holidays



(f) On weekdays

Figure 5.6 Average numbers of touched front-cover images on COMPAL, SENTO, and YUFU.

To estimate how many surrogate picture books for the digitized/web picture books had been read together on COMPAL, SENTO, and YUFU, the logged data for the three was also analyzed on the same base for KENTO. In total 300 surrogate picture books, 47 surrogate picture books, and 14 surrogate picture books were, respectively, considered to have been read together within a period of 86 holidays, 76 holidays, and 57 holidays on COMPAL, SENTO, and YUFU, and these numbers, i.e. 3.5, 0.6, and 0.2 surrogate picture books per holiday on the three. Only considering the numbers on the three, much more surrogate picture books have been read together on COMPAL than the ones on SENTO and YUFU. The result still could be considered to relate to the number ratio of the children aged 3-9 in each city.

For confirming whether children's activity in reading together on COMPAL, SENTO, and YUFU in the children's rooms of three city libraries were really enhanced, we further analyzed the logged data and drew a comparison. The data for KENTO installed in Oita Prefectural library was also added to analyze. Table 5.13 shows the average number ratios of the digitized/web picture books read together to the front-cover images of digitized/web books touched in four public libraries per holiday. The data shows COMPAL and KENTO worked well in enhancing children's activity in reading together in the children's room, and the children usually go to Oita City library and Oita Prefectural library utilize COMPAL and KENTO like to read books together with their families and/or friends. Conversely in SENTO and Yufu City library, a few and almost few children read digitized/web picture books together in the children's room, although many efforts from the librarians in Yufu City library were taken to encourage children read together in the library rather than back to home. Enhancing children's activity in reading together by the installation of SENTO and YUFU seems much more important. Continually kinds of efforts, for example, further investigating children's reading activities on SENTO and YUFU, and increasing the number of digitized/web picture books, etc., will be taken to attract more children read together in the children's room of city libraries.

Table 5.13 Average number ratios of the digitized/web picture books read together to the front-cover images of digitized/web picture books touched on KENTO, COMPAL, SENTO, and YUFU

	KENTO	COMPAL	SENTO	YUFU
Average number of the front-cover images of digitized/web picture books touched per holiday	20	36	13	9
Average number of the digitized/web picture books read together per holiday	1.3	3.5	0.6	0.2
Average number ratio of the digitized/web picture books read together to the front-cover images of digitized/web picture books touched	0.07	0.10	0.05	0.02

Table 5.14 shows the average number ratios of the digitized/web picture books actually read together to the ones hypothetically read together according to the average number ratio of the digitized/web picture books read together to the front-cover images touched on KENTO. Since KENTO installed in Oita Prefectural library, as a reference, is compared with the ones in other city libraries. Comparing with these data, the average numbers of the digitized/web picture books read together on KENTO, COMPAL and SENTO were much larger than the one on YUFU. The results show that the children in the large city area read more digitized/web picture books together than the children in the other areas. Many efforts are still needed to be taken in the future to attract more children who live far from the large city area to go to the children's room of the library to read more picture books together.

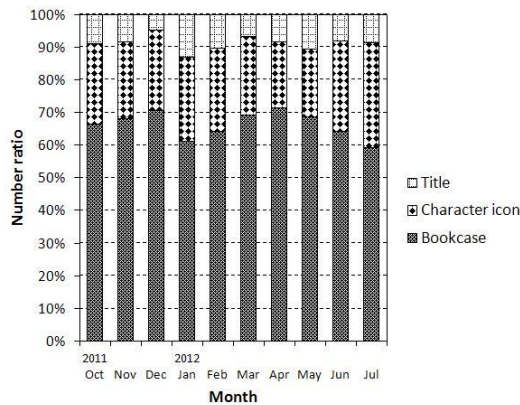
Table 5.14 Average number ratios of the digitized/web picture books actually read together to the ones hypothetically read together according to R_{KENTO} * on KENTO, COMPAL, SENTO, and YUFU

	KENTO	COMPAL	SENTO	YUFU
Average number of the digitized/web picture books hypothetically read together according to R_{KENTO} per holiday	1.3	2.5	0.9	0.6
Average number ratio of the digitized/web picture books actually read together to the ones hypothetically read together according to R_{KENTO}	1.0	1.4	0.7	0.3

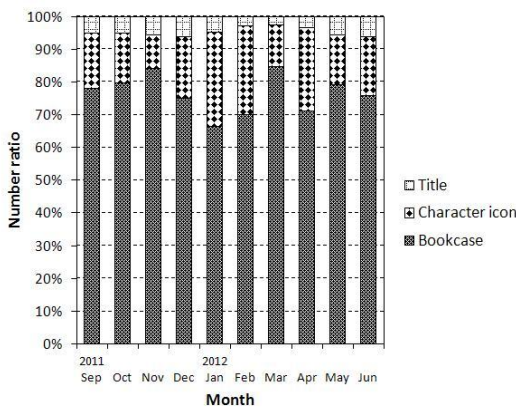
* R_{KENTO} is the average number ratio of the digitized/web picture books read together to the front-cover images of digitized/web picture books touched on KENTO, that is, 0.07, as shown in Table 5.13.

Figure 5.7 shows the relative average number ratios for touched/dragged bookcases, character icons, and titles per holiday in each month, respectively, on COMPAL, SENTO, and YUFU, where the ratio for touching bookcases was all very high. But the ratio for dragging-in

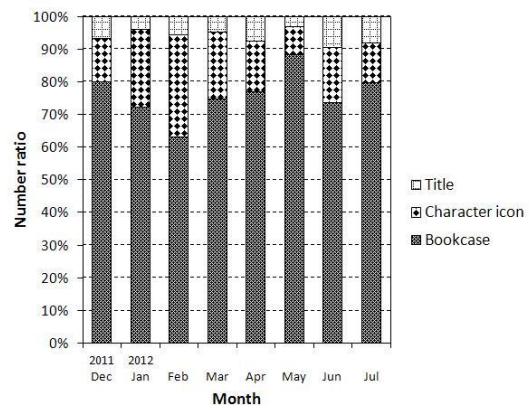
and dragging-out characters and touching the titles were all stably increasing, especially on COMPAL.



Average number ratios for touched/dragged bookcases, character icons, and titles on COMPAL



Average number ratios for touched/dragged bookcases, character icons, and titles on SENTO



Average number ratios for touched/dragged bookcases, character icons, and titles on YUFU

Figure 5.7 Average number ratios for touched/dragged bookcases, character icons, and titles on COMPAL, SENTO, and YUFU.

In the actual children's rooms we took rather long term studies to certify that the children thoroughly and constantly enjoyed the use of the BrowsReader, and also to confirm the credit that a set of the BrowsReader's can be installed in the children's room of multiple public libraries. To conclude we can say that the kindergartners in a new environment in a kindergarten become more active in reading digitized/web picture books together and can confirm that the children, including the lower graders, in a new environment in a public library will become

more active in reading together when many more and various digitized/web picture being clearly identified are collected.

From the results of the five case studies we can say that the BrowsReader will work well in steadily enhancing the activity of children, especially kindergartners, in browsing/reading together in every children's room. This benefit is also achieved by the basic design of the BrowsReader that the children who gather around and use it can browse/read surrogate picture books together with their families and/or friend with the same feeling provided when browsing/reading the ordinary printed picture books in a children's room. One key to yielding this feeling is the adoption of the color symbols/bars for linearly arranging the front-cover images. Ideally, however, the color symbols/bars should have a well known linear structure such as the one for the numbers 1, 2, 3, etc. This kind of structure for the color symbols is seen in the Munsell color system [45] and also in the color gradation in a rainbow. If the colored spine labels attached to the backs of printed picture books had reflected this ideal linear arrangement, the colored soccer-ball shaped icons in the character input panel (see Figures 3.4, 3.5 or 3.10) of the customized BrowsReader in each children's room of five libraries and a kindergarten would have been presented in the similar way to the hue-circle of the Munsell color system. Fortunately for the study we found a partly ideal linear arrangement in the spine label's colors in Beppu University's attached kindergarten. Also if the display of each customized BrowsReader had been set horizontally, the browsing/reading activity would have been much more enhanced.

6. Concluding Remarks and Future Work

A method of building a new environment for steadily enhancing the children's activity in browsing/reading together is proposed by placing a digital table installed the BrowsReader in the children's room of a library or kindergarten. In this environment a large number and wide variety of printed, digitized, and web picture books are reproduced as a set of surrogate picture books that can provide a unified view, and then the front-cover images of these surrogate picture books are presented in the form of an abstracted bookshelf. The children who visited there together with their families and/or friends can browse in an abstracted bookshelf with the same feeling that is provided when browsing in the actual bookshelves and read a digitized and web picture book as if it is an ordinary printed picture book. Any bookcase of the bookshelf and also any picture book can be enlarged by either finger touching or character input. The BrowsReader is equipped with the mechanism, which employs the CollaboTray technology, to manage the pages of the events on each picture book so that it can be read by page flipping. During the time period of children's activity in browsing/reading together the surrogate picture books together with their families and/or friends, their browsing/reading activities would not infringe upon copyright protection.

To easily realize the enhanced children's activity in browsing/reading together environment in a children's room of each public library or kindergarten, many efforts have taken in the customization of the BrowsReader to match with the features there. In the customization process, librarians are requested to collect the picture books that have the permission to be digitized and/or to qualify the picture books on the Web. The former could be the product of the library's course in creative writing open to citizens, and the latter could be found by some citizens e.g. parents when navigating websites. Based on these works the different libraries would

have different collection about the digitized/web picture books. Then by performing the collaboration among the different libraries, children would easily meet more qualified digitized/web picture books by browsing/reading the customized BrowsReader in any children's room.

The BrowsReader was improved and evaluated in a step by step process through in temporary children's rooms in three events, and in the actual children's rooms of four public libraries and one kindergarten. During these case studies we employed a free-style study of allowing children to use the BrowsReader without control or direction from the researchers, even no manual, to minimize any unexpected influence on the children's browsing/reading activities. Based on the studies in the temporary children's rooms we found that the BrowsReader was useful for children's browsing/reading digitized/web picture books and mixed with the printed ones with their friends and/or families, and we were known that children very liked to use the BrowsReader according to the questionnaires. About the studies in the actual children's rooms, we found that the improved BrowsReader could manage many more and various picture books, and was easily customized in any children's room of each library or kindergarten. We can note by the case studies that the BrowsReader is steadily used in each actual children's room and enhanced children's activity in browsing/reading together by the interview of the librarians and kindergarten teachers.

Future research will be needed to investigate in more detail that the children in a new environment become as active in reading digitized/web picture books together as in reading the printed picture books. Beyond the specific remit of this study it is important to remember that the activity of children in reading together has a positive effect on the development of the children's frontal association areas as well as cerebral limbic systems. We have got the facts in the children's room from our case studies as follows: younger children, by reading picture books together mainly with families members and/or friends, experience with a range of emotions, and older children, by reading picture books together with families and/or friends accompanying reading-aloud, acquire literacy skills, broaden communication ability, and advance intellectual thinking. Based on these facts the children in a children's room can be considered to have read a digitized/web picture book if we acknowledge their activity of flipping many pages of the digitized/web picture book, hopefully accompanied with the voice, together with

families and/or friends. No observing, questioning or interviewing a child is usually allowed in the children's room, so we will try to perform a method [3] of deciding that the children have read the picture books by identifying, based on the page-specific data, the flipped pages of these picture books. This method also will clarify the instructive picture books that should be collected in a children's room by drawing the curves of flipping the pages of the picture books in the present collection.

By analyzing the page flipping data, we foresee by this method to figure out (i) whether the children together have spent appropriate time for flipping many of the pages, and (ii) how the pages are flipped forwardly and/or backwardly. The result in (i) would be used to decide that the children have read the digitized/web picture books, and in (ii) would help to find the instructive picture books to be collected. The importance is that we have planned to formulate the method by the following rules. The first one is each child should not be observed, questioned and interviewed so that the information on individuals can fully be protected. The second one is the page-specific data to identify the flipped pages should be limited so that the copyright protection of any picture book would not be infringed. The last one is the matching among the page-specific data should be simple so that the reading would not be interrupted.

We are examining the effects of the proposed method in the children's room of Beppu University's attached kindergarten, where the web picture books freely accessible via the Web were used as the digital picture books, and the BrowsReader on which the kindergartners together could find and read various picture books was used as a book reader. By examining how often the children, especially the lower graders, together read digitized/web picture books, in the case where the digitized/web picture books in the BrowsReader have significantly increased in number, it is possible to clarify the differences between reading of digitized/web and that of printed picture books with particular concern toward comprehensibility and affectivity. We are now collecting many more qualified digitized/web picture books and grouping them by age bracket to be registered in the BrowsReader.

The logging system is also being reformulated in order to specify a range of important data, e.g. children's voices, of reading-aloud together as well as to monitor the page flipping actions even for a web picture book with no URL addresses for the page images, and to count how often the same digitized/web picture books have been read. The logged data will be compared

with the statistics and findings about reading printed picture books in a children's room. We now plan to modify the proposed method to be installed on an off-the-shelf book reader. When such a book reader is introduced, we are required to make sure that the children use a book-reader together, hopefully accompanied with the voice. One simple way to fulfill this requirement is to ask the librarians and/or kindergarten teachers.

One way of increasing non-printed picture books in number will be to improve the BrowsReader so that it can manage off-the-shelf digital picture books in a manner similar to digitized/web ones, if many more off-the-shelf digital picture books become available and their adoption would not hamper the finances of a public library. We are taking another approach; i.e. many and various digitized/web picture books are being collected by installing a set of the BrowsReader's in the children's rooms of multiple public libraries, where these collected picture books are the ones originally produced or selected by the citizens residing near one of the libraries, and by linking the BrowsReader's to a server of Oita University library via the Web. We already have begun to strengthen the collaboration among the BrowsReader have installed and will be installed in the libraries and kindergartens. Children will browse/read the collection coming from all the BrowsReader's, i.e. the collection of all the registered children's rooms, although they just are around one of the registered BrowsReader's. These BrowsReader's can also be utilized to organize a regional repository as a locally-organized but globally-usable digital library when the products are the digitized (or digital) picture books telling folktales, myths, patrimonies, etc., in a regional community.

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