MULTIPLE INTELLIGENCE BASED E-BOOKS

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ABSTRACT

This paper describes a study on the design of teaching-learning materials and the use of technology in school environment. One essential component of this study is the definition of models on how electronic textbooks (e-books), one of the fundamental tools in the school recently, should be designed to be practiced. We postulate that a crucial feature for children e-books would be to present contents by mixing different presentation modes (graphic page, talking page, hypermedia page and web page modes) and including various activities in each mode which support and nurture as many children's intelligences and learning styles as possible.

Keywords

Design, E-books, Children, Multimedia

1. INTRODUCTION

Learning in current schools environment goes beyond the classrooms. The teaching learning activities are trying to combine the best of network-based, teacher-based and courseware-based resources. Teaching-learning materials are in various media and attractive. Conventional materials such as paper books, magazines, newspaper, drawings, audio-visual objects are progressively used in an integrated manner with high-technology media such as electronic books (e-books), mainly in the form of interactive story books, simulation games, individual self-paced learning modules, problem-solving computer games, video-on-demand, interactive TV, on-line library, bulletin board, search engines, distance-learning, video-conferencing and e-mail.

With this in mind, this study focuses on one of the high technology materials, more specifically e-book, as books/textbooks are most indispensable materials in educational environment.

1.1 What is E-Book?

The result of integrating classical book structure, or rather the familiar concept of a book, with features which can be provided within an electronic environment, is referred to as an e-book [17]. E-books are developed with the intentions of overcoming the limitations of paper books. They have the advantages over paper books in that they are dynamic, reactive and able to provide the same features as well as new features such as fast hyperlinking, multimedia technology, digital annotating, digital bookmarking, and fast searching. The term is used instead of hypermedia or interactive multimedia for the reason of maintaining the paper book metaphor. By maintaining the same model on screen, users access to electronic information can be facilitated [17]. In addition, since the main idea of this study is to offer the users a learning material that is as similar as possible to the paper textbook, together with additional features, the e-book term is adopted.

E-book has also the benefit of being more appealing to children and catering the diversity of end users profiles. In coming sections, a model of an electronic textbook that tries to cater the diversity of children intelligences and learning styles is proposed. The model is based on the integration of Howard Gardner's [14] Theory of Multiple Intelligence and existing electronic book models. Before presenting a design example, the concept of Multiple Intelligence is described.

2. LEARNING THEORY AND CHILDREN'S INTELLIGENCE

Children learn in at least seven different ways: verbal/linguistic, logical-mathematical, visual/spatial, bodily-kinesthetic, musical, interpersonal and intrapersonal. Each child could learn in any one of

these ways or through a combination of several ways [1; 2; 10; 11; 13; 14]

- A child is verbal/linguistic if he loves words and enjoys reading, writing and story telling;
- A logical-mathematical child is more interested in concepts, numbers and scientific exploration;
- A visual/spatial child learns best through pictures and images, enjoys art and mentally visualizes things easily;
- A bodily-kinesthetic child needs to move and touch to learn;
- A musical child uses rhythm and melody to learn;
- Interpersonal child learns best with other people around;
- Intrapersonal child gets more out of being left alone to learn.

The above learning styles originate from a theory suggested by Howard Gardner: a theory which he calls Multiple Intelligences (MI). According to Gardner there exists at least seven intelligence in each individual and we are able to know the world through language, logical-mathematical analysis, visual representation, musical thinking, the use of the body to solve problems, an understanding of other individuals, and an understanding of ourselves. Where individuals differ is in the strength of these intelligences. This theory has proven to provide educators with concrete strategies for addressing the needs of every learner [22].

Design of e-books for teaching and learning should take into account these different learning styles and attitudes of each user [6; 12; 15; 22] particularly when the users are young children. Learning environments must allow flexible combinations of various sources of information with different models of training, student profiles and concepts, in such a way that they guide the student's learning through the information space [7]. Thus, research on individual differences may help the development of hypermedia learning environments that are useful to a wide range of users with different learning styles and preferences [9]. Designing e-books to deal with users' individual differences is no easy task. E-book should be designed to give users a high degree of flexibility. There are many ways to give e-books flexibility [18]. We propose a model that presents contents in four different modes. In the next section, our e-book model is described.

3. E-BOOK CONCEPTUAL MODEL

Formal models of e-books, which describe the structure of e-books already exist [3; 4; 5; 21]. Functional aspects and their definitions are also available and described in details by [8], [16] and [17]. However, none of these models discussed the presentation of content and type of activity involved in the book pages. Because we are developing children multimedia electronic textbook, a great emphasis on the content of each page and the activities involved in making sure interaction and learning occur have to be taken. This model is defined in terms of structure and content presentation.

E-book = structural components + content presentation components

It is _____ e with Gardner's theory.

3.1 Structural Components

A book is made up of at least three main sections: front section, main section, and back section. Each of this section is further made up of subsections as described in Figure 1.
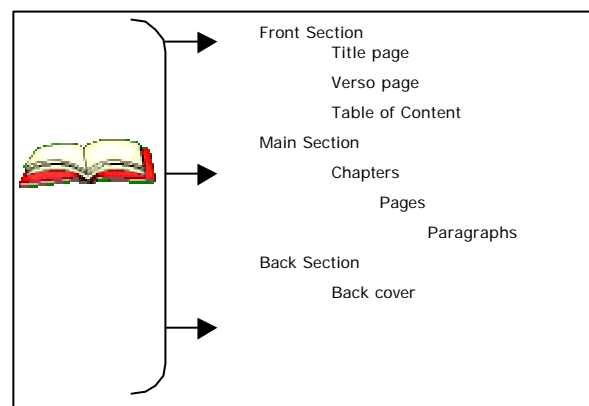
Figure 1: Structural components of e-book

Main section can have as many chapters as required and in each chapter there are no limit to the number of required pages. However, in each page, the number of paragraphs for children textbooks is frequently less than five, with an average of three. Children textbooks also normally do not have foreword, preface, acknowledgement, dedication, list of tables, list of figures, footnote, reference, index, glossary or appendix. Looking at Figure 1, it is suggested that when designing children e-book, the design structure should follow the above model. Following paper book metaphor into the design of e-book reduces the cognitive loads of users when using a new technology [17].

3.2 Content Presentation Components

Designing e-books for learning needs greater effort in the presentation of the book contents since this will partly determine the success of learning process. It is important to carefully design the way content is structured, organized, and presented. The types of activity in which the users will be involved play significant roles in the success of pedagogic design

[4]. Thus, studies on what kind of activities [20] cater for most users' needs are indeed helpful in promoting better children e-book design. With regard to this, the seemly activities, which should be included in the design of children e-book contents so as to meet the seven intelligences, include writing essays, play with word processors, reading, drawing programs, painting programs, sing along programs, listening to rhythms, puzzles, providing hands-on construction kits that interface with the computer, using email and chatting programs, and creating notes on daily activities/on-line diary (for a more detail description on many other activities and their suitability for the seven intelligences refer to Norshuhada and Landoni [19].

We group the above activities into four modes: graphic page, talking page, hypermedia page and web page. Each mode will have activities that support at least one learning style. Figure 2 shows a summary of which intelligence each mode is trying to cater and at the same time nurture.
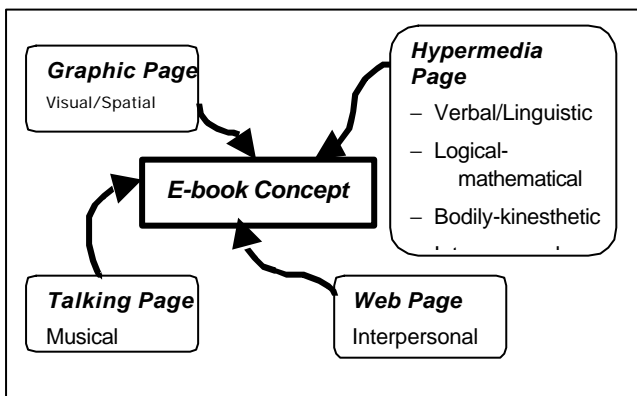

Figure 2: Summary of type of modes to match type of learning style

3.3 The Model

By adopting mathematical sets, it can be suggested that the structural components of children e-book are:

```
Book = {Front Section, Main Section,
      Back Section}
   Front Section = {Title page, Verso
                    page, Table of
                    Content}
   Main Section = {Chapter i} for ∀ i
                  ∈ N, where N =
                  [1,2,3…]
      Chapter i = {Page i} for ∀ i ∈
                  N, where N =
                  [1,2,3…]
         Page i = {Header,Paragraph j}
                  for j ≤ 5 and ∀ i ∈
                  N,where N = 1,2,3…]
            Paragraph j = {Text(f),
                          Graphics}
                          for j ≤ 5 and
                          f = font
```

```
                          where f >
                          size 14
                          and f = [san
                          serif]
   Back Section = {Back cover}
```

In the above definitions, main section can have as many chapters as required and in each chapter there are no limit to the number of required pages. However, in each page, the number of paragraphs for children textbooks (including images) is frequently less than five, with an average of three. Text used in each page should have font size larger than 14 with types in the category of san serif.

The content presentation components of children e-book should include activities as described earlier. Four different presentation modes in each page are proposed. Content in any page is presented by using four objects and these objects contain programs with activities that support the seven intelligences. In order to do this, the definition of `Page i = {Header, Paragraph j}` above needs to be changed to:

```
Page i = {Contents, Objects}
       for ∀ i ∈ N,where N = Num of
           pages = [1,2,3…]
   Contents = {Header, Paragraph j}
        for j ≤ 5
      Paragraph j = {Text, Graphics}
        for j ≤ 5
   Objects = {Object A, Object B,
           Object C, Object D}
      Object A = {Graphic page,
              Program G_i} for ∀ i =
              [1,2,3…] and i ∈ GP
         where GP = {animation
         programs, draw and paint
         programs, spatial problem
         solving games, clip art
         programs and etc.}
      Object B = {Talking page,
              Program T_i} for ∀ i =
              [1,2,3…] and i ∈ TP
         where TP = {story telling,
         sing along activities, making
         music, music listening, etc.}
      Object C = {Hypermedia page,
              Program H_i} for ∀ i =
              [1,2,3…] and i ∈ HP
         where HP = {word processing
         programs, typing tutors,
         desktop publishing programs,
         interactive storybooks, word
         Games, mathematical skills
         tutorials, logic games,
         science programs, critical
         thinking programs, hands-on
```

```
        construction kits that
        interface with computers,
        motion-simulation games, eye-
        hand co-ordination games,
        tools that plug into
        computers, any self-paced
        program, digital diary,etc.}
    Object D = {Web page, Program W
            i} for ∀ i = [1,2,3…]
            and i ∈ HP
        where HP = {email software,
        electronic bulletin boards,
        one-one games, many-many
        games, chatting programs,
        etc.}
```

**Note:

```
Program refers to the kind of technology
appropriate for an activity
G = graphical, T= Talking, H = Hypermedia, W
= Web
```

The above definition describes each page as containing contents plus a combination of any of four different objects. The content will consist of the header and the paragraphs, which usually are made of text and graphics. The contents are also supported and reinforced by using graphic, talking, hypermedia and/or web pages. And in each of these four different types of pages, a collection of appropriate activities that match the seven intelligences will also be included. Activity is presented in the form of program. The higher the number of i, in the definition Program G_i / T_i / H_i / W_i the more activities are provided in the e-book.

In giving an example on how to apply the model in the design process, begins by choosing a particular page from a textbook. Figure 3 displays an example of a printed textbook page.
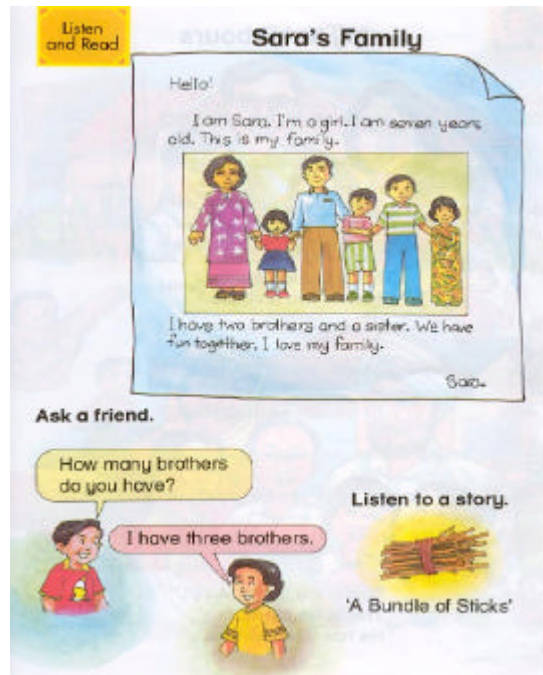
Figure 3: An example of printed textbook page

The objective of the page is to teach children about family and family values. We present here some activities for graphic and talking page.

```
Object A = {Graphic page, Program G₁,
        Program G₂, Program G₃}
  Graphic page = Display printed page
            as it is. However,
            add more family types
            graphics. Include
            also a family chart
            to illustrate the
            connection between
            members of families
  Program G₁ = ask users to draw their
            parents pictures using
            drawing and painting
            program.
  Program G₂ = provide a family picture
            and ask users to paint
            them.
  Program G₃ = allow users to
            manipulate the family
            picture.

Object B = {Talking page, Program T₁,
        Program T₂}
  Talking page = Display printed page
            as it is but put
            links to audio file
            to all printed text.
            Include also a
            conversation between
            parents and
            grandparents, whereby
            parents are inviting
            the grandparents to
            go for a picnic
```

```
Program T₁ = let users record their
             voice by making them
             believe they are
             talking to their
             grandparents on the
             telephone.
Program T₂ = include a song about
             family values and ask
             users to sing along.
```

4. CONCLUSION

Our investigation started from the observation that flexible electronic textbooks could play a crucial role in education. In particular they could allow to nurture and stimulate multiple intelligences (Gardner's Theory) in children. Real experts and users (i.e teachers) have approved the model and many said this is an interesting concept. Following this, we are now in the requirement engineering stages on how to develop an e-book builder that supports the creation of books containing the various activities.

Our requirement elicitation started many activities including reviews of existing authoring tools especially designed for children and teachers. Specification of the requirements will be validated shortly during summer 2001.

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