Conceptual Model of Children's Electronic Textbook

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Abstract. First step in developing electronic book is to build a conceptual model. The model described in this paper is designed by integrating Multiple Intelligences Theory with existing electronic book models. Emphasis is on integrating the content of a page with appropriate activities that meet and cater for the diversity of learning styles and intelligence in young children. We postulate that an additional feature for children e-book would be to present contents by mixing different presentation modes and including various activities which support as many intelligences as possible.

1 Introduction

In most software development process, the first and foremost stage is to build ideas and present them in the most effective ways. This is done through building a concept, often referred to as concept development phase. It involves the task of inventing and evaluating idea [1] and is more apparent in the development of interactive multimedia programs. Since electronic book (e-book) is an example of interactive programs, its development has also to go through this phase.

We are currently planning to develop a children multimedia electronic textbook (children ages in between 5-9 years old) which support and cater for seven different intelligences and learning styles. These seven intelligences were proposed by Howard Gardner [2] in his Multiple Intelligences theory. This theory states that there exist at least seven intelligences (thus seven learning styles): verbal/linguistic, logical-mathematical, visual/spatial, bodily-kinesthetic, musical, interpersonal and intrapersonal:

- 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.

Armstrong [3] identifies that each child could learn in any one of these ways or through a combination of several ways. We believe that e-books could play a crucial role by supporting this learning process. In order to proceed with the e-book development, the conceptual model has first to be built. This paper presents and discusses our proposed model.

2 E-book Models

Formal models by Barker & Manji [4], Barker & Giller [5], Stephen et. al. [6], and Barker [7] of e-books already exist which describe the structure of e-books. Functional aspects and its definitions are

also available and described in details by Catenazzi [8] and Landoni [9]. However, none of these models discussed about the presentation of content and 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.

The following section describes the conceptual model of our proposed e-book. This model is defined in terms of structure and presentation. It is built to cater for the seven intelligences in line with Gardner's theory.

2.1 Children's E-book Conceptual Model

2.1.1 Structural Components

Before the structure of our children e-book can be explained, a comparison of the printed version of children and adult textbooks has to be performed. This needs to be done since as mentioned earlier detailed e-book models do already exist. However, they are developed and implemented in different environment. The existing models are generalized models more suited to higher-level textbooks and scientific books. Our book on the other hand is designed for young children. Furthermore, designing e-book based on printed book metaphor has proved to be helpful in lessening the cognitive load of end users [10].

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. The following table is comparison based on a sample of 5 children textbooks and 5 adult textbooks with various subjects.

Section	Structure	Most adult printed books	Most children printed books
Front	Title page	Yes	Yes
	Verso page	Yes	Yes
	Abstract	Yes	No
	Foreword	Yes	No
	Preface	Yes	No
	Acknowledgement	Yes	No
	Dedication	Yes	No
	Table of Content	Yes	Yes
	List of tables	Yes	No
	List of figures	Yes	No
Main	Chapters	Yes	Yes
	Pages	Yes	Yes
	Header	Yes	Yes
	Paragraphs	Yes	Yes
	Text	Yes	Yes
	Graphics	Yes	Yes
	Tables	Yes	No
	Figures	Yes	No
	Links	Yes	No
	Footnote	Yes	No
Back	Back Cover	Yes	Yes
	References	Yes	No
	Index	Yes	No
	Glossary	Yes	No
	Related documents	Yes	No
	Biographical	Yes	No
	Appendix	Yes	No

Table 1. Comparison between adult and children printed textbooks

By adopting mathematical sets and with reference to the above table, it can be concluded that the structural components of children multimedia 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
    Page i = {Header, Paragraph j} for j ≤ 5 and ∀ i ∈ N
       Paragraph j = {Text, Graphics} for j ≤ 5
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 is frequently less than five, with an average of three.

2.1.2 Content Presentation Components

Designing e-book for learning needs greater effort in the presentation of the book contents. 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 [11] cater for most users' needs are indeed helpful in promoting better children e-book design.

Content presentation should be viewed in terms of 3 criteria [12] which are the number of separate intelligences it engages, the extent that each is engaged and how well content can be accessed through each intelligence. With regard to these criteria, listed below are the appropriate activities, which should be included in the design of children e-book contents so as to meet the seven intelligences:

1. Activities which should be considered when meeting *verbal/linguistic* intelligence are writing essays, poems, articles, short play with word processors, annotating voice, recording speech, reading, story telling, debating practice programs, interviewing with programs, explaining article and listening.

2. Activities that can be taken into account when meeting *visual/spatial* intelligence are drawing programs, painting programs, using spreadsheet to create charts and diagrams, interacting with interactive maps, manipulating digital images, taking digital photographs, building 2D and 3D models, and interacting with animation or motion pictures.

3. Activities which should be included when catering *musical* intelligence are story telling with songs, chanting, sing along programs, creating songs, making musical instrument, and listening to music, rhythms and rhyme.

4. Activities that should be included when designing for *logical-mathematical* intelligence are playing electronic games, puzzles, strategic games and logic games, calculating and mathematics programs, making estimation, predicting story, working with geometric shapes and patterns, and solving mysteries or problems.

5. Activities that match *bodily-kinesthetic* intelligence are inputting data using alternate input such as joy stick, mouse, and touch screen, allowing users to move objects around the computer screen, making a lot of eyes movement with animation, providing eye-hand coordination games, asking users to dance and act, and providing hands-on construction kits that interface with the computer.

6. Activities which should be considered when meeting *interpersonal* intelligence are using email and chatting programs, allowing games which require two or more players, providing instruction for group activities, desk top conferencing and meeting and listening to other user on-line.

7. Examples of activities that cater for *intrapersonal* intelligence include providing drill and practice programs, playing games which the opponent is the computer, creating notes on daily activities/on-line diary and assessing user own work.

The content presentation components of children e-book should include these activities. We propose four different presentation modes in each page. 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}` in the previous section needs to be changed to:

```
Page i = {Contents, Objects} for ∀ i ∈ N, where N = [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 ∈ N
    Object B = {Talking page, Program T i} for ∀ i ∈ N
    Object C = {Hypermedia page, Program H i}
    for ∀ i ∈ N
    Object D = {Web page, Program W i} for ∀ i ∈ N
```

Remark 1. Program refers to the kind of technology appropriate for an activity, G = graphic, T = talking, H = hypermedia, and 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.

3 Conclusion

In conclusion, we postulate that an additional feature for children e-book would be to present contents by mixing different presentation modes and including various activities which support as many intelligences as possible. This is an on going project, and in order to prove the above assumption, the conceptual model described in this paper will be investigated in the near future. Investigation will be performed to evaluate users' satisfaction on the concept of children e-book that matches activity with intelligence.

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