

The Effect of Text-tracking Design on 4th Graders' Reading of e-Books

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ABSTRACT--- *This study examined the impact of e-book text-tracking design on 4th graders' (ten-year-old children's) learning of six major classes of nutrients. The e-books used in this study were created with Adobe Flash CS 5.5 and Action Script 3.0. This study was guided by two main questions: 1) Is there any difference in learning achievement (recall and transfer) between groups with different e-book text-tracking designs? 2) Is there any difference in learning motivation (attention, confidence and relevance) between groups with different e-book text-tracking designs? This study was an experimental design where the independent variable was text-tracking design for e-books: one was word-based tracking and the other was line-based tracking. A sample of thirty 4th graders participated in the study and participants were randomly assigned into these two groups. They were asked to do a pre-test first, and then they read their assigned e-books for twenty minutes. After they finished reading, they were given a post-test and motivation survey. The results showed that students in the line-based tracking design group performed better in recall scores and confidence. This study hoped to contribute to e-book design principles for young learners and serve as a reference for elementary school teachers and e-book publishers.*

1. INTRODUCTION

The e-book is a new kind of reading resource for young children. The e-book has two main effects on early literacy learning. One is its effect on traditional adult-child storybook reading in the everyday lives of young children [1]. Children are able to read an e-book individually without sitting near or on the lap of mom and dad. The other effect is that it cultivates children's literacy concepts and skills in a digital age. For example, e-book page-turning requires a different set of motor abilities (hold-point-click) than does a real book (grasp-lift-place) [1].

Many e-books for children are programmed to be interactive and include multimedia effects such as written text, oral reading, oral discourse, music and sound effects. E-books provide a new dimension that paper books cannot offer: in addition to reading information, it is also possible to listen to spoken information. E-books enable children to engage in listening to and reading stories independently. However, there is one question emerging for e-book designers: how should they design an interface to better present the textual information and spoken information together for children? Due to limited resources on this issue, this research aims to explore this main question in order to shed light on children's e-book audio-visual design. There are several research questions in this study:

1. Is there any difference in learning achievement between groups with different text-tracking designs (word-based tracking and line-based tracking)?
 - 1) Is there any difference in recall scores between groups with different text-tracking designs?
 - 2) Is there any difference in transfer scores between groups with different text-tracking designs?
2. Is there any difference in learning motivation between groups with different e-book text-tracking designs (word-based tracking and line-based tracking)?
 - 1) Is there any difference in attention between groups with different e-book text-tracking designs?
 - 2) Is there any difference in confidence between groups with different e-book text-tracking designs?

3) Is there any difference in relevance between groups with different e-book text-tracking designs?

This study targeted 4th graders as a sample. It is hoped that the research can contribute to multimedia learning theories, and also help practical educators and instructional designers to create better e- books.

2. AUDIO-VISUAL DESIGN FOR E-BOOKS

An e-book is like a traditional storybook in several ways: it displays print and has book parts (e.g., table of contents, chapters, pages). However, it is also very different from traditional books in its multimedia supports (e.g., visual aids, auditory aids and animation) [1]. In addition to reading information, it is also possible for learners to listen to spoken information. The audio-visual feature is one advantageous trait of e-books over traditional print sources since reading aloud has been found to be one of the most potent forms of teaching children to read. The provision of both audio and textual information is a useful technique in promoting autonomous learning. Though it is often believed that using spoken information simultaneously with the same written text is beneficial for learning, available evidence indicates that learning could be inhibited by the presentation of the same verbal information in both modalities. Researchers argued that verbal redundancy effects may occur when learners are required to integrate sources of audio and textual information [2].

To improve the audio-visual feature, most e-books for children have a text-tracking function to facilitate the integration of the auditory and textual sources. That is, a printed text changes by highlighting and coloring as it is narrated. Some e-books allow the reader to follow the text tracking in each screen as many times as they like and tracking of the text appears in units of sentences, phrases or separate words [3]. Studies show that young children benefit from reading highlighted texts in e-books [4]. Researchers have claimed that the unit of text tracking may influence children's improvement in word reading. Highlighted text at the word level is a better support for word reading than sentences or phrases [3]. However, empirical evidence for this argument is limited. Most studies have targeted adults as participants. Few studies have explored the impact of text-tracking design for young learners. For children who have an underdeveloped phonological loop and attention control working memory, it is necessary to explore how to equip the audio information to the e-book with textual information.

3. METHOD

Participants

The data collection was conducted in the 2014 spring semester. Thirty participants were recruited from one elementary school in southern Taiwan. Students' ages ranged from ten to eleven. Students were randomly put into two treatment groups.

Program design and development

In this study, a fourteen-page e-book program "Rescue Princesses Hulala" was created to facilitate children's learning of the *six major classes of nutrients* (carbohydrates, fats, minerals, protein, vitamins, and water). The original content was from a textbook and this study recomposed this unit as an adventurous story in which the main task was to rescue Princess Hulala, who was kidnapped by a bad guy. To accomplish this task, learners must master the six major classes of nutrients. Adobe Flash CS5.5 Professional and Action Script 3.0 were used to create the e-book. The program was designed with an 841px * 595px window (A4 size). The screen size made it possible for the instructor and students to install the e-book program on any mobile device. In this particular study, tablets were the primary device used.



Figure 1. Photos of children engaged in the reading activity.

Through reading of the e-book, students were expected to 1) remember the names of the six major classes of nutrients and in which foods they are found, and 2) understand how the six nutrients affect the human body and human health. This e-book was designed as a self-learning module that children could read independently. Figure 1 shows children engaged in the reading activity.

Treatment

The e-book was created in two versions with the same audio (narration) and texts, but the text-tracking design was different: one was word-based text-tracking and the other was line-based text-tracking.

- Word-based text-tracking

The word-based version was designed by taking into consideration that word level exposure through highlighting would better support the readability of the book for children: each word in the text was colored stimulatingly with the narrators' reading. Figure 2 is a sample page of the e-book for the word-based tracking e-book.

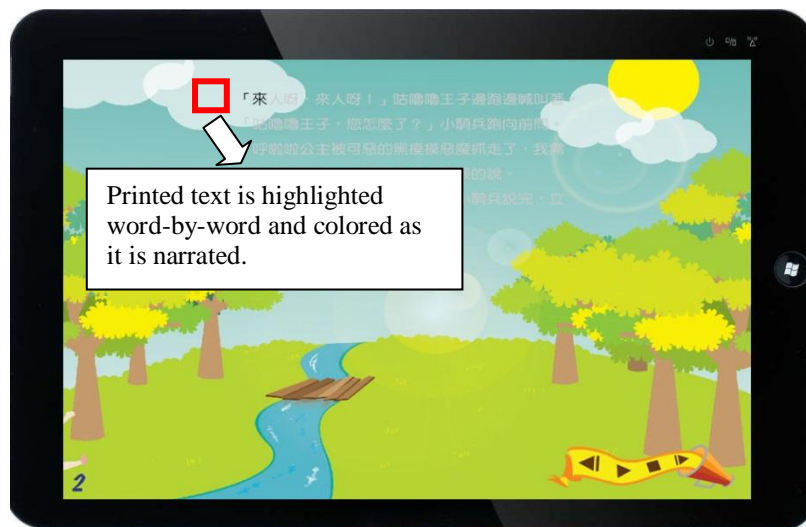


Figure 2. Snapshot for word-based tracking design

- Line-based text-tracking

The line-based version was designed by taking into consideration that line level exposure through highlighting would better support the readability of the book for children: each line in the text was colored stimulatingly with the narrators' reading. Figure 3 is a sample page of the e-book for the line-based tracking e-book.

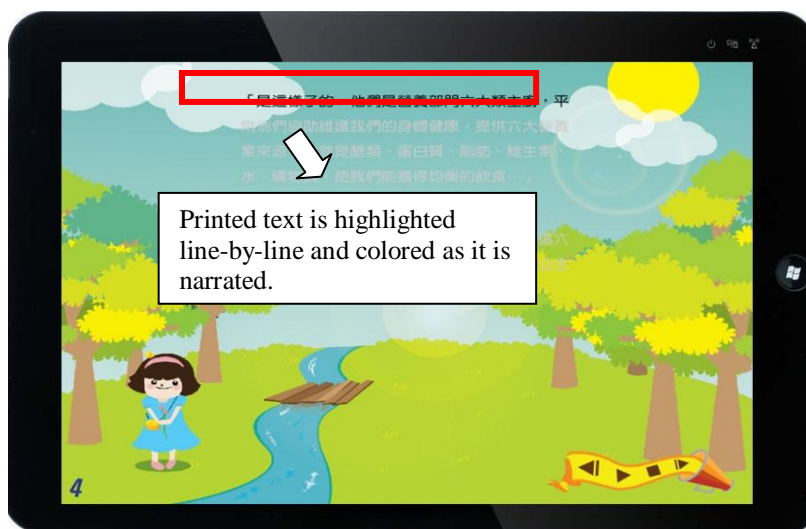


Figure 3. Snapshot for line-based tracking design

Research procedure

The paper-based pre-test was given two weeks before the experiment. During the experiment, students were randomly assigned to one of the two groups of the e-book program and were asked to read it individually. All students performed the experiment in a computer lab. Students were given twenty minutes to finish the reading task. After they finished reading, they were asked to do a paper-based post-test as well as a motivation survey.

4. RESULTS

Learners' pre-test scores were first examined to see if there was any prior-knowledge difference between groups. The results showed that no difference existed between groups. That is, students' prior knowledge of the six major classes of nutrients was equal between the two groups. For the learners' post-test score, some difference existed between the two groups. Table 1 shows the descriptive statistics and test results for learners' scores.

TABLE I: DESCRIPTIVE STATISTICS AND T-TEST RESULTS FOR LEARNERS' SCORES

Dependent variable	Group	N	Mean	S.D.	t	p
Recall	Word-based tracking	16	5.94	1.29	-2.24	.03*
	Line-based tracking	14	7.00	1.30		
Transfer	Word-based tracking	16	3.63	1.20	.43	.70
	Line-based tracking	14	3.43	1.28		
Attention	Word-based tracking	16	3.79	.75	-.05	.96
	Line-based tracking	14	3.80	.63		
Relevance	Word-based tracking	16	4.44	.56	.284	.78
	Line-based tracking	14	4.38	.65		
Confidence	Word-based tracking	16	3.33	.63	-2.06	.05*
	Line-based tracking	14	3.90	.85		

Total score for recall was 10

Total score for transfer was 6

Total score for attention, relevance and confidence respectively was 5

* $p < .05$

As Table 1 shows, there was no difference in learners' motivation about the e-books. However, there were significant differences in students' post-test scores in recall ($t = -2.24, p = .03$) and confidence ($t = -2.06, p = .05$) between groups.

5. DISCUSSION

This study examined the impact of different e-book text-tracking designs on 4th graders' (ten-year-old children's) learning, and the findings show that the line-based text-tracking e-book worked better in learner recall as well as confidence. The superiority of the line-based text-tracking design may be due to several reasons. First, the word-based text-tracking design may have generated more cognitive load for learners than the line-based tracking did. In the word-based text-tracking design, since the audio and the text were presented simultaneously, learners had to listen to each word and watch it at the same time. Students may have spent all their time catching audio and words, and understanding nothing on the delivered content. In the line-based text-tracking design, students did not have to catch texts word-by-word. They could read the words at their own pace, and the line-based tracking became a reminder to tell learners where the narrator was. In addition, in the line-based text-tracking design, it was possible for learners to rely only on visual information (or auditory information) since the narration was played after the line turned colored. Since the text and audio were not shown at the same time, learners may have taken advantage of only one of the channels. For young learners who are cognitively underdeveloped, this may have resulted in insufficient mental articulation during listening and reading. Learning with only one channel may have caused less failure compared with learning with connections between the auditory and visual channel [5]. All the above reasons explain our findings; however, we still need more advanced studies to support the superiority of line-based text-tracking design for e-books.

6. CONCLUSION

This study examined the impact of e-book text-tracking design on 4th graders' (ten-year-old children's) learning of *six major classes of nutrients*. Students were divided into two groups and provided with different books: 1) word-based text-tracking version, and 2) line-based text-tracking version. The results showed that the line-based text-tracking version

e-books worked significantly better in recall scores and confidence for students. We will continue to conduct studies in the following directions: 1) using an eye-tracking system to understand learners' visual attention while listening to audio, 2) understanding the role of narration pace on the modality effect, and 3) confirming the effect on young learners aged from seven to twelve. In addition, we will keep improving our e-book design and explore its effects in the future. The study had limited participants and a short duration; the results might have bias and cannot be generalized broadly. Further study with a larger sample size and diverse treatment groups will be conducted soon in order to provide better evidence.

7. ACKNOWLEDGEMENT

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8. REFERENCES

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