Exploring Approaches to Help Students with Reading Disabilities Enhance Their Reading Comprehension through the Use of the Tablet

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Abstract
Reading is the foundation of learning in formal education. In the mobilized digital century, how the mobile device can facilitate the reading of students with reading disabilities (RD) is of interest. The purpose of this study is to explore text display modes suitable for students with RD, based on a mobile device. The study also investigates the impact of collaborative learning, as opposed to individual learning, on students with RD. The research design consists of five stages, including preparation, development, testing, modification, and implementation. Four types of reading articles, randomly corresponding to four presentation styles have been designed, including plain text, text embedded with key phrase explanations, text highlighted character-by-character, and text with audio. The study subjects are mainly 3rd to 5th grade students. Data collection includes reading test results and related information (e.g., time spent on reading and time spent on replying to questions), a 3-item questionnaire, and observations. Presently, the first three stages have been completed; it is currently in the fourth (modification) stage. Eight RD students participated in the testing task, with two engaged in individual reading and the other six engaged in paired reading. Based on the pilot test findings, several areas in the reading design need to be modified, such as adding phonetics to all Chinese characters displayed, making option buttons more salient, and replacing one of the display modes with a new, more helpful mode. The modification is expected to be completed by the end of May. The final implementation will take place in June.

Keywords: Checkpoint-based design, collaborative learning, mobile reading, reading disabilities

Introduction

As of March 2014, the number of students with special needs in Taiwan, including in elementary, middle, and high schools, was 100,814. Among these students, those with learning disabilities reach 28,557, accounting for 28.3% of the total number (Special Education Transmit Net, Taiwan, 2014). Reading disability is among the various types of learning disability. Reading is the foundation of learning in formal education, and entails absorbance and comprehension of the content read. The reading process involves complex mental abilities, including word recognition, comprehension, fluency, and motivation (Breznitz, 2006). Therefore, when students have a reading problem, they are likely to encounter comprehension difficulties which will subsequently affect their reading fluency and motivation, and may eventually hinder their knowledge acquisition.

Technology has been used as an auxiliary tool to assist learners with disabilities in their learning. In the mobile age, handheld devices such as cell phones and tablets, rather than desk-top or lap-top computers, have increasingly become the most widely-used media for attaining and conveying information. The user interface of the handheld devices is viewed as more humanized as it is based on a multi-touch design, enhanced with multimedia features, such as text, graphics, audio and video. Shah (2011) reported that tablet computers are helpful for students with disabilities, as applications are available for them to substitute for bulky older types of assistive technological tools. The purpose of this study, however, focuses on exploring display modes appropriate for students with reading disabilities (RD) to read when they are using a mobile device to engage in reading tasks. Two purposes are addressed in this study:

1. Examining the impact of different types of text presentation on the reading performance of students with reading disabilities; and
2. Examining the impact of collaborative learning, as opposed to individual learning, on the reading outcomes of students with reading disabilities.

Literature Review

Enhancing Reading with Technology

As the technology has advanced, the presentation of reading materials has changed accordingly, particularly in terms of changing from paper mode to electronic mode. Electronic reading materials such as e-books and interactive books integrate multimedia into reading content, such as pictures, animations, audio and video, to more dynamically present the content and concepts conveyed. This type of dynamic presentation is helpful for increasing reading comprehension as it allows readers to discern the text messages through multiple approaches, rather than reading pure text (Chun & Plass, 1996; Hanley, Herron, & Cole, 1999). Some researchers have claimed that integrating a reading support system to facilitate the engagement of students with learning disabilities in "reading to learn" is a helpful approach (Ko, Chiang, Lin, & Chen, 2011).

Fun-Oriented Learning

Chuang and Chen (2009) compared the impact of computer-assisted instruction and computer-based game teaching on the learning effect of elementary school students, and found that the latter significantly improved the students' learning memory and also reinforced their problem solving skills through helping them understand multiple available solutions. Similarly, the survey results reported by Attewell and Savill-Smith (2004) indicated that the young people highly interested in mobile phone games improved their abilities in the areas of spelling, reading, and math. Chuang, Lee, and Chen (2010) contended that digital console games helped children with learning disabilities to learn, especially those with attention disorders.

Technology-Supported Collaborative Learning

Computer-Supported Collaborative Learning (CSCL) refers to using collaborative learning in computer-assisted learning situations. An experiment conducted by Dillenbourg (1999) indicated that CSCL helped improve children's learning performance more significantly than did individual learning. Wang and Chen (2008) investigated the impact of learning methods on students' learning performance, in a study in which 139 junior high school students conducted an ICT project using peer collaboration. The study results revealed that peer learning could enhance the comprehension ability of the students who had an imaginative learning style, and had a compensatory effect on the expressive style of the students. Huang, Yang, Huang, and Hsiao (2010) reported that collaborative learning positively affected knowledge network construction. Tseng, Hwang and Chan (2005) disclosed that using mobile devices as assisting teaching tools significantly helped student collaboration in the classroom. As mentioned, mobile devices have been reported as being able to help increase student learning interest and also facilitate their learning. However, students with learning disabilities are a highly heterogeneous group; therefore, whether the aforementioned learning methods are suitable for them requires further investigation. In this study, not only text display mode but also a reading approach suitable for students with reading disabilities is examined.

Methodology

Research Stages

To achieve the study aims, five research stages are included:

1. Preparation: prior to developing the reading system, two experts, who are educators, teachers and/or counselors, with experience of teaching students with reading disabilities, were contacted to elicit information regarding the general learning situations of students with reading disabilities, their reading levels, reading styles, interaction styles, and personalities.
2. Development: four components were considered when developing the reading materials, including (1) the display aspect, (2) the checkpoint-based design, (3) the user interface, and (4) the automatic recording feature. These four components are described in the following Research Design section.
3. Pilot test: five to ten students with reading disabilities were to be selected to participate in the testing task. A rubric form was created to track the students'

information, one for each, including their reactions to using the mobile device, the materials designed, and the reading interface developed.

4. Modification: the reading system will be modified based on the feedback collected and observed from the students participating in the pilot test.
5. Implementation: After system modification, 24 students with reading disabilities will be chosen to participate in the reading task. In addition to answering checkpoint questions, the participating students will also answer questions after finishing reading each article.

Research Design

To explore the text presentations suitable for students with reading disabilities (RD), four components were considered when designing the reading materials.

A. The display mode

Four different presentation modes were designed to display the reading content: plain text, text embedded with key phrase explanations, text highlighted character-by-character throughout the article, and text with audio.

B. The checkpoint-based design

To increase the students' reading interest, four checkpoint questions were added to each article, similar to the game-based learning design. At the beginning, the students are instructed that they will play a reading game, in which they will encounter a number of checkpoints (multiple-choice questions), and that they will need to pass the checkpoints (by answering the questions correctly) in order to reach the finish line. After successfully completing the reading, each will be rewarded with a small gift.

C. The user interface

The students can choose the size of the text before and during reading. In addition, when reading the article displayed with the character-by-character highlighting, the students can select the text display speed (0.5 seconds and 1 second).

D. The automatic recording system

The system was developed to automatically keep track of the information associated with each student's responses, such as time spent reading each article and time spent answering each checkpoint question.

Participants

For this study, we selected elementary school students, particularly third to fifth graders, as the study subjects. These study subjects were selected from the Special Education Transmit Net posted by the Ministry of Education, Taiwan. The selection criteria were:

- Students certified as having a reading disability by a special education accreditation institute;
- Students with reading disabilities currently enrolled in an elementary school;
- Excluding those who have physical disabilities, visual or hearing impairment, emotion disorders, or mental retardation;
- Having an IQ of 70 or above.

As stated, five to ten students with reading disabilities were to be selected to participate in the pilot test, and a total of 24 students will be chosen to participate in

the final experiment. For students with reading disabilities, collaborating with one peer may be a rather challenging task. Therefore, in this study, we intend to pair students, as opposed to grouping multiple students, for the collaborative learning experiments. The pairing method will be based on individual students' aptitude, preference, and willingness, rather than mandatory assignment. Those who are engaged in individual reading will read the articles alone, whereas those who are assigned to collaborative reading will read the articles in pairs. Each student/pair will read the four articles where each article is randomly matched with one of the four presentation modes.

The Tool

The 7-inch tablet was selected as the research tool for this study. The Android system was adopted to design the reading materials as it is a free, open-source system.

Data Collection and Data Analysis

Both quantitative and qualitative data are being collected. The quantitative data consist of test results, a 3-item questionnaire and system logs, such as the time each student spends on reading each article and answering each question. The qualitative data are mainly the observation records. A rubric form has been created for recording and tracking the students' information, one for each, including their reactions to using the mobile device, the materials designed, and the system developed.

The following comparisons will be made to reflect the impact of the various design and learning approaches on the students' reading performance:

- Differences in student performance among the four display modes (plain text, text embedded with pictures, text highlighted character-by-character, and text with audio); and
- Differences in student performance between individual reading and collaborative reading.

The qualitative data will be analyzed using content analysis. The data will be coded, classified, and analyzed. Both the quantitative and qualitative data will be triangulated to strengthen the reliability and validity of the study findings.

Current Progress

Presently, the first three stages have been completed. The study is currently in the fourth (modification) stage. Snapshots of the portal page, article types, article text, and a checkpoint question are shown in Figures 1 to 4.

Figure 1. The portal page

Figure 2. Four article types

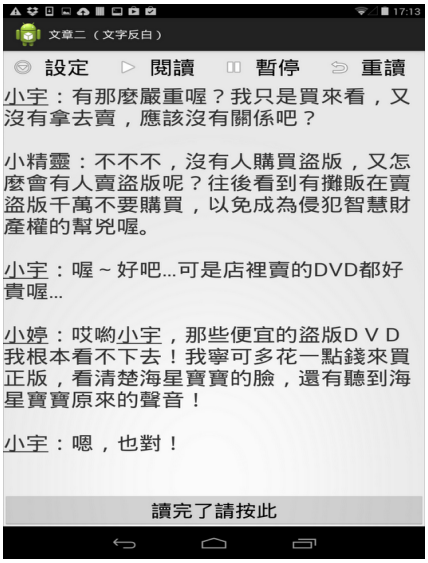

Figure 3. An article text

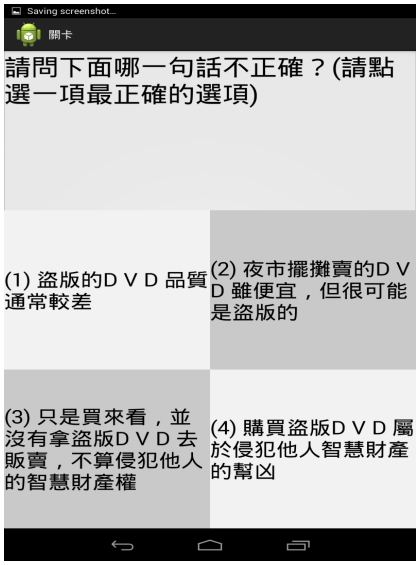

Figure 4. A checkpoint question

Eight RD students participated in the pilot test, with two engaging in individual reading and the other six conducting paired reading. Based on the students' test results and observation data, there are several areas in the reading interfaces needed to be enhanced. Some major revisions include adding phonetics to all Chinese characters displayed, making option buttons more salient, shortening the article length from 500 plus words to below 350 words, showing the article character by character only when highlighted, rather than displaying the entire content first and then highlighting the character one by one, and replacing one of the display modes with a new, more helpful mode. More specifically, the mode with text embedded with key phrase explanations is deleted, and a new mode with plain audio without text will be added. The modification is expected to be completed by the end of May. The final implementation will take place in June.

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