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Preliminary Research on the Utilization of Electronic Textbooks

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Abstract: This report focuses on electronic textbooks which have been researched and developed in connection with full implementation of new guidelines for teaching. It discusses findings from an analysis of the features offered by such textbooks and the potential learning activities to which they might contribute. In addition to the features and utilization methods of electronic textbooks already being sold, the report also examines electronic textbooks published by several companies, which have been distributed as samples, to identify new features that have been added in response to anticipated uses. A test study was conducted to analyze "motivational features" and "methods of addressing setbacks in learning". In addition to the existing features of previous electronic textbooks, the following areas were identified as having the potential to address the broad needs of teachers and expand teaching effectiveness: 1) attention to universal design; 2) attention to spiral leaning, prospects for learning, and heightened awareness of related topics; and 3) enhancing features that aid instructors with class preparation and effective classroom use of materials.

Keywords: Electronic Textbooks, ICT , Learning Environment, Instructional Method

Introduction

Digital content had been developed for electronic textbooks by the Information-Technology Promotion Agency of Japan, an independent administrative institution, between 1999 and 2003 as a part of the millennium project policy called "Informatization of Education". Around the same time, Dainippon Tosho Co., Ltd. was already engaged in the development of electronic textbooks, with the same layout as conventional textbooks, for educational content under development by the Ministry of Education, Culture, Sports, Science and Technology. The publisher was involved in a research group to investigate how to use the electronic textbooks as a tool to lead students toward understanding (visualization of thought process) by actually using the electronic textbooks in the class on a spot basis.
Since then, in addition to being sold and distributed in CD form, digital content has also become available for purchase and use by downloading necessary content over a network. Between 2004 and 2006, a network content distribution service was introduced and the systematic examination of its potential for use was conducted along with research on trial applications.

In recent years, there have not only been various experiments and observational studies, but also research trials on use scenarios for the "Science Network" and the verification of improved learner ability. These have looked, for instance, at 1) frontrunner initiatives using Japanese electronic textbooks; 2) initiatives focusing on the effective use of presentational content (e.g. electronic textbooks developed from arithmetic textbooks and evaluated for

their method of utilization); and 3) examples showing how digital content can be effectively utilized in course design and in initiatives to improve learner ability.

However, the utilization of ICT and digital contents was hindered by difficulties in the educational setting. Moreover, schools often did not have enough funding to purchase educational digital content. As a result, developers also found it difficult to regularly update contents to fully reflect schools' educational intentions.

1. 1. Purpose and Objectives

Under these circumstances, in 2009 a high definition display and an electronic black board were introduced to classrooms as a part of the support effort by the state to create a learning environment. In connection with teaching guidelines (Course of Study) to be fully implemented in elementary schools in fiscal year 2011 and in middle schools in fiscal year 2012, electronic textbooks were created by various companies in conjunction with revisions made to regular textbooks. As a result, the situation involving electronic textbooks has gradually changed and they are now being used more actively [10].

This report focuses on electronic textbooks for elementary schools created by various companies in conjunction with ongoing textbook reforms. In addition to the features and utilization methods of previously sold electronic textbooks (for Japanese, English, etc), it also examines the recently developed electronic textbooks to see what uses are expected and what new functions have been added. The study seeks to consider the prospective uses (i.e. features which, if available, would made certain uses possible) that would result once the guidelines were fully implemented in practice.

2. Summary of the Latest Preceding Research

While much preceding research has been conducted on digital contents, research on electronic textbooks (including digital textbooks) first started appearing in 2005. By 2010, numerous studies were being published.

Research has been discussed from various perspectives. Some discuss the potential of electronic textbooks[7], while others highlight the problems involved in electronic textbooks[14]. Others still try to examine the issue of copyright [6].
The Japan Society of Educational Information includes many reports on electronic textbooks in their annual conference proceedings for 2010 (volume 26: 394-437), while volume 12.1 of Gifu Women's University Culture Information Research is a special issue devoted to research on electronic textbooks.

In terms of teaching, electronic textbooks are often used for Japanese, special education, arithmetic/mathematics, and foreign languages [4] [8] [11] [13].
Meanwhile, South Korea is often introduced in Japan as an example of a country with ongoing research on electronic textbooks [1] [3] [5].

This report builds on trends in the research described above. It begins with an analysis of currently available electronic textbooks and then examines electronic textbooks released in sample form by the various companies. The goal is to establish an initial frame of reference for analyzing the characteristics of electronic textbooks.

3. Research method

The report will focus on electronic textbooks for elementary schools created by the companies in conjunction with textbook reforms. As mentioned above, the textbooks used in this research are the ones distributed as samples by four companies (for Japanese, arithmetic, social studies and science, as of October, 2010).

In addition to examining the features and utilization methods of previously sold electronic textbooks (for Japanese, English, etc.), a test study will examine (1) what uses are expected and (2) whether new features have actually been added.

For this purpose, the researcher analyzed the sample electronic textbooks from two perspectives, i.e. "motivational features" and "methods of addressing setbacks in learning", with the help of two elementary school teachers and two graduate school students who plan to become teachers. Motivational features are examined because electronic textbooks offer the advantage of handling information in multiple modes relative to conventional paper textbooks. The features of electronic textbooks are expected to invite learners to engage in learning activities and encourage them in a multi-sensory way. Methods of addressing setbacks in learning are examined because electronic textbooks have interactive features by which teachers can predict areas in which a child may stumble and can fill in blanks with links to supplementary explanations, practice questions, demonstrations of how to think, and so on. It is difficult for conventional textbooks to provide this functionality; trying to do so with conventional textbooks will inevitably lead to very thick textbooks with many charts. In short, electronic textbooks are expected to address the various needs and circumstances of learners more effectively.

Analysis was carried out on each of these two dimensions, with the ARCS model suggested by Keller used to analyze motivational features, and the setbacks model proposed by Hubbard used for features that address setbacks [2] [12]. Items for which over 70% agreement was reached (i.e. items identified by four people, or those identified by three people and agreed to by one of the remaining two people) were discussed by all members of the study to brainstorm the intended motivational features and methods to address setbacks. Similar items were then organized in a table by type.

Through this approach, we have tried to identify as concretely as possible the characteristics of electronic textbooks (how they differ from conventional paper textbooks, what new features are awaited).

4. Results

The study revealed the following.

The sample electronic textbooks from the four companies all shared the following four features in common which retain the original features of previously sold textbooks:

・Features to supplement direct experience (motivational feature, addresses learning setbacks)

・Features that cause learners to think based on images, visualization features (motivational feature)

・Scaling features (motivational feature)

・Scrolling features (motivational feature)

・Read-out-loud features (motivational feature, addresses learning setbacks)

・Annotation features (when used with digital blackboard)

The following are new improvements observable in all four companies.
・Embedded support features (repetition, spiral, presentation of related matters) (some usability support features as well) (addresses learning setbacks)
・Enhanced interactive features (motivational feature, addresses learning setbacks)
・Improvement in display (addresses learning setbacks)
・Lesson preparation support (motivational feature, addresses learning setbacks)
・Lesson process support (motivational feature, addresses learning setbacks)

In other words, these newly added functions, which are seen as having the potential to address the broad needs of teachers and expand teaching effectiveness, include 1) attention to universal design; 2) attention to spiral leaning, prospects for learning, and heightened awareness of related topics; and 3) enhanced features that aid instructors with class preparation and effective classroom use of materials.
Moreover, individual companies had their own special ideas for improved features, as follows:
・Unique teaching material support features (Modify and edit textbook materials, as well insert external materials) (motivational feature, addresses learning setbacks)
・Post-it and curtain features (motivational feature)
・Features to provide prospects for learning (for specific grade, previous and next grades, overall elementary education, toward middle school) (motivational feature, addresses learning setbacks)

5. Findings

Analysis of the identified characteristics of electronic textbooks revealed that they are designed to cover a wider range of children with different levels of learning ability, from those who face difficulty in learning (including children who do not show any interest in learning) to those who learn beyond what is covered in the textbooks. In this respect they differ from conventional paper textbooks which are designed to target children with average leaning ability. They also, to a large degree, factor in universal design as pointed out by Shibasaki et. al [9].

The results so far make it possible to conclude that the two analytical viewpoints adopted initially as a frame of reference for examining characteristics of electronic textbooks have some validity for the purposes of analyzing their features. Some features, however, were identified both as motivational features and as features that address learning setbacks. Thus, we crossed 1) the perspective of

Universal Design	Attention paid to font size and colors (considering impaired color vision) as well usability of the menus, furigana (Japanese phonetics) added

	Cannot have any concrete image because of a lack of experience	**Cannot tell how much learners comprehend (cannot determine what he/she does not understand)**	**Cannot understand the meaning of words. Cannot use the words.**
Seems interesting (Attention)	Uses interesting images, audio or video of things that learners cannot directly experience or which supplement their lack of experience.	Uses techniques to guide learners toward things they vaguely know or understand somewhat to give them an "aha" moment	Uses techniques to make learners interested in terminology and the meaning of words.
Seems worthwhile (Relevance)	Uses techniques that make learners feel something is useful or related to their own experiences or other study topics	Uses techniques that make learners aware of what they do not understand (makes them feel it is worthwhile to work harder).	Lists topics and terminology that learners have already learned or will learn.
Seems achievable (Confidence)	Uses content and clues to give learners without experience a sense that they can understand if they work a little harder	Uses techniques that encourage learners to challenge themselves with what they do not understand.	Uses words to give significance to study methods and methods for going deeply into a topic.
Glad to have done it (Satisfaction)	Provides detailed instructions for learners to understand and accomplish something that they have never experienced before.	Enables small steps; when learners do not understand something, they can step back to what they do know.	Uses techniques to confirm the meanings of acquired words, and to check comprehension and achievement.

Fixed support	Has drills, etc.	**Support for self-study**	Data and investigation.	**Usability support**	Has supplemental teaching materials

Figure 1 Frame of reference for feature analysis of electronic textbooks

motivational features suggested by Keller, with 2) the perspective of typical setbacks faced by children with learning challenges as suggested by Hubbard, and also combined 3) home study support and ways to address advanced students and 4) attention to universal design, both of which were found to be common factors, in order to produce the frame of reference for initial analysis shown in Figure 1.

6. Future Issues

In the future, we intend to use these analytical frameworks in analysis to identify, as is the goal of this report as well, the methods of effective use of each electronic textbook's features and to further refine our analytical frameworks.
For instance, in the case of Japanese electronic textbooks (considering the several companies which make Japanese electronic textbooks), each of the features described in the cells in Figure 1 will be further analyzed and compared among various textbooks to identify which textbook has most enhanced a particular feature. It is our hope that these findings will then be used to identify the underlining principles of electronic textbooks that best utilize instructional content and curricular features.

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