ISBN: 978-981-14-2064-1

A Highly Efficient E-book based on the Repertory Grids: Example by the Cherry Blossom of Taiwan

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Abstract

A highly efficient e-book based on the repertory grids is developed in this study. The primary design principle is: helping the learners to construct their personal knowledge during the learning activity by using the Repertory Grids; enhancing the interaction between the proposed system and learners by combining image, audio-visual and multimedia elements into the learning materials. The cherry blossom of Taiwan is used as the learning objective of this study, and 70 students from 2 classes of college freshman in Tainan City are recruited as the study participant. In the experiment, the students are divided into a control group receiving related websites learning and an experimental group that employs the system developed in this study. To assess the proposed system, the learning achievement is assessed by using the t-test for pre-test and post-test. The experiment shows that the system can indeed enhance the learning outcome for the learners.

Key words: e-book、repertory grid、e-learning

Introduction

Unlike conventional books and other traditional sources of information, e-books are presented in multimedia format, the layouts are animated and interesting, and the contents are richer. Although the e-book is not a mainstream textbook format, some researchers have used its advantages to tackle inadequate learning among students, using it as a tool to assist in learning. Most studies have been positive about e-book penetration, but Stoeckle [1] showed that although e-books can enhance the reading skills and motivation of students, special attention must be paid to students using e-books during class, as the students may be easily distracted, thereby leading to poor learning. Wang and Yang [2] discussed the effect of the interactive design of e-books on the outcomes of Chinese lessons for grade 4 students. The results showed that in character writing, the focus and satisfaction of students who used low-interaction e-books were significantly higher than those of students who used high-interaction e-books. This may have been because the students were only 10 years old, and their cognitive and processing abilities for multimedia learning were limited.

The current content design of e-books was examined in the present study. The human–machine interface design did not have any interactive features, containing only simple event buttons. There was only one way to turn the pages, and the configuration of the buttons was not uniform but scattered over the pages; the only means of determining their function was to click on them. In other words, the e-books lacked high interactivity and lesson contents that attracted students, leading to poor learning motivation and lack of concentration, and thus could not enhance learning outcomes.

The theoretical basis of the RGT was derived from the personal construct theory (PCT) proposed by Kelly [3][4]. Kelly held that everyone is a scientist; people develop unique explanations based on their fields of experience, and these explanations generate knowledge concepts that form the basis for how they judge events. Kelly considered the process of PCT to be a course of projection, where the unique construct in each entity is reflected in the construction of the grid. In other words, the contents and results of the grid construction represented the cognitive system in the entity, and researchers analyzed the process and results of these constructions [5][6].

Therefore, this study hoped to use the RGT assisted learning strategy to help students to effectively build personalized knowledge through learning. A high-efficiency Taiwan Cherry Blossom e-book was designed to let students read and learn through the e-book method and enable the students to improve their understanding of cherry blossoms and identify the different varieties. Hence, this study investigated the following questions:

Can the proposed Taiwan Cherry Blossom e-book enhance students' learning outcomes?

Literature Review

A. Interactive e-books

In recent years, many scholars have reported the positive results of using e-books in fields such as nature and life science technology, language, and mathematics. Korat and Segal-Drori [7] held that multimedia e-books, such as those with animation, music, sound effects, and audio narration, can be of great help to children with language disabilities. Chang and Hsu [8] held that applying ARCS model in teaching methods was effective and advantageous in an e-learning environment; it is a feasible innovative teaching method that can generate positive learning outcomes.

B. RGT and its application

Numerous scholars have studied the application of RGT. Lin, Hung, and Hung [9] used RGT to study two science teachers' argumentation instruction of meta-strategy knowledge; one teacher was experienced in teaching this participant and the other had little relevant experience. The experienced teacher noticed that most of the students were capable of generating an argument, but very few knew how to carry out an argument

based on evidence. Therefore, the researchers helped the students gather data from various sources, and recommended that they build their own knowledge frame, to enhance the students' ability to integrate their scientific knowledge and understanding into their argumentation. García-Mieres, et al. [10] studied the possibility of using RGT to understand paranoid psychosis and determine the possible symptoms of patients with schizophrenia; through RGT, these messages were primarily used to construct key clinical hypotheses, with critical fields such as self-concept and family relationships as possible treatment objectives.

RGT is divided into four steps as follows. Element elicitation can include a person's name or an event, concept, or idea [11][12]. For construct elicitation, the traditional Kelly's repertory grid has a group of three elements; these elements were compared, and which two elements were similar and how the third element was different were identified to obtain the matching attribute group. Rating involves filling the grade for the form (element, attributes); the grade reflects the rating and represents its difference from other elements. Analysis and discussion involves explaining the results of the grid. The study followed these steps to construct a cherry-blossom-related RGT for students' learning.

The best results will be obtained if your computer word-processor has several font sizes. Table I recommends all the font sizes for your reference. As an aid to gauging font size, 1 point is about 0.35 mm. Use a proportional, serif font such as Times or Dutch Roman.

E-book Feature Design

The contents of the Cherry Blossoms e-book were divided into six sections: home, user instructions, contents, cherry blossom learning material, cherry blossom distribution map, and a quiz, as shown in Fig. 1 and described as follows.

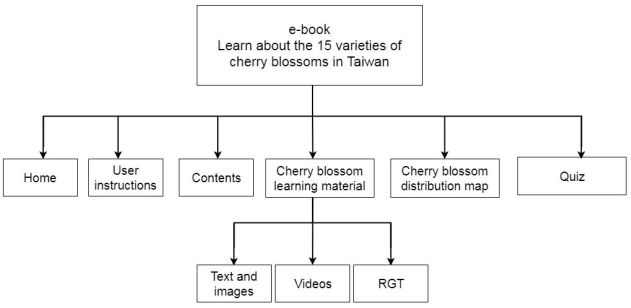

Fig. 1 Cherry Blossoms e-book feature map

(1) Home

The cover, demonstrating the contents of the e-book: "What cherry blossom is this? Learn the 15 varieties of cherry blossoms of Taiwan."

(2) User instructions

Explains the operation of the e-book, including text and illustrations.

(3) Contents

Chapter 1 introduced the cherry blossoms of Taiwan. Chapter 2 discussed commonly seen cherry blossoms in Taiwan (Taiwanese native species, nonnative species, and rare species). Chapter 3 described the various Taiwanese cherry blossoms in detail. Chapter 4 contained RGT learning. Chapter 5 provided a distribution map of Taiwanese cherry blossoms. Chapter 6 contained games.

(4) Cherry blossom learning material

The participant was the 15 varieties of cherry blossoms in Taiwan. The varieties of cherry blossoms seen in Taiwan were categorized into three types: native, nonnative, and rare species. The learning material was presented in three sections: text and images, videos, and RGT learning material.

(5) Cherry blossom distribution map (knowledge map)

This map used different colored markers for cherry blossom varieties to enable students to easily learn their distribution. Students could click on the markers to view images of the cherry blossoms.

(6) Quiz

This was the posttest used to determine students' learning outcomes.

A. Production of audio teaching material

For the audiovisual learning materials in the e-book, the ITRI TTS Web Service [13] was used to generate the audio files, which were then placed in the video. The ITRI TTS Web Service used a robust prosody synthesis system with Chinese word segmenting fault tolerance capability to generate synthetic speech with clear, unattenuated, and cadenced intonation, as well as to provide pronunciations that are close to those produced by a human voice. The audio options included combinations of Chinese and English, switching between Chinese and English, male voice, female voice, volume control, read-aloud speed, and pitch.

B. RGT design

The four steps were generated according to RGT as follows:

Step 1: Element elicitation: The elements were primarily based on the 15 varieties of cherry blossoms commonly seen in Taiwan.

Step 2: Construct elicitation: After referencing online data and comparing and collating the data, we set the five traits for identifying cherry blossoms, namely color, type, stalk, number of petals, and fragrance, as the learning constructs.

Step 3: Rating: Between 1 and 5.

Step 4: Conclusions: Finally, we designed the various corresponding RGTs according to the learning objects for the three main types of cherry blossoms; Fig. 2 depicts the post-design RGT of native cherry blossom species.

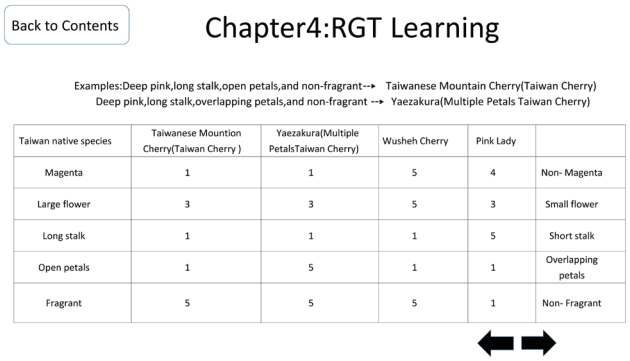

Fig. 2 RGT of native cherry blossom species

C. Tests design

Flash was used to create 30 multiple-choice questions. Each question had four options, including textual question-and-answer and imagery question-and-answer. When users took the test, the system randomly selected 10 questions for them to answer. After the users completed the test, they could immediately find out how many of their answers were correct. If users wanted to take the test again, they could click on the retest button.

Experimental Results

The research objective of this study was to verify whether the Taiwan Cherry Blossom e-book helped the students learn about the topic at hand. The t-test findings for the pre- and posttest results of the experimental and control groups are explained as follows.

A. Research participants

This study recruited 70 freshmen students from the department of information management at a university in Tainan as research participants. The 35 students in the experimental group used the proposed e-book and the 35 students in the control group used web-based learning.

Before the start of the experiment, the prerequisite knowledge of the students in both groups was determined with regard to the learning material. An independent samples t test was used to analyze the pretest results of the two groups; the results are as shown in TABLE 1. The mean pretest score of the experimental group was 42.571, with a standard deviation (SD) of 16.687; the mean pretest score of the control group was 38.000, with an SD of 14.307. The p-value of .223 did not achieve the .05 significance level, indicating that the pretest scores of the experimental and control groups did not differ significantly; hence, the groups' basic capability was the same.

TABLE 1
Pretest analysis (Independent sample t-test analysis)

	NO.	Mean	SD	T
Experimental	35	42.571	16.687	1.180
Control	35	38.000	14.307	

P > 0.05

B. Analysis of learning outcomes

(1) Analysis of the pre- and posttest results of the experimental group

These results were analyzed using a paired samples t test; the experimental results are provided in TABLE 2. The mean score of the pretest results was 42.571 and the SD was 16.687; the mean score of the posttest results was 65.714 and the SD was 21.731. The p-value of .000 achieved the .001 level of significance, indicating that the pre- and posttest scores differed significantly in the experimental group.

TABLE 2
Analysis of the paired samples t test of the experimental group

Experimental	NO.	Mean	SD	T
pretest	35	42.571	16.687	-5.116
posttest	35	65.714	21.731	

***p<0.001

(2) Analysis of the pre- and posttest results of the control group

The pre- and posttests for the control group analyzed using a paired samples t test; the experimental results are as shown in TABLE 3. The mean score of the pretest results was 38.000 and the SD was 14.307; the mean score of the posttest results was 47.428 and the SD was 17.547. The p-value of .012 achieved the .05 significance level, indicating improvement in the control group between the pre- and posttest scores.

TABLE 3
Analysis of the paired samples t test of the control group

Control	NO.	Mean	SD	T
pretest	35	38.000	14.307	-2.657
posttest	35	47.428	17.547	

*p<0.05

(3) Posttest analysis:

Posttest analysis of the experimental and control groups was performed using an independent samples t test, and the experimental results are shown in TABLE 4. The analysis demonstrated that the posttest scores of the experimental group were higher than those of the control group, with the mean scores of the two groups differing by 18 points. The p-value of .000 achieved the .001 significance level, indicating that the posttest scores of the experimental and control groups differed significantly. Therefore, a comparison of the pre- and posttest scores among the two groups indicated that the Taiwan Cherry Blossom e-book could more effectively improve the learning outcomes of students.

TABLE4
Analysis of the independent samples t tests of the experimental and control groups

	NO.	Mean	SD	T
Experimental	35	65.714	21.731	3.873
Control	35	47.428	17.547	

***p<0.001

Conclusions and Future Research

The study using RGT to develop the Taiwan Cherry

Blossoms e-book. The students learned through the audiovisual contents, clear human–machine interface design, RGT, and cherry blossom knowledge map, gaining a novel learning experience. The analyses of the independent sampled t tests on the posttest scores indicated that in comparison to the test results for conventional web-based learning, the Taiwan Cherry Blossoms e-book more effectively enhanced the students' learning outcomes. Furthermore, the analysis results of the questions on the ARCS questionnaire showed that the ARCS model enhanced students' learning motivation, achieving the research objective. Since our research participants were 18-year-old freshmen, the conclusion that the low-interaction control group outperformed the high-interaction experimental group, which Wang and Yang [2] arrived at, was not supported by our experimental results.

The test content is provided a question-and-answer test, whereas the students may expect a test that included interesting and relevant games, meaning that the test fell short of the students' expectations. Therefore, creating situational games or including level designs that could enable students to integrate themselves into the scenario and learn more cherry blossom knowledge would further enhance students' learning motivations and outcomes. Additionally, the qualitative analysis showed that the learning strategy of using RGT to supplement teaching content had relatively low scores, because the students were unfamiliar with RGT and therefore needed more time to learn how to use it to build relevant knowledge. Therefore, if the concept of RGT and instructions on how to apply the technique could be taught to the students before they began learning, and a few examples provided so that the students could practice, then a more favorable learning result can be achieved. Finally, we hoped to add an audio search feature; if students could use audio features to search for their desired content, it would enhance their willingness to use the e-book as well as their learning motivation, and additionally promote interactivity.

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