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The effectiveness of an Intelligent Annotation Sharing System on e-learning

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ABSTRACT

Reading is a very important part in learning process. When reading the teaching materials of textbooks in a traditional way, students usually underline the main points and take notes to help memorizing, thinking and understanding the contents of the teaching materials. With the progress of network technology, e-learning has gradually become a new learning trend. However, the digital e-teaching materials of e-learning are always the texts that cannot be changed by students as an easier reading format.

In this paper, we propose an algorithm named Expert Keywords Annotation Alignment Algorithm (EKAAA) and based on which we have developed an Intelligent Annotation Sharing System (IASS) as an auxiliary tool for students to read the e-teaching materials. Based on the cluster to which a student belongs, the annotation sharing system adaptively provides the student a suitable sharing model. The models serve as a "scaffolding" to guide the students' learning, intending to achieve the purposes of auxiliary learning and knowledge sharing. Finally, we use statistics to analyze the effectiveness of the Intelligent Annotation Sharing System on e-learning.

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1. Introduction

Traditionally, when we are reading the teaching materials of textbooks, we usually have the habit of underlining and notetaking to help ourselves with memorizing, thinking and understanding the contents of the teaching materials. However, with the progress of network technology, e-learning has gradually become a new learning trend. Although the acquisition, transmission and storage of electronic documents enjoy obvious advantages when compared with the traditional paper documents, students find it unavailable to conduct any annotation act on the electronic documents while reading them. However, annotation is a traditional learning strategy commonly used by general students. Therefore, the reading pattern with annotation unavailability is the greatest obstacle to e-learning.

Although some websites provide students with single-sided annotation act, such an interactive pattern is of limited help to students. This is because the students of low-score cluster with poorer learning ability are always incapable to rearrange the main points, the contents they have learned and the notes, and the students of high-score cluster are unable to share with other students the annotation process of their reading. Therefore, the students of low-score cluster cannot acquire the knowledge of the students of high-score cluster through the knowledge sharing mechanism.

In view of this, the study attempts to develop an Intelligent Annotation Sharing System (IASS) as an auxiliary tool for students to read the e-teaching materials. According to different clusters of students, adaptive annotation sharing patterns are provided to them for learning and sharing knowledge by themselves, hoping to achieve the purpose of adaptive learning.

Based on the above phenomena, the study is undertaken with the following aims:

(1) Scaffolding theory is employed as the foundation to construct an Intelligent Annotation Sharing System (IASS) as an auxiliary tool and adaptive sharing platform for students to read the teaching materials.
(2) Expert Keywords Annotation Alignment Algorithm (EKAAA) is proposed to examine whether the annotation contents of students contain the keywords selected by experts, and evaluate the annotation act of students in a more objective and reasonable way.
(3) Taking EKAAA as the foundation and by means of Data Mining, the study establishes adaptive Annotation Patterns, and recommends intelligent annotation sharing model (IASM) to different clusters of students for reference.
(4) Statistical methods are employed to analyze different clusters of students. After the students have been guided by IASM, the paper studies whether it is helpful to enhance the learning effects of students.

2. Literature review

The study develops the IASS of digital learning platform and employs constructivism as the theoretical foundation, intending

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to let students use the annotation tool to attach personal reading process to systematic rearrangement, turn the teaching materials to be useful knowledge, and share the knowledge among different clusters of students to achieve the purpose of knowledge sharing.

Constructivism is a theory of knowledge, as well as a theory of cognitive learning. The implication it suggests is to transfer knowledge from the instructor to the student. It emphasizes that knowledge is an active construction of students, instead of the passive acceptance or absorption of information by students (Chang, xxxx).

The so-called "annotation" refers to the special signs made on the contents of teaching materials. When a reader is undertaking a reading activity, if he/she puts some meaningful annotated signs on the book, it will be helpful to the subsequent readers (Marshall, 1997). Thus, it is very important to find out main points and retrieve useful information from a large amount of reading materials to help reading (MacLellan, 1997).

Why do students have such "annotation" act in the learning process? Slotte et al. (2003) think that there are two main reasons: one is that students think that the process of notetaking can help them learn, and the other is that students think that the "notes" produced from annotation act will be very useful to their reviews in the later days. Hidi and Anderson (1996) indicate that putting summarized signs on the representative information and contents of an essay is of great help to the comprehension of the essay.Focusing on annotation act, Nokelainen, Kurhila, Miettinen, Floreen, and Tirri (2003) make a preliminary study of learning by adopting the methods of pre-test, log analysis, questionnaire, and term-end test, and study the influence of annotation system on learning. The study also finds that the testees generally think that the annotation system provided by the study is helpful to learning, and the self-made annotations are more helpful to students themselves than those made by their classmates (Nokelainen et al., 2003). A study of Quade (1996) also reveals that in the computerized instruction environment, notetaking in computer has better learning effect than notetaking by pencil and paper to Quade (1996).

Marshall (1997) argues that according to the appearance, form and position of annotated signs, annotated signs can be divided into two kinds: telegraphic signs and explicit signs. Telegraphic signs refer to the underlined and colored annotations added to the contents of teaching materials, whereas explicit signs refer to the personal notes added to the teaching material.

In the study of website annotation system made by Hwang and Wang (2005), they use the sharing function to stimulate the learning motive of students. The research results show that the learning way of annotation sharing can better improve the learning effect of students than the annotations of individuals (Hwang & Wang, 2005).

Although many scholars use annotation system to do researches, they hardly mention how to share the valuable annotation process of a student with other students who need sharing. Hence, the study attempts to employ scaffolding theory proposed by the psychologist, Vygotsky. According to Vygotsky, the development of "cognition" is divided into two levels: one is the real level of development, and the other is the potential level of development. The former refers to the level that students can independently solve problems, whereas the latter refers to the level that students need the guidance of or cooperation with other people (teachers, the more outstanding classmates) to solve the problems encountered in the active knowledge construction process (Vygotsky, 1978). The distance between these two levels is called by Vygotsky as the zone of proximal development (ZPD) (Vygotsky, 1978). Therefore, if instruction can be close to the ZPD of students, it can effectively help students to be promoted from the original development level to a higher development level. It also refers that the teacher has adopted a temporary support structure to assist students in developing their abilities. This kind of guidance is called "scaffolding" (Vygotsky, 1978). A scaffolding chart is shown in Fig. 1.

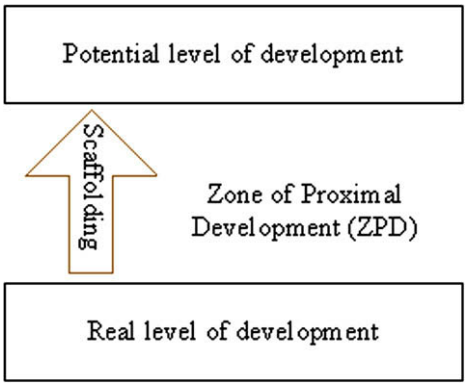

Fig. 1. Scaffolding chart.

3. Research approach

The study mainly proposes using Expert Keywords Annotation Alignment Algorithm (EKAAA) to inspect whether the annotation contents of students contain the keywords selected by experts, find out through the annotation association rules of Data Mining the Annotation Pattern of the students of high-score cluster to serve as the learning scaffolding for the students of different clusters, and further achieve the purposes of knowledge sharing and learning. The complete flow chart is shown in Fig. 2.

3.1. Pre-test

In order to understand the difference in annotation act of the students of different levels while reading the teaching materials, the study took 110 students of a high school as the research targets to carry out the research. In the beginning of a school term, LMS was used to carry out a pre-test of "VB program language" curricula. The pre-test result was used as the reference of clustering. In order to enhance the prediction functions of the test, the paper stresses the cross polarization discrimination (XPD) analysis of questions, as shown in Table 1.

From the CPD index shown in Table 1, the CPD of Q9 is lower than 0.2, implying that it is not a good question and has to be eliminated. Therefore, the study has nine valid questions.

3.2. Cluster

According to the arguments of Kelley (1939), under normal distribution the most suitable rate is 27% for high-score and low-score clusters respectively. Hence, the pre-test results of students achieved in the study are divided into 3 clusters, as shown in Fig. 3.

3.3. Import of annotation process

After the students have made annotation, the system automatically imports the annotation process to the database to serve as the source of information for "Expert Keywords Annotation Alignment" in future.

3.4. Expert Keywords Annotation Alignment Algorithm (EKAAA)

Since the study provides very complete contents of teaching materials, most of the students add such "telegraphic" annotations

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