Some Development in Interactive Calculus On-Line Learning System for Industrial Vocational High School

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Abstract

The main purpose of this study is to develop an interactive on-line learning system, which is to create the information technology instruction environment to help industrial vocational students to learn math. We hope to assist students to learn math by the convenience of the Internet.

According to an unofficial investigation in Taiwan, students hope teachers can provide the solving process and hints when they study math. Therefore, this study has combined the features of Internet, the scaffolding theory of L. S. Vygotsky and the elaboration feedback theory . We organize the main ideas of the Limitation in Calculus and develop an interactive on-line learning system. The features of this system are:

1. to organize the question styles, to provide students hints to solve the questions and to help students to learn the concept of the course.
2. to take the elaboration feedback and to help students solve the questions immediately.
3. to connect with the information bank, to record students' learning time and to analyze students' myth for solving questions.
4. to provide the on-line test for encouraging students to do the active learning.
5. to provide the interaction function for students and teachers to share mutual experience.

The following research is to analyze the entire question bank by item response theory (IRT) in order to make the well-structure test. To develop a humanized interactive learning system is our goal. We hope the concrete affection of this system can be evaluated.

Background

Under the pressure of the entrance exam, most vocational school students have low learning motivation and achievement. Mathematic is a basic subject for their learning in the future. If an on-line learning system, which can help students to learn mathematic without the limitation of time and space can be provided, students can learn in their own way. It will improve students' learning achievement on mathematic.

This study about using technology to assist teaching has popped up recently such as CAI (computer assisted instruction), VOD (video on demand) and DI (distance instruction). According to those investigators, we have two conclusions. One is that the Internet technology is hard to substitute the traditional lecture class. The other shows that students can learn better with the help of the Internet technology without the limitation of time, spaces and the class size.

According to a survey from the website, among 897 voters, there are 239 voters (26.64%) who hope mathematic teachers to inspire learners by using questions. Also, there are 393 voters (43.8%) who like teachers to provide solving skills and lead them to solve the questions. It shows that students not only want to know the content of the textbook but need the assistance for solving mathematic questions.

Based on the illustration above, I would like to use the features of Internet and develop an on-line system to help students learn mathematic. This study adopts the concept of Vygosky's scaffolding and the elaboration feedback in the feedback theory to design an on-line interactive learning system in order to help vocational students learn mathematic effectively.

Purpose

The main purpose of this study is to develop an on-line learning system, which is based on the education theory and meets students' need. This may help those low learning achievement vocational students to learn mathematic happily and more effectively. The concrete purposes are:

1. To build up an on-line learning system model combined the opinions of experts, teachers and learners in order to design and revise the system structure.
2. To make useful questions by teachers and investigators.
3. To understand students' learning situation and analyze their problems through the system.
4. To apply the conclusion of this study to teachers who set the asynchronous distance instruction system.

Study Step

1. To collect the related information and learning theories and to explore the features of on-line learning system. By using the result to build up the on-line interactive learning system.
2. Based on the system development theory, the system needs to be analyzed, structured, tested and revised.
3. After the evaluations of the experts, scholars and learners, we can understand the application and essentiality of the system.

The concept of the interactive on-line learning system

According to the investigators' discussion, observation and teaching experience, we decide to build this system on the WWW (Word Wide Web) to help students learn mathematic. Throughout the features of Internet, the course content will be organized and the hint will be given. We hoper students can learn mathematic actively so that they can build up their own mathematic knowledge. Learners will have the mathematic cognition by the process of questions-response-feedback.

There are three main ideas in this system: Scaffolding theory, feedback theory and Internet database.

1. Scaffolding theory

Structural teaching method is to encourage students to participate actively and to learn mathematic by their own experience and to build up their own mathematic knowledge (Susan & Thomas,1992). The structuralism scholar, Von Glasersfild, believes there are two basic hypotheses in structuralism (Von Glasersfeld, 1991):

(1) The subject can gain and build up the knowledge by old cognitions.

(2) The function of cognition is to experience the real world and to adjust the knowledge.

Von Glasersfeld also explains the difference between structuralism takes teaching method:

Structuralism and traditional teaching and training as two parts. Students need to understand rather than memorize the knowledge. Like calculus, students need to know the limitation, differentiation and integration rather than the solving speed and correct answers.

Scaffolding means to provide suitable supports, lead, assistance to learners in order to help them solve the problem independently. Also, students' abilities can move to a higher level. Scaffolding theory is provided by the Russian psychologist- Vygotsky who emphasizes the importance of the learning environment. In this theory, the social interactive context and learners co-participation are the most important elements. Vygosky think learning is a kind of internalization process. Learners, peers and instructors are combined as a society. Therefore, learning is a socialized activity: the process is an interaction of personal spontaneous concept and learning scientific concept. It consists association, collection, chain, diffuse and pseudo-concept. With the gaining of the activity experience, learners will reduce their dependence and build up their own cognition. Finally, they can complete the activity independently. This developing process is called internalization (Vygotsky, 1978).

When learners learn many new courses, they need the assistance from the people whose knowledge level is higher than learners. For example, the assistants give the hint, tell the solution or simplify the question. Under these assistances, learners' learning activities will be moved to the potential level. These are a zone of proximal development between the reality level and the potential level. ZPD (zone of proximal development) means the largest range that learners can achieve in a learning process. Simply speaking, learning is an abstract concept. That means learners put their original concept as a base, in a learning environment, to cite higher levels cognition through social interaction. Meaning while, social interaction turns this concept into intellect. When learners turn this outer interactive process into inner independent thought the concept has developed to a higher level. Therefore, learning is called as a process of social internalization in an ordinary class.

Regarding to the guided participation concept, Rogoff explained the relationship between individual thought and culture and the functions of guidance, support, challenges, instruction and stimulation in human interaction. According to Rogoff's saying, the guided participation process can help learners to build a bridge between known and unknown knowledge and to develop the activities and skills, which are recognized by the culture. Furthermore, learners can take the responsibility to solve the question on their own (Rogoff, 1990).

According to the above theories, this system will organize the question styles into different chapters and will give the proper explanation and hint. After answering the question, students will get the feedback.

See figure 1, the system provides the hint of questions helping students to practice the questions. The students could choose to appear the window of hints by themselves.

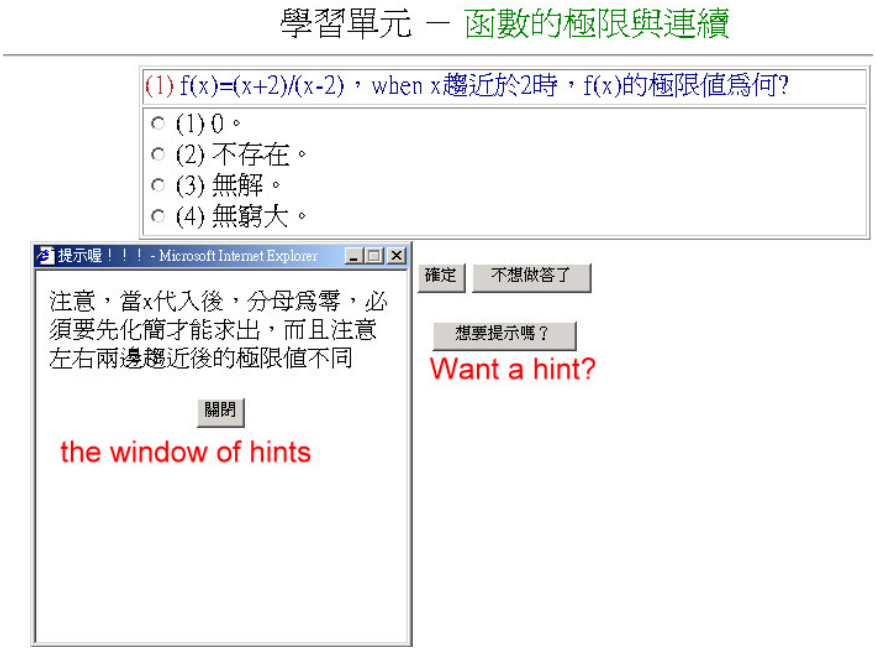

Figure 1. the hint of windows

2. Feedback theory

The main point of Interactive on-line learning system is to give students feedback in a proper time and style. Sales(1988) divided feedback into five types: no feedback, knowledge of response, knowledge of correct response, answer until correct and elaboration feedback. This study adopts the elaboration feedback that is the most effective.

After answering the question, students are able to know why they are right or wrong. If they have the wrong answer, they will get the proper feedback that helps students to think and answer again. Throughout these effectives and real feedback, students have a chance to think and practice.

See figure 2, the system provides the feedback of questions helping students to correct their direction of thinking. The students could choose to answer again or give up the practice of this question by themselves.

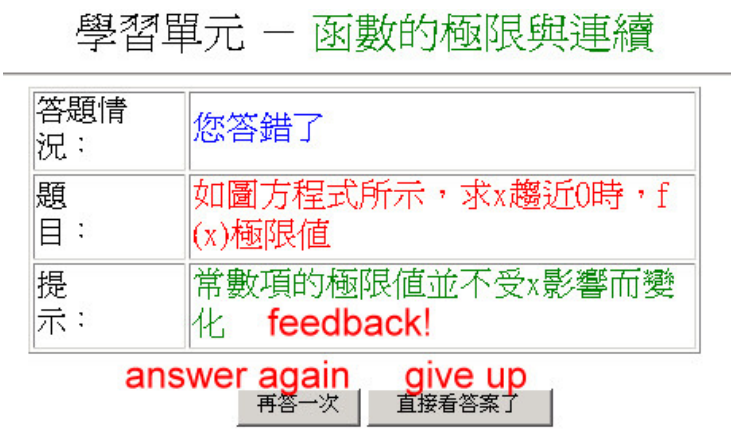

Figure 2. the window of feedback

3. Internet database

Besides beyond the time and space limitation, on-line system can connect the homepage with the database, which provides learning material, exercises and learning records of students. This system not only helps students learn mathematic but records their learning process, such as time, times, units, questions. The system manager can analyze learners' learning situation and answers' accuracy. Also, the information can be used analyze students' myth for solving questions, to find the make-up point and to apply IRT (item response theory) on building up the question bank. As a result, we can practice information technology on learning mathematic and improve mathematic education.

System structure

The investigators have set up the main structure and functions of this system by analyzing, structuring, testing and revising the whole system structure. The system structure is shown as Diagram 1. The main parts are client and sever in Internet. Layer one, browser, assists students to learn mathematic. Layer two, www sever, managers and controls the client, which provides the course content, exercises and tests. Layer three, SQL seer, receives and manages the information from www sever which records and provides the proper feedback to www sever.

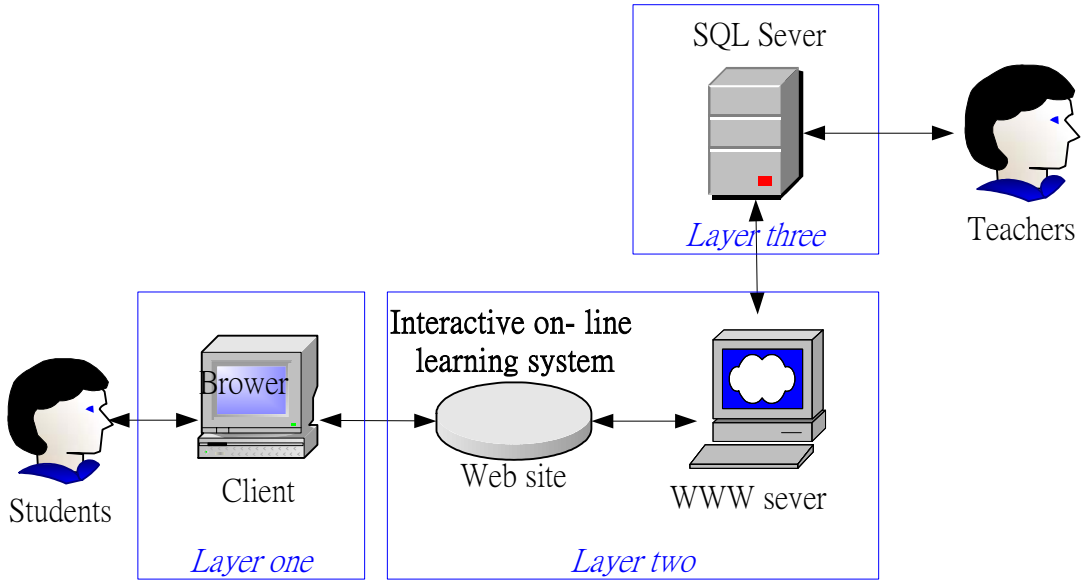

Diagram1 System structure

System frame

The main frame of Interactive On-Line Learning System includes bulletins area, learning area, discussion area, evaluation area.

Bulletins area:

Teachers can announce the assignments or notice. Students can receive the recent information about the course.

Learning area:

The area help students learning the course and practicing the questions. The system will provide the hints to help students structuring their concepts. When students answer the question, the system will give a feedback immediately to correct students' concept.

Discussion area:

Students can discuss their problems in this area. The function will help students having more interests in mathematic.

Evaluation area:

Teachers can design some questions in the database. Teachers can analyse students' concept through their answers path. Teachers could analyze the entire question bank by IRT in order to make the well-structure test. The function will help teachers to know their students' problems. Teachers can instruct some course again in the classroom.

See figure 3, to show the main page of system.

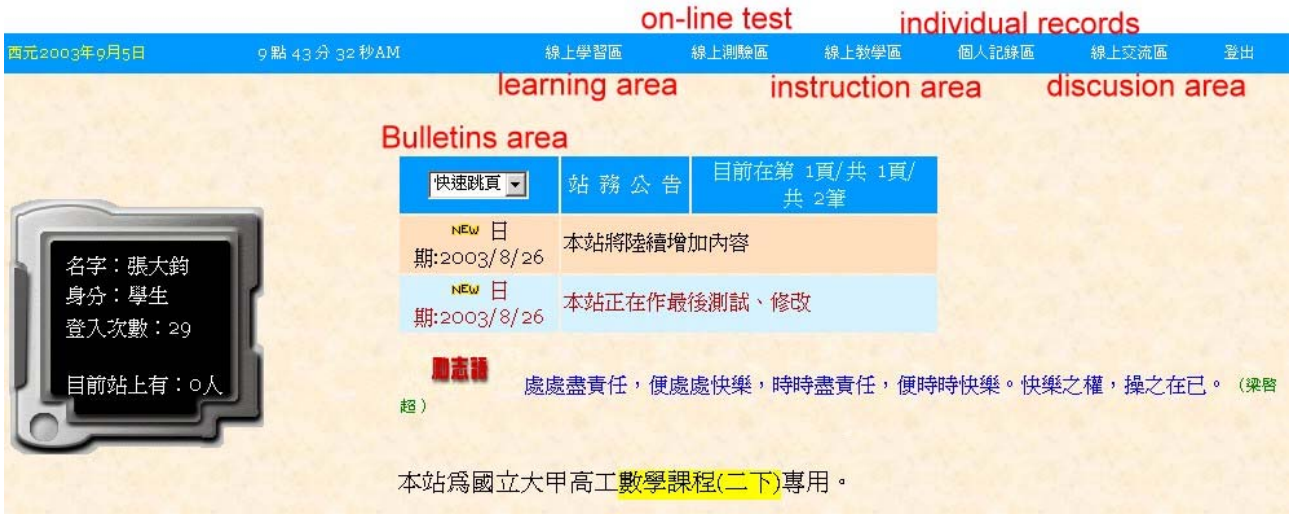

Figure 3. the main page

System evaluation

After finish this system, we have invited five experts and three mathematic teachers to have a discussion seminar. In the seminar, they provided some suggestions and we arranged the discussions:

1. Those experts take positive attitude to the interactive on-line learning system. Especially, the homepage can connect the database to record students' learning process and to apply the learning theories on Internet learning and to offer a chance for students to learn independently. Students can have support and feedback in time.
2. This system can assist students to learn mathematic effectively. The formal experiment study should be done to support the effect of this system.
3. The important thing to design the questions in the induction ability of the question and thought of the students. In this way, we can analyze students' myth.
4. In order to have real effects of this system, investigators should expand the range of users.

Also, we pick five students in our school to use the system. Five students who have used this system have given some suggestions:

1. Students feel happy to have extra learning assistance outside classrooms.
2. The best thing for students to use this system is that it shows the class points on the homepage again. Students can review the class easily. Moreover, the exercises will provide hint and feedback, which lead students to think and understand the content.

In conclusion, this system structure has matched the expectative goal, which plays a role of a tool for helping learn mathematic. This system cannot substitute the inside classroom teaching. On

the other hand, this system should have a complete mathematic course and teaching experiments in order to prove its theory and function.

Conclusions and suggestions

The interactive on-line learning system can work on WWW. It is an assistant tool to help students learn mathematic. It combines scaffolding, elaboration feedback and database connected with homepage. The features are:

1. To organize the question styles, to provide students hints to solve the questions and to help students to learn the concept of the course.
2. To take the elaboration feedback and to help students solve the questions immediately.
3. To connect with the database, to record students' learning time and to analyze students' myth for solving questions.
4. To provide the on-line test for encouraging students to do the active learning.
5. To provide the interaction function for students and teachers to share mutual experience.

Found in this study:

1. After building this interactive on-line learning system, the investigators should pay more attention on organizing student data and revising the content and question function in order to attract more teachers to join this system structure.
2. Interactive on-line system makes teachers understand students' learning situation, practice situation and learning effects outside classroom.
3. On-line interaction unction helps students to have co-learning and attracts students to learn.
4. Interactive system can improve the learning effectiveness.

The following study is to analyze the entire question bank by IRT in order to make the well-structure test. To develop a humanized interactive learning system is our goal. We hope the concrete affection of this system can be evaluated.

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