

CAI System and Authoring of Problems for Exercise

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Abstract

Recent advance of information technology and the spread of the computers into the schools have opened new possibilities in the field of education. It will improve the educational technique both in teaching methods and tools.

We introduce our CAI system and the authoring of the problems for the exercise.

1. Introduction

In Japan we are facing a serious problem in that the educational level of students both in high school and undergraduate is gradually declining. It has become very difficult to maintain the educational level of high school students due to the high entrance rate from junior high school. At present the entrance rate from junior high school to senior high school has reached 97%. And to enter university is becoming much easier than before due to the decrease in the number of 18-year-olds in Japan. This produces many students of less willing to study hard and to pursue their own academic interests at university.

To improve this situation, the Japanese Ministry of Education and Science has begun to take action to maintain a definite standard level of education in high school. A reduction in the amount of the subjects and an allowance of more freedom in the curriculum at high school are being put into practice. As a consequence, we have faced new problems in university. They are decline in the educational level and diverse students of various educational course at high school.

Under the current situation, the Ministry has also recognized that information technology, that is IT, is one of the major issues in education. The Ministry has distributed computers to elementary schools and high schools in order for students to become familiar with the information technology. The subject concerning information skills is going to be taught at senior high school from 2003 in

Japan.

Much concern has been focused on employing technologies such as networking and multi-media to make class more exciting and attractive at university [1]. The computer will be a very useful tool in education [2]. The simulations of physical phenomenon will make it possible for the student to understand physics visually and intuitively [3]. On the background of the utilization of the information technology, various educational attempts have been tried to make the class more attractive and students more eager to study with the aid of information technology [4].

We have also been developing the CAI system for the education of the introductory physics at our university [5,6].

2. CAI system

Our CAI system is composed of three independent parts. They are (1) an electronic text, I call this Hyper text hereafter, (2) Problem exercise and (3) Authoring of the problems. The Hyper text is written with MS_Word at first and converted into the Html file. The Hyper text contains the simulation programs written in Java and video clips of experiments also. They can be seen with an Internet browser such as Netscape or Internet Explore and so on. This means that our Hyper text are independent to the platform under the Internet.

Another merit of the Hyper text, as an electronic text, is that it is far easier to revise compared with the printed one. The contents and the expressions will be modified frequently to be suitable to the level of the students.

In the development of the Hyper text, the following distinctive features are intended.

- (1) Make it clear what students must study in the subject.
- (2) Make it easier to understand with the help of the simulations and video clips of the demonstration experiments.
- (3) Attract academic interests of the students by

allowing for the students to operate the simulation programs of physical phenomenon by themselves.

In the problem exercise there are two exercise modes. One is an “a la carte” in which students can repeatedly solve the problem that they have chosen. Another is a “course ware” in which students must solve the problems sequentially which are registered in the course ware file. In the course ware mode the learning history of the student is recorded in the History file.

And we have also developed the authoring system with which a teacher can make a course ware of the exercise with ease. We believe that problem exercise will help students to understand the subject completely.

2.1. Hyper text

Figure 1 shows a sample page of the Hyper text. The important sentences are stressed in red, which shows the students what they “must remember”. Two buttons in the text “Demo” and “Video” are the start buttons of a simulation and a video clip, respectively. If a student clicks the button the simulation program or the video clip will start.

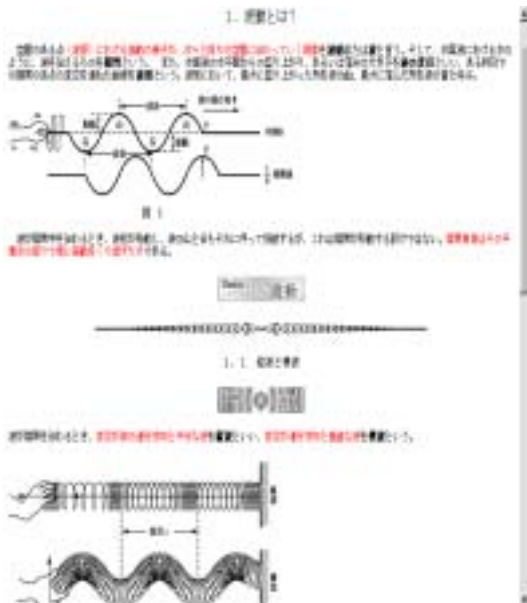


Fig. 1 Sample page of the Hyper text

Figure 2 also shows the demonstration of a sinusoidal wave. An amplitude A , a wavelength and a period T of the wave can be changed with the slide bars. And with the changing of the sign in wave formula the wave travels to the opposite direction. Students will understand the correspondence of the wave parameters to the graphical sinusoidal wave.

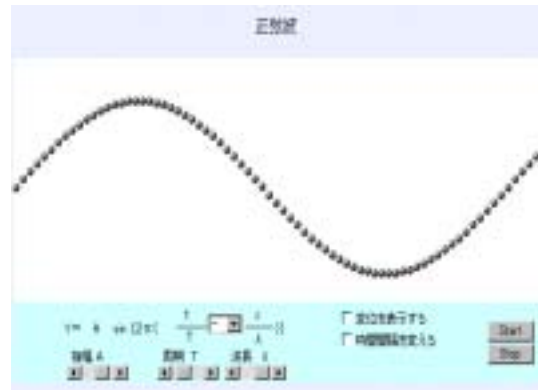


Fig.2 Simulation of the sinusoidal wave

2.2. Problem exercise

Figure 3 shows the flow chart of the exercise program. Initially, the course ware file and the record of the learning history of the student are fed into the computer. Then, the computer displays the problem in the Problem_File.cai according to the latest record of the History.cai file of the student. In the file, the titles of the problems finished are recorded along with the date and time.

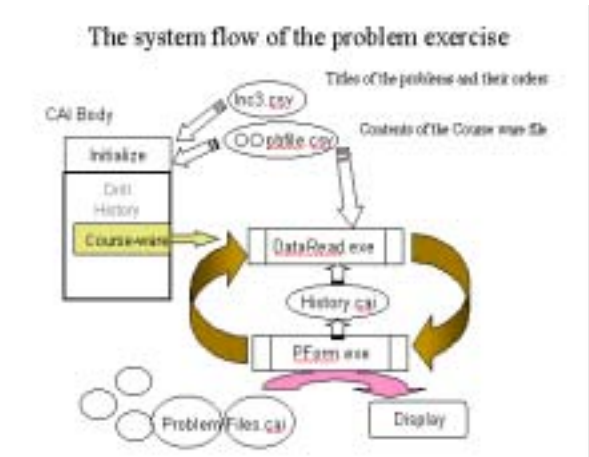


Fig. 3 Problem exercise

When the student has finished the problem his learning record is registered in the History.cai file. This routine is repeated each time the student proceeds with the exercise.

Figure 4(a) shows a sample problem of the exercise. The problem is a circular motion with a constant speed. The values of the variables such as speed, radius and mass are settled randomly by the computer. So if two students seated next to each other are solving the same problem the values in the problem will be different. This keeps the students from cheating in the exercise. After the answers are completed students click the

second row is the number of question in the problem. Middle of the blue section contains the range of each variable and the last three rows show the title of the problem, the presence of figures and its file name, respectively. The middle section of the sheet which is colored purple is the section where the problem and its equations are written. The last section contains the block of the cells of the question, answer, unit and the number of the significant figures of the answer.

The procedures of the authoring of the problems are very simple.

(1) First the range of variables of the problem are determined.

The computer will settle the values of the variables randomly within the range.

(2) Next the problem is written on the sheet.

A variable x in the problem is denoted as x .

(3) And last the questions and the answers are written.

The answer written in the authoring sheet can be expressed in the algebraic formula using the variables. The input value is compared with the correct answer numerically within the range of the significant figures of the answer.

You can determine the number of significant figures of the answer.

Other patterns of answering are also available such as a selection of the correct one among the answers, filling the blank and so on. You can also use the character string as the answer.

The authoring form is modeled after the template of the problem display form, which is shown in figure 7.

Fig. 7 The problem display form

The problem sentence including equations and questions are displayed on this template. We can display the figure relating to the problem in the figure section of the template. The figure can be

drawn using mathematical functions as well as the bit map files.

3. Concluding remarks

Some of the students were very interested in the computer simulations in the Hyper text and computer based exercise but some students were not. They wanted to hear the solutions of the problems even though they had solved the problems correctly. It seems that those students have no confidence solving the problems. It is necessary to encourage them by other means.

The merits of the utilization of a computer and its networking in education seems to be that

- (1) Students can proceed with their studies steadily at their own pace because they can study repeatedly until they understand.
- (2) Students can study the educational materials whenever and wherever they want.
- (3) We can deal with students of various levels of understanding at one time.

4. References

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