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# The Modern Education Mode for Engineering Drawing

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**Abstract.** After having carried out the Engineering Graphics education reform for more than six years, we established a total modern teaching mode. It includes the reform of course contents, teaching methods and other relative aspects. A series of textbooks on Descriptive Geometry, Mechanical Drawing and Architecture Drawing have been published. Every book has a multimedia CD attached, and an Internet multimedia teaching system has been developed. The reform helps students and teachers greatly. The teaching qualities have continously been supervised and controlled, the student's imagination and ability of design and drawing were greatly improved.

*Key words:* graphics education, modern education mode, teaching technology, multimedia CAI software, VRML teaching system

*MSC 2000:* 51N05

## 1. Introduction

As computer hardware and software, multimedia technology, and CAD and CAM have been developed and perfected, the education of Engineering Drawing (ED) faces a great challenge. For a long time the education of Engineering Drawing kept the old style in China; the teaching thought, teaching contents and teaching methods did not change. Now with the modern information technology we reform the whole education system of Engineering Drawing. We have achieved great progress in many aspects and we created a set of modern education mode.

## 2. The contents of the modern education mode

### 2.1. The course system reform

#### 2.1.1. Begin from 3D modeling

Descriptive Geometry and Engineering Drawing is mixed into one course at most universities in our country. In general it assigns 40–80 class teaching hours and 20–40 exercise hours.

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Many textbooks have the similar arrangement: beginning from drawing standards, drawing with instruments, fundamentals of projection theory and finally Engineering Drawing. To suit the new situation of the development of mechanical design, we adventurously changed the arrangement of the course, beginning from 3D modeling. In the very beginning of the first semester for the freshmen, we teach 3D modeling with the help of computer 3D software. And then we teach the basic principles of projection. By this way, students obtained a powerful tool to imagine space objects and afterwards they learn Engineering Drawing easier.

### 2.1.2. Three combinations

We reform the course system totally and carry out the three combining methods, that is:

- drawing combined with design,
- manual drawing combined with computer drawing, and
- class teaching combined with interactive studying in network.

For the manual drawing we emphasize freehand sketching, for computer graphics we emphasize 3D modeling. Students must complete 3–4 pieces of manual drawings and 2 pieces of computer drawing in one semester. We assign 20 computer hours for students to draw on the computer with AutoCAD and other 3D software. Besides we assign a free 3D design period to allow students to create imaginary solids in a group. In this section, students use the projection theory, shape design method and exert their imagination to create a 3D model and to draft its 3 views; students usually use the computer to display these design. Fig. 1 shows such a drawing designed by students.

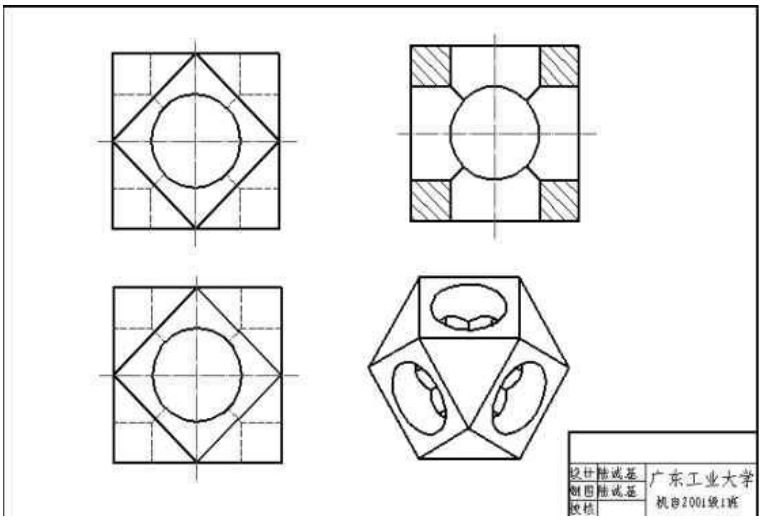


Figure 1: Design solid created by students

### 2.2. Teaching material construction

The development of textbooks is a very important work in our teaching reform. We published a series of textbooks and exercise books. For every textbook, a CD-R is attached. This CD-R is not an electronic book but a multimedia courseware with graphics, 2D and 3D animations, voices, and text to imitate the teacher's teaching. Fig. 2 is one of the content of the CD. We have already completed a series of multimedia CAI software on Descriptive Geometry and Engineering Drawing and used them in all classes and after classes. Students can review with

the Engineering Graphics CD or on the Internet. So the computers take over a lot of work for teachers so that teachers will pay more effort in innovative research.

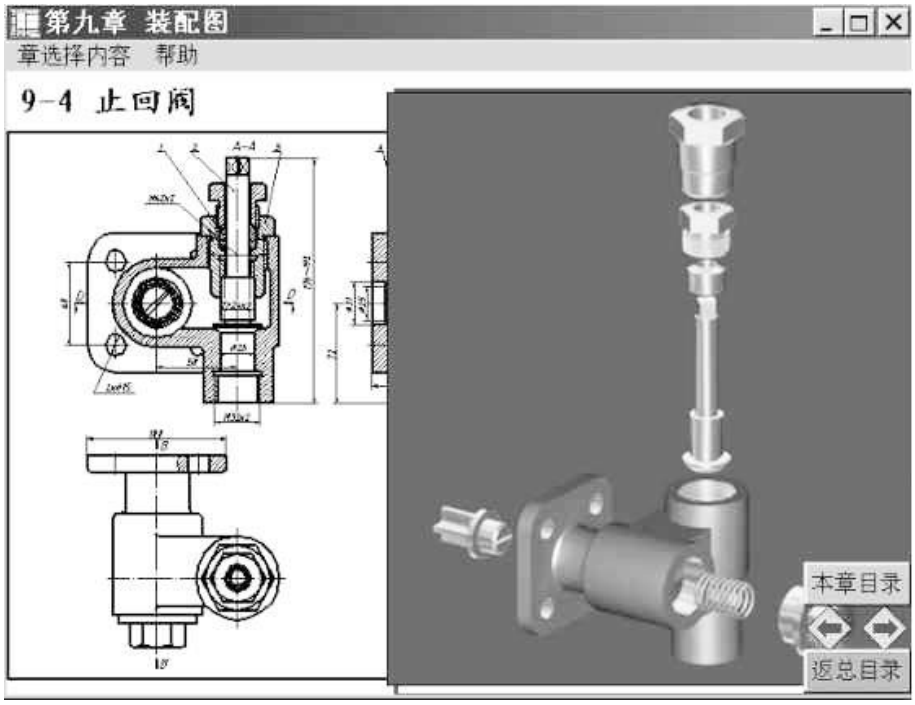


Figure 2: One of the content of the CD

### 2.3. Total adoption of modern teaching techniques

In our class teaching, we have abolished the old teaching methods at all, including blackboard and chalk, wall-picture, optics projector and epidiascope etc. All our Engineering Drawing classrooms are equipped with multimedia computers, large screens and video projectors. And our department possesses a big computer graphics laboratory. The computer multimedia CAI software and Internet CAI are the main teaching techniques in our school. It optimizes the class teaching, represents vividly and accelerates the studying process. The use of appropriate teaching software reduces the time to write and draw on the blackboard, gives the time to teachers to add new information and initiatively teaching.

### 2.4. Reforming the exercise and exam method

We are developing an exercise system and a test system on the network to judge the students' progress more exactly and scientifically. We have already finished a set of question-answer-system to help student comprehend. It includes the analysis of all exercise problems, 3D models and some solution steps. These systems are available on a CD or on the net. Figs. 3 and 4 are samples of this exercise system.

### 2.5. VRML education system and graphics web site

We established an Engineering Drawing web site (web.gdut.edu.cn/∼draw/). It includes the introduction to teaching and research work in our department, the tutorials and a VRML system to help students understand. Fig. 5 shows a virtual assembly process on the web with VRML. Fig. 6 is a page out of the web teaching system.

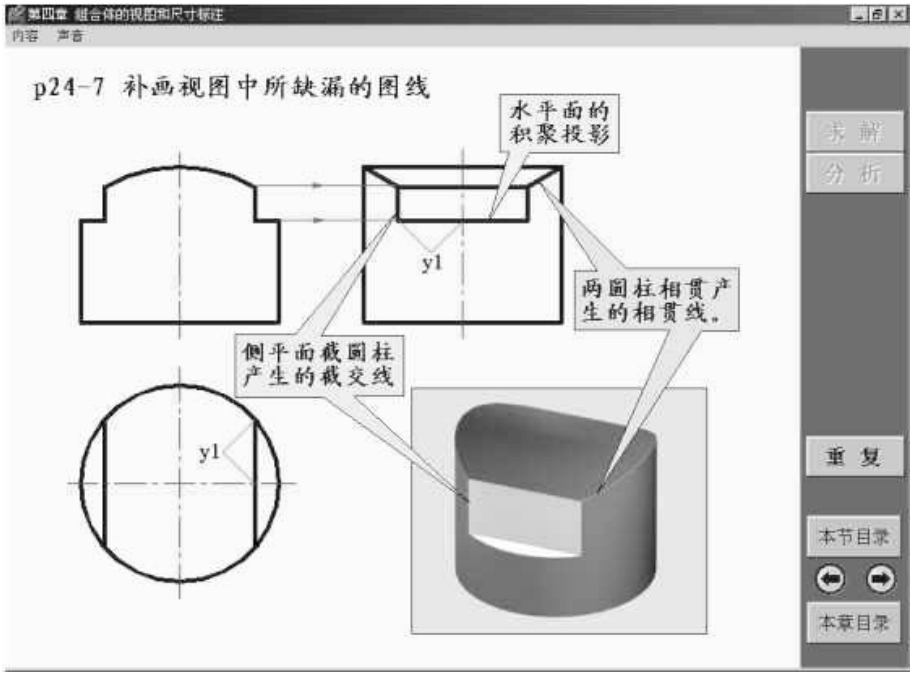


Figure 3: A model of exercise system

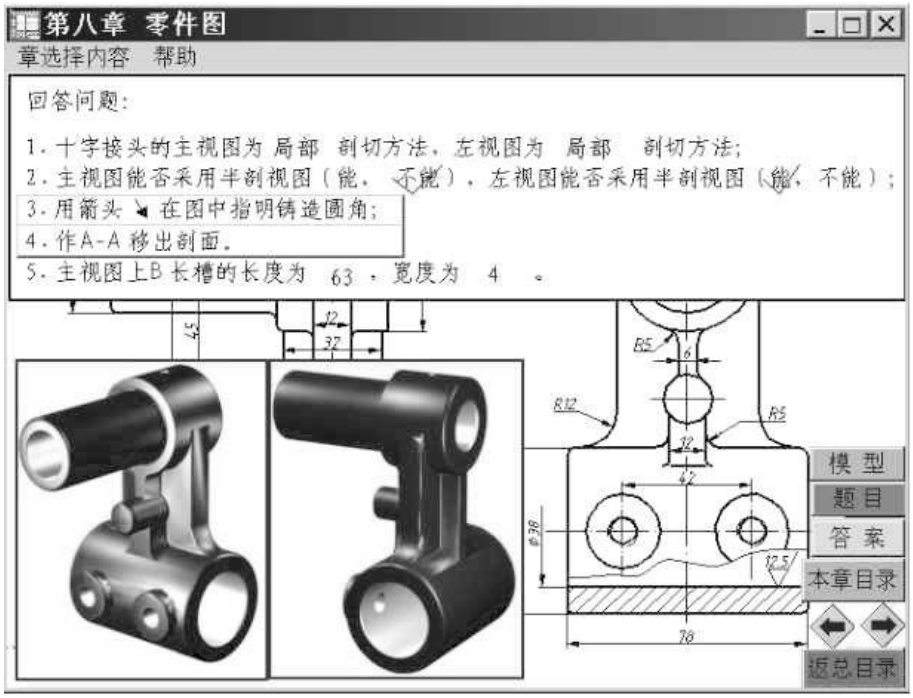


Figure 4: Reading the detail drawing

### 2.6. Implementing innovative education

Due to the reform explained above, the schedule of study can be controlled by students themselves. Those students, who understand well, can complete the fundamental requirements early. Thus the teacher will assign them to a higher mission, for example, 3D modeling, small design or joining the teacher's scientific research work etc. Now many students join the

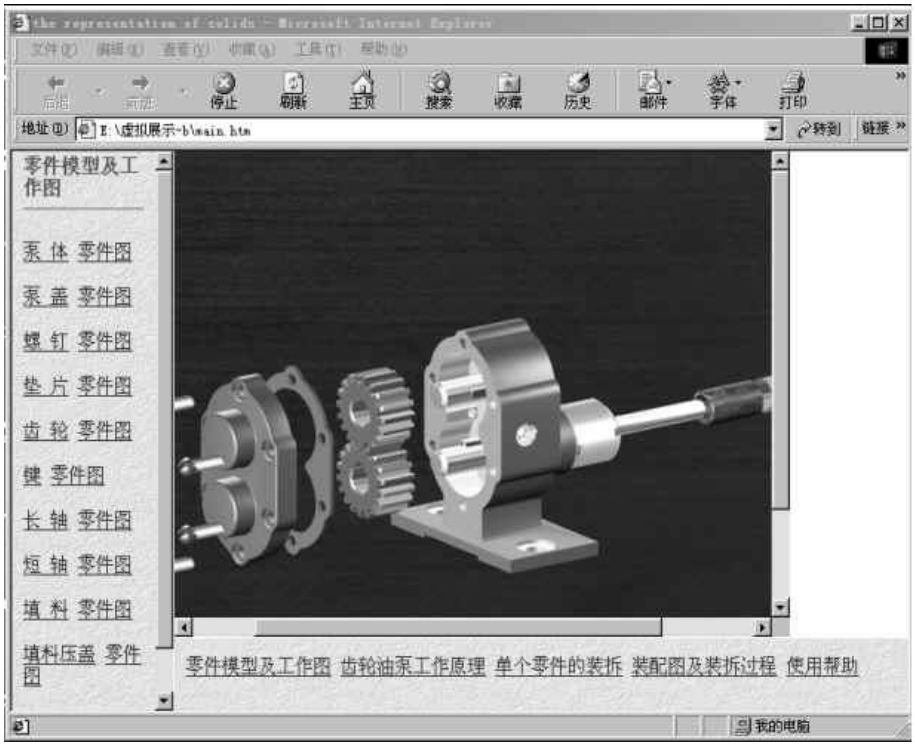


Figure 5: Virtual assembly system on the web

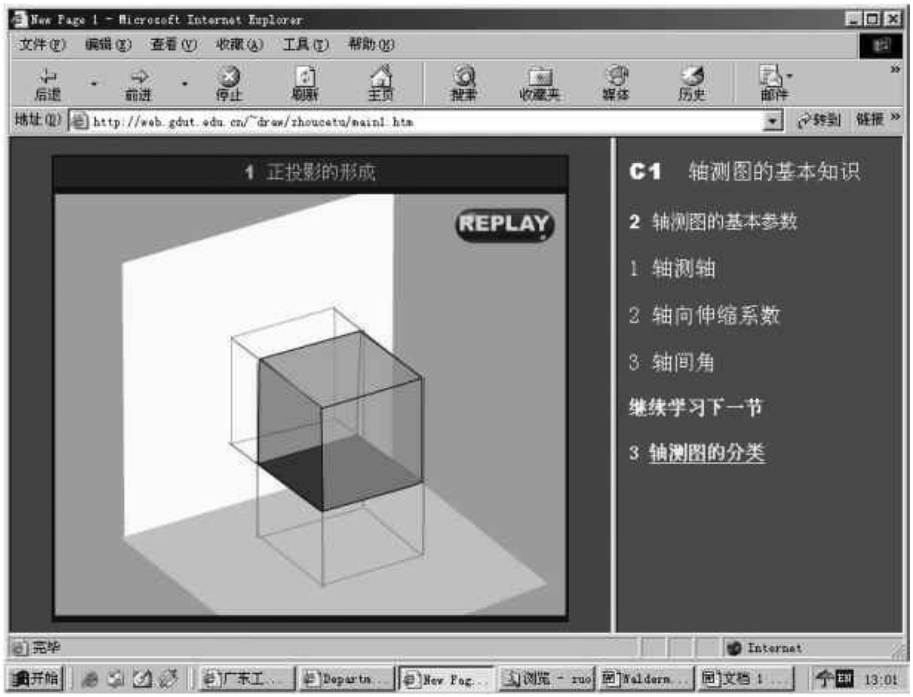


Figure 6: A page of the teaching system

working groups for developing multimedia and web CAI software. Some results of them have even obtained awards from university and state.

### 2.7. Advanced teaching management system

We are preparing a set of teaching management programs, including teaching plan, teaching schedule, teaching material, teaching equipment, students record, lab arrangement, and test system. We have already completed some parts of them. These reforms will greatly reduce teachers' routine work and make the management more scientifically.

## 3. The software developing work

Without CAI software, the reform of Engineering Drawing would not have been carried out at all. At the beginning there was no CAI software available for Engineering Graphics. So we spent years to develop multimedia CAI software and to permanently update it according to the teaching progress.

### 3.1. The kinds of CAI software

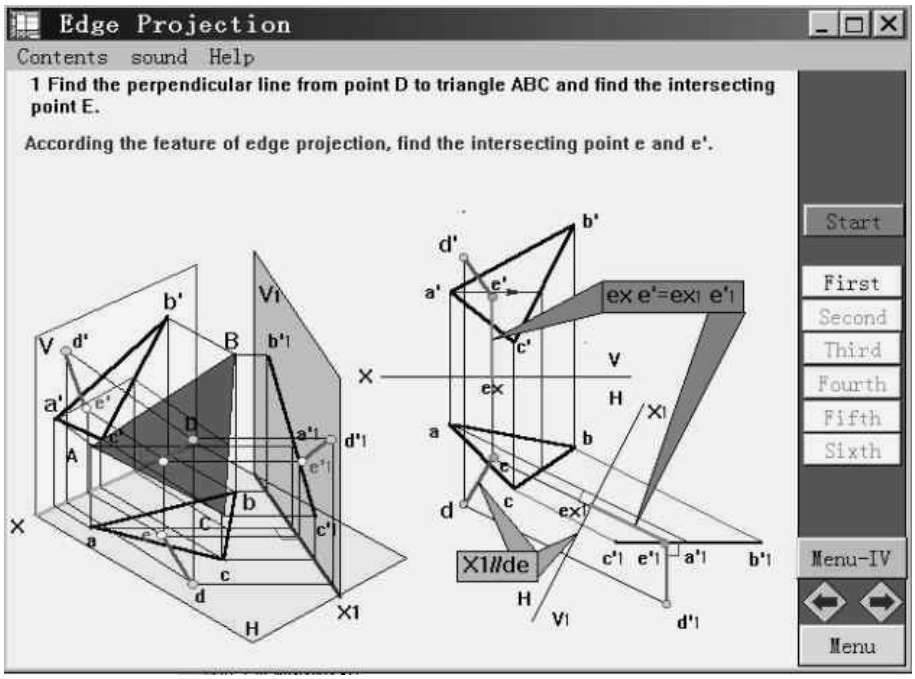


Figure 7: A teaching page with step by step

We developed three kinds of software.

- The first one is class-teaching software that is developed with a multimedia author-tool and represents the teaching contents in detail with more graphics, 2D and 3D animation, analyses step by step, voices and text. Fig. 7 is a page of this teaching software with drawing step by step.
- The second is for students' view and exercise analyses. It is saved on a CD or available on the local network.
- The third is a web-based software that is a big network station for releasing and receiving messages, supplying students' general prompting and other resources and supplying a VRML system as a model storeroom where students can obtain many exercise and practice. In Fig. 8 a web page with a step by step process is displayed.

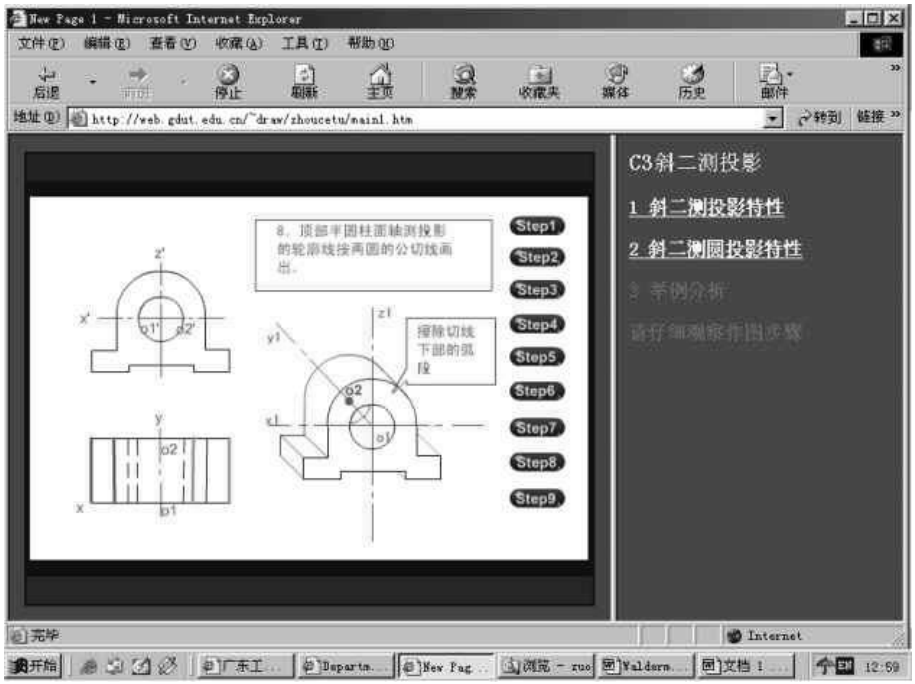


Figure 8: A web page with step by step

### 3.2. The software design method

For developing the multimedia software, we have used many developing tool, such as 'TOOLBOOK', 'AutoCAD', '3Dsmax', 'Photoshop', 'VB' etc. For the web-based software, we use 'Frontpage' and 'Dreamweaver' to establish the main page. We use 'Flash' to draw 2D animations and we use VRML to establish real time 3D animations. Of course we need to prepare graphics, script and voices before. Graphics capture tools and CD-RW software and driver were also needed. Until now, we have finished all the teaching system, exercise system, some parts of the test system and the management system of for Engineering Drawing. A virtual reality teaching system on solid's representation based on the web has also been developed for the students' review. We published 4 sets of CDs, two are for Mechanical Drawing (teaching edition and students edition), one for Engineering Drawing (students edition), and another one for Architecture (students edition).

## 4. Teaching method and result

The modern teaching mode introduced above has importance signification for reform education of ED. It changes the course system of ED in various aspects, it totally optimizes the course system, insures the teaching quality, and accelerates the process of students' study. It throughout supervises and controls the teaching and studying and creates a new education mode for high quality person's training. Students are very much interested in this new method. They can study initiatively, obtain more information and establish a new relationship between teachers and students. The following Table 1 shows the results of comparing the situation before and after the reform.

Table 1: Comparing different aspects before and after the teaching reform of Mechanical Engineering in the teaching year 2002

| | *number of students for one teacher* | *Lecture hours* | *Practice hours* | *Manual drawing A3* | *Computer drawing A3* | *3D modeling A3* | *Average score* |
|---|---|---|---|---|---|---|---|
| *Before reform* | 90 | 106 | 58 | 6 | 0 | 0 | 75 |
| *After reform* | 240 | 80 | 40 | 4 | 2 | 2 | 79 |

## 5. Conclusion

We have obtained important progress in the teaching reform and created a modern education mode. The work we have done before gave us a rich experience and made us doing faster in the future. We still have a lot to do in the teaching reform and we will try our best to continue moving forward. Modernization of education is an important research task. It includes not only the aspects of research of the culture trait and psychology, but also more important aspects of education technology. Multimedia CAI and web-based education software are the main means to realize education modernization. So it has a boundless research perspective. With the help of modern education techniques, studying Engineering Drawing is no longer dull and dry. It becomes colorful, sentient and creative. Thus a global education course sharing becomes possible and education can be gained everywhere in the world. To realize this mission is the educators' duty and glory.

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