Dr. prof. Lévai, Zoltán
Budapest University of Technology

STUDENT MADE "GAME" PROGRAMS FOR ANALYSING MECHANISMS

A few years ago the Vehicle Engineering Department decided to have graphic programs for computer aided learning made by the students themselves.

The aim was dual:

I. we wanted to increase the number of computer programs aiding learning in the mechanical engineering field,

II. we wanted to implant early in the mechanical engineering students the desire to make graphic softwares.

Namely, we perceived that though the first-year students learn some language or other (for example, in the Vehicle Engineering Department the Fortran language), the traditional computing tasks which occuring the second year do not really test the communicating ability of the students with the computer. There was no need for programming for the solution of the tasks. The students could easily obtain ready programs. The input of the input data and the running of the program are eather primitive tasks.

There was no stimulation to create ingenious solutions. For developing creativity the animation programming is much more suitable than to calculate something by computer.

Prior to presenting our concept in detail, I briefly present the condition system in which our students learn.

Curriculum

The time of study is five years (ten semesters). When the student enters the university, he or she selects a complete curriculum, in which the electives are already few. In the Vehicle Engineering Department, the structure of the curriculum is **conductive**. This means that the theoreticcal, astract and general subject-matters of instruction are not concentrated to the first two-three years, but they are extended to five years. At the same time, application is parallel to the instruction of

theory because the practical, concrete and special in a sense subject-matters of instruction are also extended to five years. The theory and practice, the abstract and concrete, the general and the special are in equilibrium in every semester.

As a result of this structure, the level of the theoretical qualification of the students does not culminate in the third year, but it continuously grows until the final state examination. At the same time, the theoretical knowledge is firm because the student always feels its usefulness and necessity, being always able to associate it with some concrete engineering problem.

Of course, the concrete engineering problems are also related to each other, therefore we narrow the application into a certain field, and thus we are able to demonstrate the relationships between the problems as well.

A part of the students studies the automobile from the first year, another part of them studies the railway vehicles, etc. **This kind of specialization**, however, does not influence essentially the subsequent professional career, since either the automobile or the railway vehicle etc. **serves only as an example for application**. All the proficiency, skills and readiness which the student develops in himself or herself educating on the automobile can be made use of in any field of mechanical engineering.

The theoretical and general subject-matter of instruction is represented by such subjects in the curriculum of automobile engineering as Chemistry, Matematics, Mechanics, Electromechanics, Metallography, Material Technology, Manufacturing Processes, Machine Parts, Thermodynamics, Fluid and Gas Mechanics, Automatic Control, Theoretical Physics, etc. (For example, Mechanics in the 2nd, 3rd, 4th, 7th, and 9th semesters, Theoretical Physics in the 8th and 9th semesters).

The "specialized" engineering courses are as follows: Engineering Physics (1st semester), Analysis of Automobile Mechanisms (2nd, 3rd and 4th semesters), Service and Maintenance of Automobile (5th semester), Manufacture and Repair of Automobile (6th semester), Automobile Theory, Design and Research (7th, 8th and 9th semesters), Automobile Laboratories (from 2nd to 9th semester) and Diploma Work (10th semester).

This string of courses with concrete field of application as an example and with the analysis of its concrete problems

a) permanently and continuously integrates in the student the theoretical and practical knowledge developed in them until then,

b) transmits for the student additional theoretical knowledge also itself, and in this way

c) develops association system of a higher order laying the foundations of a scientific attitude of mind as well, moreover

d) produces and intensifies in the student the desire to acquire more and more theory, to go deeply into theory, during wich

e) it develops the engineering abilities and skills.

The making of the graphic programes by the students for computer aided learning is associated with the subject of Analysis of Automobile Mechanisms in the second year.

The faculty staff

The number of students learning at Budapest University of Technology is 7 thousand, the number of teachers is 1500.

This means that the student-teacher ratio is favourable. It makes possible that instruction should be individual. For example, in laboratories one assistent actually teaches 3-5 students intensively. (The time spent in laboratories is rather significant: many subjects are associated with laboratory, the students spend on an average 2-3 hours weekly in every semester in different laboratories.)

We have computer programs made by those approx. 30 students who choose the automobile as an example of application. The only task of an assistant is to direct these 30 students as a tutor, but depending on the concrete theme, the students can consult also whith the other teachers, with the expert of the given field.

Hardware

The hardware supply of Budapest University of Technology is very poor compared to the West-European standard. Actually, the university has only one really large computer. Access is difficult. The Vehicle Engineering Department posesses two personal computers and 10-12 home computers (Commodore 64.). Only the Commodore 64 is commercially available at a price which can be afforded by the students (or by their parents).

Since the students make the computer programs as a homework, we regard it as natural that the majority of them writes the program for Commodore 64. This does not worry us particularly because it is possible to bring

about relatively fine thigs with Commodore 64, which is proved also by the mass of popular game programs written on it and available commercially. As a matter of fact, the student made programs are also "game" programs taken in a good sense (only gasoline runs in the pipes instead of rats if the operation of the carburetter is in case).

Program-making

At the end of the second semester, each student selects a mechanism for the analysis of which he writes a program. The assortment is great. Some write a program for the suspension mechanism of the wheel some for the epicyclic gear. A fine task is meant by the animation of the power-assisted steering mechanism, or the pneumatic brake, which already require proficiency in hydraulics and pneumatics as well. The computations of vehicle dynamics can be also "enlivened" very well by the animation of the diagrams.

After the selection of the mechanism, the student decides for what computer he writes the program. For those students who select the Commodore 64, we recommend the Simon's Basic aid program.

During the elaboration of the program, every student receives individual consultation from the tutor - according to a special schedule - at least every two weeks. The completed program must be submitted on tape or disc at the end of the 3rd semester. At the beginning of the 4th semester, the student receives a new task, or gets back the old one to develop it further.

Example

In the following we briefly present a student made program which explains the functioning of the hydraulic clutch.

Executing the program, Figure 1 showing the mechanism of the clutch in front-view and in cross-section is gradually outlined on the screen. Meanwhile explanatory texts also appear on the screen.

Then, the clutch "comes to life". The shafts begin to rotate, the liquid circulates. All this is accompaned by a sound as well. Therby the first part is terminated.

On the second part of the program only a detail of the clutch appears, and only the circulation of a single liquid particle can be seen.

The speed vectors and the diagram of the clutch appear, approximately in the same way as it is to be seen in Figure 2. After this, it is possible to change the operating condition of the clutch. One can increase the speed of the turbine by means of input, and it can be immediately seen how the speed vectors change. The deformation of the vector triangles shows very demonstratively the development of power transmission as a function of the RPM ratio.

Experiences

Though we began to involve the sophomores in the making of animation programs only a short time ago, and only relatively few perfect programs have been produced until now, it is to be seen that the students make this with great pleasure.

They are able to give full vent to their imagination.

Every student is able to follow an individual way, there are no standard patterns.

The performance of the student can be measured very well.

It develops the didactic sense of the students as well.

The principle of "learning-by-teaching" asserts itself well.

The making of these advanced graphic programs is a very good introduction into CAD, with which the students begin to concern themselves after the third year of study.