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THE USE OF COMPUTER TO INCREASE EFFICIENCY IN EDUCATION

INTRODUCTION

Computer drawing programs opened up new opportunities in the teaching of geometry. These systems make it possible to create drawings quickly, accurately and with flexibly changing the input data.

Dynamic geometric systems have become part of the high education. We make some experience in teaching descriptive geometry by using the program Cinderella. We report about some experience.

DYNAMIC GEOMETRIC SYSTEMS

Dynamic geometric systems can be useful for the teaching of geometry and descriptive geometry. The emergence of computer programs in education forces people to rethink their views, as we have to reconsider what we regard as important. Formal knowledge is devaluated, and a higher value is associated with the capability for problem solving.

A dynamic geometric system is not just a computer-aided drawing tool that makes the preparation of static drawings possible. They provide not only access to geometric objects like the intersections of lines or perpendiculars to given lines. A general feature of these systems is that they store the steps of the construction. This means that when the place of figures is changed, all the figures will be changed which are designed from that figure. In fact we gain a lot more than exactness. Through the movement we can observe how the figures are constructed upon each other.

The key features of interactive geometry systems:

- Dragging objects,
- Macro operations (in order to facilitate constructions),
- Loci (tracing the movement of a point).

PROJECTIVE GEOMETRY AND COMPLEX NUMBERS

The extension of geometry by infinite elements removes a lot of special cases from usual Euclidean Geometry. A projective plane consists of the points of the usual, Euclidean plane together with one additional “infinite” point for every possible direction. The lines of the projective plane are the Euclidean lines together with one special “line at infinity”. All infinite points lie on the line at infinity.

A point or a line has to be represented by numbers: the coordinates. Usually a point in the plane is described by its (x, y) -coordinates. But (x, y) -coordinates are not representation for the points at infinity. The solution: every point (x, y) is represented by its three-dimensional coordinates $(x, y, 1)$. These coordinates are the homogeneous coordinates of the point. The points of the form $(x, y, 0)$ correspond precisely to the “points at infinity” of Projective Geometry.

Finding the coordinates for the points of intersection is nothing else but solving a quadratic equation. Over the real numbers a lot of equation have no solution. For example in the case when two circles do not intersect. Over the complex numbers a solution always exists. In the case of visually non-intersecting circles the intersections still exist: they have complex coordinates and we cannot see them in the real plane.

There is an important question: if the construction remains executable after a modification of the input data. Cinderella performs the calculations on the projective plane, and therefore, it will be able to interpret the point of intersection of the two parallel lines at infinity with homogeneous coordinates. The introduction of complex number calculations greatly simplifies geometric constructions by eliminating “vanishing” intersections.

THE RESULTS

The objective of the descriptive geometry is to make the spatial design easier. This often happens in a way that the spatial design is traced back to the plane geometry.

It is widely used in engineering practice and architectural drawing that makes descriptive geometry an essential base of computer aided design.

The dynamic geometric program that we chose is able to save all the designs as an interactive web page. The teacher can construct a sample configuration and mark the set of starting objects and the desired object to be constructed. Then he

or she can export the exercise together with a restricted set of tools. Since we do not have to adjust the proceedings of the solution, we just have to adjust the set of desired objects, so the program accepts more than one approach to the solution. There is no need to install the program, to make the interactive pages work. A special file should be attached to the web page, in order to the students can work on the internet during the seminars.

We made a survey in two groups of first-year-students majoring in mechanical engineering.

The first group worked with dynamic geometric system on the computer, while the second group worked with “paper and pencil” approach. The two groups had the same tasks and they had the same homework. The difference lies in the drawing opportunities of the program.

The data were elicited from three tests. The first test took place on the eighth week, the student worked with paper and pencil. The second test took place on the fourteenth week. The third test was a delayed test (in five month). The student worked with paper and pencil too.

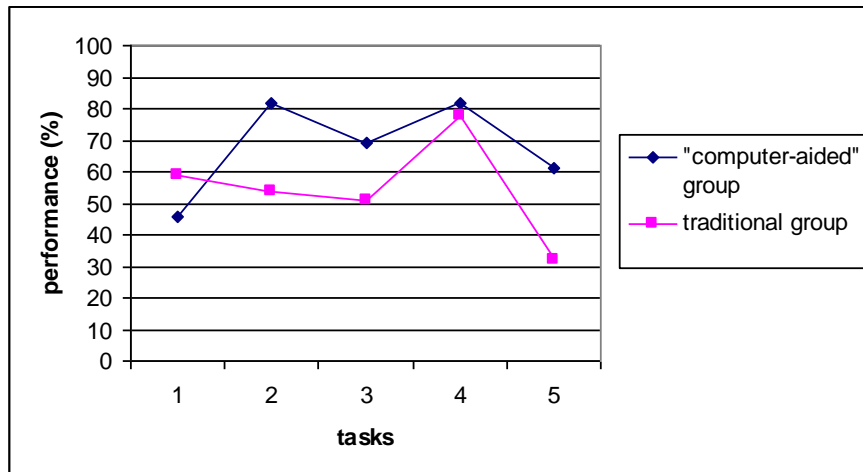


Figure 1: The outcome of the test 1.

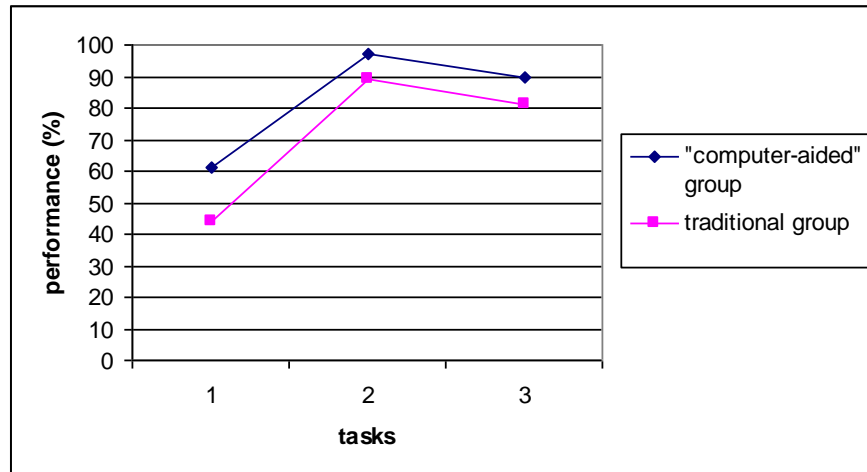


Figure 2: The outcome of the test 2.

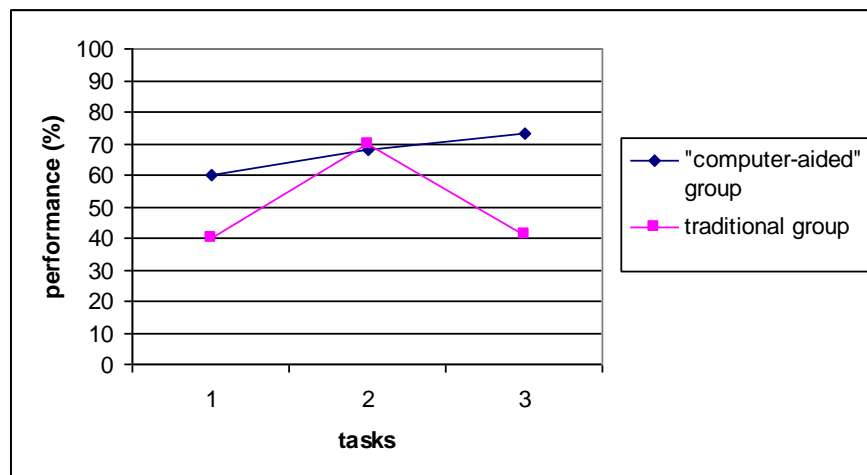


Figure 3: The outcome of the test 3.

The results of the test papers show that the „computer-aided” group worked more accurate and effective.

In the test 2 there are no such big differences between the groups. On the basis of the three tests we can say that the learning process was more successful in the “computer-aided” group. The students in this group were more creative and initiative in the construction process, maybe because of the facility of removing of false parts of the picture by a single click of the mouse. The students were

pleased to use the computer; they found it easier to design with the help of the computer.

SUMMARY

We can say that the dynamic geometric systems help the teaching of geometry and descriptive geometry. The computer programs can help the effectiveness of the lessons. We can improve the students' problem solving abilities with the help of the interactive exercises and we could more easily trace the thoughts of the students. Coordinating teaching with computers is very time consuming, but on the basis of the tests we can say that this time returns.

REFERENCES

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ÖSSZEFOGLALÓ

Napjainkban egyre nagyobb teret nyer a számítógéppel segített tanítás. A dinamikus geometriai rendszerek az oktatás elemeivé váltak a felsőoktatásban. A dinamikus geometriai rendszerek alapvető jellemzője, hogy nem csupán statikus ábrák elkészítését teszik lehetővé, hanem a szerkesztéseket dinamikus egységnek tekintik.

A program tárolja a szerkesztési lépéseket, így egy alakzat helyének változtatásakor az összes olyan alakzat helye is változik, amelyet belőle szerkesztettünk. A mozgítás során így látható az alakzatok egymásra építettsége, és elemezhető a szerkesztési folyamat.