BACK

EXPERIENCES WITH CBL AND THE TI-92 IN AUSTRIAN HIGH SCHOOL CLASSES INTEGRATING MATH, PHYSICS, AND CHEMISTRY

Brigitta ASPETSBERGER
Bundesrealgymnasium Landwiedstrasse 82
A-4020 Linz, Austria, Europe, aspetsberger@utanet.at

Klaus ASPETSBERGER
Paedagogische Akademie des Bundes in Oberoesterreich
Kaplanhofstrasse 40, A-4020 Linz, Austria, Europe, aspetsberger@utanet.at

Abstract
Experiments carried out by students are very motivating and lead them to a better understanding of principles and processes in sciences. The main objective is to find functions fitting best to the experimental data and to interpret the special values of the parameters of these functions. The students have to combine knowledge about the different types of functions with the knowledge about chemical and physical facts. We report about first experiences of CBL/TI-92 within the final exam at an Austrian grammar school. Basic skills for making experiments, documenting results and using and transferring basical knowledge are discussed. In this presentation we will report about the experiences made with students at the age of 17 to 18 carrying out experiments in chemistry and physics in science courses.

Introduction

We report about a project being carried out at the Bundesrealgymnasium Landwiedstrasse, which is an Austrian Grammar school in Linz, in the year 1999/2000. Six different groups of students have been involved in this project consisting of 61 students at the age of 16 to 18 years. About 50% of the students were girls and there was one group consisting of girls only. All of them did not have much basic knowledge in chemistry and no experiences with the TI-92 or the CBL system. Experimenting and working in groups was a new experience for the students. First experiences and some experiments are described in [Aspetsberger 1999].

Basic Skills

As the main basic skill in mathematics the students should be able to recognize functional interdependences from data. For this reason knowledge about different types of functions is required, e.g. linear, reciprocal, potential or exponential functions. The students should know the typical shapes of the graphs and how the graphs alter if occuring parameters are varied. As a special case of functions the students should know about direct and inverse relationships.

A verbal basic skill is the ability of the students of doing experiments by using detailed written instructions. A further problem was documenting the results. The students have to learn how to write a technical report. Especially, summarizing the chemical/physical background and interpreting the results is quite difficult.

Finally, the students have to learn some practical and social skills when experimenting in groups. Experimenting in science courses is a good training for the multiple intelligences [GARDNER 93] of the students.

Final exam

In Austria it is usual to use computers not only in normal lessons but also in our final exam called "Matura."

It was one task of the student to determine the unknown concentration of a green coloured solution following Lambert Beer's Law (Light absorption is direct proportional to the concentration). The student had to make a serie of different solutions from a stock solution of known concentration and to measure their light absorbance using a colorimeter. Due to Beer's Law the concentration/absorption data points lie on a straight line. Measuring the light absorbance of the unknown solution the student was able to determine the unknown concentration of the solution. Furthermore the student gave

background information about how a colorimeter works and how to interpret Beer's law.

Once more a real time problem occured. 20 minutes for preparing the experiment and 8 minutes for presentation were a very short time.

Experiments and the use of computers in final exams can lead to unpredictable situations, especially if there is a break down of the computer. It is recomended to keep an additional TI-92 with some basic data in reserve.

Experiences

The students were really motivated. They spent more time as obligatory in the laboratory and they would like to continue the CBL-TI-92 project. Students being not very good in chemistry and mathematics got a real chance to do it better. Some girls who did not be very interested in these two subjects enjoyed the project. They were proud about their "beautiful curves" and their good results.

According to a questionnaire, which the students answered at the end of the project, they enjoyed practical work. They felt free of the "pressure of learning" and appreciated being independent during experimenting. Chemical and physical laws became more illustrative for the students. Some students also mentioned that it was important to learn using technical instruments and computers for their future life. Only 2 of 61 students would not like to continue this project.

The major problem was the lack of time. We had only 50 minutes per lesson for explaning and doing the experiments. Therefore the discussion and interpretation of the results often had to be deligated to the next lesson. That turned out to be a loose of actuality. A further problem could be the large number of students (~ 30 pupils) in regular science classes. In our project we had only small groups of 10 to 16 students. However, also in

this "ideal" situation an additional person was helpful, e.g. when problems with the calculators occured or explanations of mathematical relations were neccessary. Working in chemical and physical laboratories using new technology forced interdisciplinary thinking by the students.

It was quite easy for the students to get familiar with the CBL and to apply the CHEMBIO program on the TI-92. However, for further mathematical manipulation of experimental data the students had to learn more about the handling of data-matrices, plotting graphs, defining functions, determining regressions curves etc. This required a detailed introduction of handling the TI-92. This could have been skipped in our project, if the students would have used the TI-92 in regular math lessons. A second obstacle was the simplicity of the CHEMBIO program. It was easy to handle the program for the students, if they did not make any mistakes. However, the program was not "fault tolerant". If the students had entered a wrong value or selected an inappropriate submenue it was very difficult to leave the program or to correct the wrong inputs.

References

- [ASPETSBERGER 1999] Aspetsberger B., Aspetsberger K.: *Integrating Math to Science Courses using TI-92 and TI-CBL.* ICTCM, Iternational Conference on Technology in Collegiate Mathematics, San Francisco, November 4-7, 1999
- [GARDNER 1993] Gardner H.: *Frames of Mind. The Theory of Multiple Intelligences.* Fontana Press, An Imprint of HarperCollins Publishers, London, Second Edition, 1993