Prace Naukowe Wyższej Szkoły Pedagogicznej w Częstochowie
Matematyka IX, Częstochowa 2003

Mathematical Applications of Computer Science for the Preparation of Prospective Primary School Teachers

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These days computers are a common part of our daily life. Success of each person in this global information age is measured by their ability to obtain, analyze and use information. Schools, as integral part of the global information system, should reflect the current needs for information exchange.

In the year 2000, the government of the Czech Republic endorsed the document *A Plan for State Information Politics in Education*, which mainly declares free access to information and communication technologies (ICT) for all students and educators. According to this document, already grades 1 to 5 in Czech primary schools have free ICT access. According to J. Coufalová (2002) [2], primary student literacy should be expanded to include ICT, which implies that prospective and established teachers should be taught new pedagogical ICT methods.

Let us list the main items which are requested of the teachers by ICT. The teacher should lead the pupils to active work with information, he himself should also know how to use the information resources to support the development of thinking and creative activities for children. The teacher should know how to use all the advantages of computers, as a universal aid for both teachers and students. The use of computers in education should not be an end in itself, but rather it should enrich valid curriculum. After listing all these items, there arise some questions:

- How to prepare teachers to actively use ICT in education?
- How to persuade teachers about the impact of computers in education?
- How to overcome timidity and psychological barriers to using computers?

Many problems exist for teacher preparation in ITC. In this article, we will treat the problem of mathematical information preparation of prospec-

tive primary school teachers. In this connection, it is necessary to emphasize some specific starting points which apply to prospective primary school teachers. The mathematical background of prospective teachers is relatively limited (in comparison with mathematics specialists), mostly they are not experienced computer users and they are mostly skeptical of the real use of ITC in education.

For prospective teachers of grades 1 to 5, the mathematics department requires teachers to enroll in a seminar, one of which is *Instructional Applications of Computer Technology*, which is in the winter semester of the fourth year of their study program. The goal of this subject is to show them actual instructional use of computers in contemporary schools with emphasis on primary school mathematics. During the development of the course syllabus, two different approaches were used:

- Lecture preparation for teachers (preparing various materials, tables, graphs, statistics, posters, the use of WWW for obtaining programs, information and data),
- Classroom use of computers (text editor, spreadsheet, specific teaching software, the use of WWW for information and data).

According to B. Brdička (2002) [1], graduates of pedagogical faculties should not merely use ICT. They should understand the practical implications of ICT innovation. Nowadays technologies are probably completely different than those which will appear in the future. That is why specialized knowledge of one computer application is not as important as basic understanding. Our intent is not to present students with ready-made methods and instructions. We try to give them an opportunity to be creative and independent, and for discovery of hidden possibilities and unusual connections.

The content of the seminar *Instructional Applications of Computer Technology* is divided into six main topics:

- **Excel** – The foundations of speadsheets, mathematical calculations, tables and graphs, practical applications of Excel.
- **PowerPoint** – Creating presentations on primary school mathematical topics.
- **Children's programming languages** – Baltík - introduction to the program. This program is an example of a technology to support cognitive teaching.

- **Mathematical teaching programs** – Matik, Veselé počítání, Gordiho zábav'e počty, Alík - work with commercial and individual programs, incorporating and using educational programs in mathematics teaching, computer program evaluation.
- **Internet** – School and mathematics Internet pages and links, Internet journals and libraries, actual possibilities of e-learning. Term project: *Internet as a Data Information Source*, in the framework of the mathematics curriculum for grades 1 to 5.
- **Instructional, psychological and ergonomic aspects of computers.**

1. **Excel**

   The elements of MS Excel were learned in a computer science course, which is common to all programs of study for prospective teachers, during their first year of study. In our course, we primarily study mathematics and statistics applications in spreadsheets, how to give various mathematical functions to create two-dimensional and three-dimensional graphs. Students work on problems originating in the curriculum of grades 1 to 5, using MS Excel.

   Work with the application MS Excel is interesting for students. Students find value in working with MS Excel, because they can use the ideas in their diploma thesis.

2. **PowerPoint**

   The application PowerPoint is introduced to students as an easy and accessible tool for creating presentations. We concentrate on primary school mathematics. Students make the presentations from the subjects of grades 3 to 5 in primary school. They are required to give the presentation in front of the other students. They make comments to the topic they chose, how to use it during teaching, and discuss the possible classroom problems. After each presentation there is a discussion in which other students comment on the pros and cons.

   In spite of some timidity at the beginning, for most students the creation of presentations is an interesting and fun activity. A good motivation for the students is the possibility of immediate use of the presentation as printed slides for practise teaching. Many students, only while preparing presentations, discover additional interconnections with other applications – the possibility of using data and pictures from the Internet, the possibility of using existing text files, spreadsheets and graphs.

3. Children's programming languages – Baltík

Instructional programs Baltík 2.0 and Baltík 3.0 are produced by the software company SGP Systém. The program Baltík is advertised as a system for children, which introduces programming languages. The original orientation of Baltík is programming and computer science. In our seminar, we introduce Baltík to our students from a different point of view – a fundamental programming environment which is an ideal platform for development and cultivation of mathematical thinking for grades 1 to 5 in primary school. The environment of Baltík is accessible to all pupils. It offers a great opportunity for learning by discovery and it agrees with the research on cognitive technologies given by J. Vanek (2003) [6].

The work with Baltík was not received positively by all prospective teachers, in spite of the fact that the little wizard character in Baltík invites the development of new topics and their solutions. Some prospective teachers did not take the challenge, they expected ready-made topics and canned solutions as might be found in classical teaching approaches. Other teachers couldn't see any potential instructional use for Baltík.

4. Mathematical teaching programs

In the context of mathematics instruction, the prospective teachers are getting acquainted with available commercial and no-cost programs. Our aim in not to teach how to use a concrete software product. Students are given an overview, in order to know how to understand the program offer and to critically evaluate similar available products. In the seminar we pay attention to possible inclusion of a topic into mathematics instruction. In the context of diploma theses, an archive of teaching programs was created in the department of mathematics which we would like to enhance by student seminar contributions.

5. Internet

On the Internet, we focus on WWW pages with school and mathematics topics, Internet journals and libraries, and actual possibilities for e-learning. Students work on a WWW project as a data and information source, in the framework of the mathematics curriculum for grades 1 to 5 in primary school. We would like to realize some of the projects in the classroom next school year.

6. Instructional, psychological and ergonomic aspects of computers

Instructional, psychological and ergonomic topics are interspersed throughout the course. According to J. Vaníček (2003) [6], the preparation for teachers in computer technology encompasses more than just adding computers to an existing course. Incorporation of ICT technologies into teaching is closely connected with the possibility of changing working habits, re-organizing teaching and re-defining teacher-student relations, with new possibilities and new instructional advances for teacher preparation.

What is our experience so far? I will express them by words of students taken from their final reflections of the course.

> Kateřina: "I never liked computers much. I did not understand what they are good for – maybe for typing text and mobile telephone messages. Now I look at them differently. They do a lot of interesting and useful things. It is not at all so complicated as I thought. There are a lot of things I don't know how to do, but I will try to make a presentation for my diploma thesis defense."
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> Jarmila: "I have always been interested in computers but I was not able to imagine their use for primary grades 1 to 5. Now I can see that it is possible. Everything has to be thought out, planned, and then the result is worth doing. I already tried to use computers during my practise teaching."

Our endeavor is to teach prospective teachers how to introduce information and communication technology into teaching, naturally and meaningfully. This introduction should reflect the present development of information community and the computer, in order to become an obvious instructional element of teaching.

Based upon positive reactions from our students we think that the form of the seminar fulfilled our expectations. Maybe we succeeded in overcoming psychological barriers and timidity of students about computers, and in persuading students about real possibilities for using computers in schools for mathematics instruction. In the context of fulfilling seminar assignments, prospective teachers illustrated that they were able to use the possibilities of ICT both for preparing lectures and also for proposals of practical activities of pupils, and that the computer became for them a natural tool and a means for instruction.

The paper was supported by GAUK 316/2001/A-PP/PedF.

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