

Informatics and ICT in Polish Education System

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Abstract. The reform of the Polish national education system started in the school year 1999/2000. One of the main features of it is the plan to integrate Information and Communication Technology (ICT) into almost all school subjects. The second important feature is preparing students to use computers and software in other subjects during separate ICT lessons. The separate lessons on using computers and ICT are called informatics. Informatics lessons are obligatory in primary schools and in middle schools (*gimnazjum*). In high schools (*liceum*) there is an obligatory subject called information technology (IT) and an elective subject called informatics (computer science). It is possible to take the maturity exam in informatics when someone has graduated from the high school. The authors work as a team, and have prepared subject curricula, informatics textbooks, electronic materials for students and accompanying guidelines and books for teachers for all stages of the education system. We are also engaged in teacher-education and in-service training. We want to exchange our ideas, as realized within these materials, and we would like to present our experience in making these ideas alive in our schools. The realization of informatics education in secondary schools is a continuing process. We are at the moment, in the year 2005, when the first graduates of the new education system will come to study in our universities. So it is necessary to make some reflections on the past.

1 Introduction

Since September of 1999, the education system in Poland is divided into: primary school (6 years), middle school (called *gimnazjum*, 3 years) and high school (called *liceum*, 3 years). Children begin the school education when they are seven.

The Ministry of National Education published a document *Guideline for teaching mandatory topics in the primary, middle and high school* [2], which can be considered as **the education standards** for subjects in all types of schools. Regarding information and communication technology (ICT), it is emphasised there that the teachers and schools are responsible for enabling all students to learn how to:

Search, sort and make use of information coming from different sources and effectively use information technology for that purpose.

Students should learn to communicate information to others through a variety of means. One of the main objectives of the modern school is to **prepare all students to**

live and work in the information society [1]. To this end, ICT has been included in all school subjects in the standards. Students therefore should first be introduced to ICT and then they should have every opportunity to use ICT across curriculum, in studying all other subjects. It requires to:

- propose new informatics and ICT curriculum,
- integrate ICT with all other school subjects across the curriculum,
- elaborate and publish new education packages consisting of textbooks for students, software and electronic data, teacher's manual and Internet service,
- prepare teachers for introducing students to ICT and for using ICT in their teaching.

The authors, in collaboration with the publishing house Wydawnictwa Szkolne i Pedagogiczne S.A. (WSiP), started in 1997 with the project *Meetings and Learning with Computer*. The main goal of this project is to address all four areas, that is, to prepare curricula integrating ICT, elaborate learning and teaching materials for new curricula, and train teachers in using new curricula and materials.

2 Main Assumptions

The project is a realization of the education standards, and its main goal is to integrate ICT into all school subjects, with learning activities for students and teaching activities for teachers. It is assumed that the introductory classes on using computers and ICT, called *meetings with computer*, are oriented towards preparing students for *learning with computers*.

The project is addressed to primary, middle and high schools. For each type of school, the following items are elaborated and published:

1. **Curricula** for: Introductory ICT, ICT across curriculum, and for other subjects in the area of using ICT.
2. **Education packages** for students, e.g. textbooks¹ [9], [11], [12], software and electronic data.
3. Teacher's manuals² [10], [13].

¹ Gurbiel, E., Hardt-Olejniczak, G., Kołczyk, E., Krupicka, H., Sysło, M.M., *Informatyka, Podręcznik dla ucznia szkoły podstawowej, klasy 4-6*, WSiP, Warszawa 1999.
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² Gurbiel, E., Hardt-Olejniczak, G., Kołczyk, E., Krupicka, H., Sysło, M.M., *Informatyka, Poradnik dla nauczycieli szkoły podstawowej, klasy 4-6*, WSiP, Warszawa 1999.
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4. In-service training courses for teachers who decide to work in schools using proposed materials.
5. Internet service [3].

3 Curricula

There are three types of curricula, prepared in the project, for each type of schools:

- ICT across the curriculum, with a realization of the school's and teachers' tasks in information technology.
- Informatics and ICT curriculum, as a separate subject, which prepares students to use ICT.
- Connections between the above curricula.

The main emphasis in the project is put on the spiral introduction of new and more advanced topics. The topics in the curriculum have been divided into five groups:

- A. The use of a computer and its peripheral devices.
- B. The influence of ICT on personal life, the local community, the outside world, and society.
- C. The use of ICT tools, i.e. different kinds of software packages.
- D. Communication, searching and using information, mainly with the help of ICT.
- E. Solving problems and decision making using ICT.

Topics from group **A**, **B** and **C** are mainly assigned to separate lessons. The main objective of these lessons is making students familiar with the rules of using computers, networks and applications designing for information processing. Topics from group **D** and **E** more often require some material from other subjects, because processes of communication, searching information, solving problems are common for all domains of science and real life. The exception to this rule is the informatics curriculum for high schools, in which topics from group **E** concern computer science methods of solving problems.

3.1 ICT Across Curriculum

The ICT across curriculum is not divided into subjects since it concerns the activities of the whole school. It has been constructed by taking from the education standards of different school subjects: teaching goals, topics and skills, related to ICT [4], [5], [6] [7]. In particular, it was taken into considerations:

- formulations which *explicitly* refer to ICT and computers, contain notions and tools related to informatics education;
- formulations which refer to different aspects of information, which today, or in the near future, need the use of ICT;
- topics and goals which, when ICT is used, may increase the students' competence in using computers and ICT;
- topics and activities, which can be supported and enhanced by using ICT.

3.2 Informatics and ICT Curriculum

The separate lessons on using computers and ICT are called **informatics**. The Informatics curriculum is in fact a realization of the statements from the education standards.

The main goal of informatics classes **in primary schools** is to prepare students to use computers and their software, mainly to be able to use them in other subjects. It was assumed in the education standards that, at this stage of education, students should use a computer environment adjusted to their abilities (e.g. to age) and needs. To this end, a special software system has been designed and produced, which is an easy and spiral introduction to the professional MS Windows environment [14], [15].

In middle schools (*gimnazjum*), during the informatics classes, students are prepared to use computers, computer networks, and multimedia on a more advanced level. It should give students a more solid background for using ICT in other subjects. Moreover, students are introduced also to problem solving with algorithms. The language of implementing algorithms is Logo. The MS Windows environment is used at this stage of education.

In high schools (*liceum*) there are two subjects. One of them, called information technology (IT), is the continuation of earlier students' preparation in using computers, networks and multimedia tools for managing information. The stress is put on working with information in a good style, using possibilities of some tasks' automation. There is nothing about algorithms and programming. Informatics (computer science) is an elective subject addressed for young people who are interested in computer science as an element of their future education. The informatics lessons are expecting to show computer science as a discipline connected with designing and implementing new systems of information processing. It should include ways of solving problems in the following stages: analysis of a problem situation, making specification, designing the solution, realization and testing the solution. Students are introduced to classic algorithms, programming languages, theory of data bases, programming interactive websites.

4 Informatics Maturity Exam

Students who take the informatics subject in high school, could also take the maturity exam in it. The examination standards [16] are formulated in three areas:

- knowledge and understanding of basic concepts, methods and processes connected with informatics,
- using knowledge and information in solving theoretical and practical tasks,
- using informatics methods in creating new information and problem solving.

There are two parts of the exam: theoretical (without the use of computers) and practical. In both cases, the student should prepare appropriate documentation in which his or her solution is described. The student's work is externally moderated.

5 Reflections

5.1 ICT in Other Subjects

The placement, and the ways of developing computer learning support, should be precise in the curriculum of particular subjects. It should concern curriculum content, as well as appropriate new content and skills, which are possible only by using ICT methods and skills. Changes in the curriculum should take into account the possibility of computer deployment, which really will enrich known and established methods of working.

Computer use and ICT should appear (in subjects other than computer science) in two roles: as a didactical support, which enriches learning and teaching processes; and as an element integrated into particular school subjects, as elements which are inseparably connected with particular subjects.

Success in using computers in teaching depends on the level of their integration within established methods of learning and teaching – on their integration in curricular and in didactical support for students and teachers.

Research results concerning the efficiency of computer didactic aids indicated that lack of effects in this field (computer use in education) is caused by their insufficient integration with the school subjects. It is not enough to stand these machines "next to" the teacher, to have some positive results. Their conceptual "placement" in each region of teaching and the learning process is vital, as well as their mutual integration [8].

In the project *Meeting and learning with computer* a proposal for integrating computers with the teaching process is realized on two levels. First of all, the ICT curriculum (addressed to the whole school) is accompanied by content from curricular guidelines of all subjects and their connections with these curricula. Next, we propose integration activities with ICT used in other school subjects. For this purpose we prepared for use in other school subjects a textbook for students at the middle school [9] and accompanying teachers' manual [10]. In the students' textbook we demonstrate how to use computers in other school subjects using their curricula and textbooks and taking into account how students have been prepared within their informatics classes.

In the book *Learning with computer in the middle school* [9] we present typical exercises from the textbook for different subjects (on the middle school level). We demonstrate how the student can use in doing exercises: a computer, software, multimedia, and the Internet. In all exercises skills from computer science classes are used. The computer doesn't replace the teacher but it could be a means of doing some operations easier and faster than without it as well as broadening knowledge and skills. In the examples and exercises we don't use educational software. The three main goals of our class scenarios are: the application of skills from the informatics classes; using them to create active ways of performing in other school subjects, and to enrich students' skills such as using software applications, using Internet sources and services, or multimedia files on CD-ROM disc.

Our solution that there is a separate textbook with exercises from different subjects is not the best way of integrating ICT with the whole school curriculum. These exercises should be placed in textbooks for these subjects. But there is a long way to go in changing the teachers' and authors' of educational materials approach to using

computers and networks in the learning process. We are satisfied that our textbook plays some role in teachers-education in different departments. They could consider it as an example of good practice.

5.2 Algorithms and Programming at Middle School Level

The informatics curriculum for middle schools includes topics concerned with problem solving, algorithms and basic programming skills. It is the only subject in a new education system which has a disadvantage well-known from previous solutions. The disadvantage is a result of linking together topics typical for computer science with topics connected with the effective use of the computer and its software. One of the reasons that this kind of connection does not succeed, is the level of the teachers' preparation. It's obvious that teaching difficult and abstract concepts at a basic level requires some extra competencies from a teacher. Our experience shows that it is a great difficulty to realize these topics in schools. Many teachers do not even try to do it.

Another question: is problem solving, algorithms and development of programming skills really essential for middle stage education? One answer is yes, because young people at this stage of their education should understand what the areas of interest in different knowledge disciplines actually are.

5.3 IT and Informatics Subjects at the High School Level

The problem we describe in the previous section is closely connected with informatics education at the high school level. Young people who like playing computers and surfing the Internet declare their interest in opting for an elective subject. They do not know what it is really about, because there was no signal at the middle level that problem solving, algorithms and programming need some skills of thinking, reasoning, and understanding mathematical concepts.

Another problem is, once again, teachers' preparation. Informatics subject in the form described in the document *Guideline for teaching mandatory topics in the primary, middle and high school* and defined by maturity examination standards is a great challenge for the teacher. In our opinion, teachers of informatics subject in high schools should be graduates of a computer science department. At our university, we prepare computer science students to become teachers. And we can point to good practice examples, when after graduating from university they work effectively and successfully in high schools.

6 Conclusions

We have finished the work connected with education standards, curricula and learning materials for all stages of the education system. In the year 2005, the first graduates of the new education system will come to study in our universities. According to the assumptions of the education system reform, they should be better prepared for using ICT in their work.

The problem that concerns us is the shape of an informatics education more connected with the introduction to computer science in secondary schools. The

question of the content and the methodology employed in introducing the basic concepts of computer science at the secondary level is extremely important.

The second important question is, how could we facilitate and speed up integrating ICT with other subjects? What kind of activities are the most effective?

Now, as university workers, we are engaged in changing the shape of teacher-education. The Ministry of National Education has recently published standards of teachers education, so it will cause further changes in the study programmes.

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