Outreach to Prospective Informatics Students

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Abstract. In this paper we first identify the main factors which influence the students' attitudes to study computer science related disciplines. Then various outreach initiatives and activities implemented in Poland are described and discussed. They range from changes in the national curriculum for middle and high schools to formal and informal lectures, courses, and workshops organized by public and private institutions of tertiary education. Project Informatics +, addressed to 15 000 students from five regions, is presented in details and its outcomes after the first year of running are reviewed shortly.

1 Introduction

In this paper, the term 'informatics' (pl. *informatyka*) is equivalent to 'computer science' and we use 'computer science' when we want to emphasize scientific aspects of the discussion. The term 'computing', however, which embraces 'computer science', 'software engineering', 'information systems', 'information technology' and some other computer-related titles, has no official counterpart in Poland. Recently, the term 'computational thinking' became popular.

This paper is a continuation of our works on informatics education in Poland presented at the previous ISSEP meeting.

In the paper [17] presented in Klagenfurt (2005) we focused on the question: how much informatics is needed to use information technology and how to prepare teachers for their new role as moderators of students' learning, to use information technology in various situations.

In the paper [18] presented in Toruń (2008), motivated by a gradual decline in the number of students applying to earn a computer science degree, we described a learning and teaching framework for schools which is aimed at increasing student interests in studying computer science as a discipline, or at least in better understanding how the computer and its tools work and can be used in solving problems which may occur in different areas. We are convinced that the learning methodology about computer use by students and applying computers and information technology to solving

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problems is a good motivation and preparation for their future decisions to study computing and become computer specialists.

Both papers [17] and [18] refer to the situation in high schools in Poland in the mid 2010's, when information technology was a curriculum subject (1 hour per week for one year).

In this paper, with the same motivation as in [18], we present outreach[1] activities aimed at prospective students and also at the public about the importance of computer science knowledge and attractiveness of the computer related professions in the knowledge based economy and society.

In 2008 the national curriculum was modified and some of the changes were in favor of informatics education – we describe them in Section 3. It is expected that beginning of 2012 informatics education of all school students will be put on a higher level and students will be better prepared for considering computing as a discipline of their future study and professional career.

The society needs a continuous inflow of good students in computer science, science, and engineering to be educated and trained as professional specialists for informatics related jobs in order to sustain the developments and achievements that are necessary to meet the expectations of the information society and its citizens. Yet, the number of students opting for computer science education appears to be declining and various factors affect students' interests in these fields.

The methodology used in our activities with students is based on the idea of **computational thinking** (see [19], [2]). We are convinced, repeating after [18], that computational thinking could be added to the traditional three Rs: (i.e. **r**eading, w**r**iting and a**r**ithmetic) as an additional basic skill needed especially by high school students – they will be better prepared to choose a future career as either a computer scientist or a computer specialist.

The paper is organized as follows. In Section 2 we shortly discuss social understanding of computer science with relation to its popularity as a discipline of study and interest among schools. In Section 3 we briefly describe informatics education in Poland. Section 4 is concerned with the main topic of this paper – we present a number of outreach initiatives and activities undertaken in Poland and describe their role in computer science education in schools and in the society.

2 Computer Science Education in Crisis

There is a general opinion that school students are not prepared to make a decision about their future career and professional life related to computer science. Moreover they misunderstand what computer science really is. In [18] we have extensively discussed main factors which have caused for the last 3-5 years a substantial decrease in the number of computer science enrollments – for instance it was estimated that it dropped in half in the USA. Here, following [18], we briefly repeat some of the arguments which are important for our discussion about outreach activities.

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[1] **Outreach** is an effort by an organization or a group (here curriculum teams, universities) to connect its ideas and practice to the efforts of other organization (here schools), groups, specific audiences, or the general public.

Many people, among them education policy makers, teachers, academics and parents, do not consider computer science as an independent science and, therefore, as a separate school subject. Most of them confuse computer science and information technology and limit informatics in education to provide students and teachers with computers and Internet access.

Informatics education in school does not clear up the myths about computer science, for instance it is still confused with computer programming. Students have access to high-level tools for designing and producing complex applications without any knowledge of fundamentals of computer science such as logic, discrete mathematics, programming methodology, or computability.

Today almost all students have computers and access to Internet at home. Therefore most of high school graduates are quite fluent in using computers to play, search the web and communicate and, as a result, they have no real interest in pursuing computer science as a career choice. They have tasted enough information technology while growing up and want something different at the university level. To change this, informatics classes should prepare students for further study instead of being satisfied with the knowledge and skills they have already learned.

Youth's infatuation with technology does not extend to their desire to learn the discipline of computer science – one of our goals in outreach activities is to motivate students to go 'beyond the screen' and investigate how computers and software work so they can create their own computer solutions.

One of the challenges to a curriculum in computer science is to catch up to the new technology and to adjust it to rapidly changing markets and users' expectations. There is no longer a need for a large number of computer scientists working on foundations of the discipline and developing basic products as it was in the 1960's and 1970's. However there is still a demand for experts and specialists in various areas of computer use and applications who are competent in the range of the university curriculum in computer science. A computing degree can help to find a job in science, engineering, health care, finance, and so on. The availability of jobs, as well as the impact of computing in society should motivate students to study computer science.

The White Paper by the CSTA [16] lists a number of challenges and requirements that must be met if we want to succeed in bridging the gaps in education and improve education in informatics as a computer science discipline:

- students should acquire a broad overview of the field of computer science;
- informatics instruction should focus on problem solving and algorithmic (computational) thinking;
- informatics should be taught independently of specific application software, programming languages, and environments;
- informatics should be taught using real-world problem situations;
- informatics education should provide a solid background for the professional use of computers in other disciplines.

One of our goals in this paper is to show how we partly meet these challenges in our approach to informatics education for all students in schools in Poland, and enhance and support schools by some outreach activities addressed to prospective computer science students.

3 Informatics Education in Poland – In the Past and Today

In the education system in Poland, **informatics education** consists of two types of classes and/or activities:

- separate informatics classes;
- across-curriculum integration of computers, information and communication technology, and Internet with learning and teaching of all subjects.

Detailed information about the development of informatics education in Poland is included in [18]. Here we refer only to the most important steps, in particular we report on changes in the curriculum introduced by the reform at the end of 2008.

The first informatics classes in Poland were organized in the mid sixties. The main topics of instruction were algorithms for numerical calculations and programming in Algol 60 – algorithmics was restricted to numerical methods. The first national curriculum for informatics as an independent subject was proposed in 1985. In the mid 90's, the term 'information technology – IT' (later 'information and communication technology – ICT) was accepted by the education policy makers in Poland and a new subject information technology was introduced to the curriculum by the Education Reform of 1997 and as a result information technology became the high school independent subject in 2002. Informatics as separate subject for all students has returned to high schools as a result of the reform of 2008.

It is interesting to note that informatics as a separate subject has been in the national curriculum and in the schools in Poland since its introduction in 1985. The author is not aware of any other such country.

3.1 Education System in Poland

For a long time formal education in Poland started at the age of 7, which has recently been lowered to 6. Since 1999 the school system at the primary and secondary levels has consisted of three stages:

- primary school – 0-6 grades (age 6 to 13);
- middle school (in Polish: *gimnazjum*) – 7-9 grades (age 13 to 16);
- high school – 10-12 grades (to 13 in certain vocational schools) – (age 16 to 19).

Independent informatics subjects have been in our national curriculum since 1985 and recently have been modified by the reform at the end of 2008.

3.2 New Curriculum of Informatics

In what follows we describe in more details the actual curriculum of separate informatics subjects approved at the end of 2008 and introduced to primary schools (1-3) and to middle schools in 2008 and as it will be introduced to primary schools (4-6) and to high schools in 2012. The changes made to the existing curriculum are important to any outreach activities taken by a tertiary education institution. From one side, it may be assumed that school students are familiar with the topics listed in the curriculum, and from the other side – outreach activities should enhance and extend the curriculum topics. It is very important to connect outreach activities to what is actually taught in schools – one can easily lose attention and interest of school students when the topics are far from what they know and from what they can follow. As a teacher in the project Informatyka + (see Section 4.4), prior to my lectures and workshops, I usually ask school teachers who accompany students from schools how advanced their students are in algorithmics and programming. Similarly do other members of our staff in this project.

3.2.1 Primary Schools

In the previous curriculum, in primary schools there was informatics in grades 4-6, at least 2 hours per week for one year (or one hour per week for two years). In the new curriculum the separate informatics subject, called now **computer activities**, has been substantially extended and now it runs through grades 1 to 6.

In grades 1-3, computer activities do not form a separate subject and are supposed to be fully integrated with other activities like reading, writing, calculating, drawing, playing etc. – in fact there are no separate subjects in grades 1-3, only activities.

In grades 4-6, one hour per week for three years is assigned to computer activities. At this stage it has been already advised to teachers and expected from students that these activities follow the general approach to problem solving with computers described shortly in Section 3.3.

3.2.2 Middle Schools

In middle schools, as it was before, **informatics** is at least 2 hours per week for one year or one hour per week for two years.

The curriculum of informatics for middle schools contains, as before, a section on algorithmics, algorithmic thinking and solving problems with computers. Although programming is not included in the curriculum, an introduction to Logo or to another programming language is a part of the instruction in some schools and students from those schools take first steps in programming.

Within algorithmics, students are expected, as outcomes, to be able to (this part of the curriculum has been modified):

- explain what an algorithm is,
- provide a formal description (specification) of a simple problem situation and propose an algorithm for its solution;
- use spreadsheets to solve simple algorithmic problems (e.g. the change problem);
- describe, how to find an element in an ordered or an unordered sequence of elements;
- use a simple sorting algorithm (e.g. by counting);
- perform (run) some algorithms on a computer – either writing a program in Logo or in another language, with the help of spreadsheets or running an education software.

As a novelty, activities of students within the framework of Web 2.0 have been introduced to the curriculum such as students taking part in web discussions and publish their information and opinions. It is assumed that these activities of students are moderated by teachers.

A new textbook for informatics in middle schools [8], incorporating changes introduced by the new curriculum, was published in 2009.

3.2.3 High Schools

In the new curriculum for high schools **information technology** disappears as an independent subject and informatics has been introduced in its place, at least 1 hour per week for one year. In consequence, beginning of 2012, there will be also **informatics for all students** in high schools, as it is in middle schools.

Informatics (understood as computer science) remains in high schools as an elective subject and is taught only in some schools. Students may also take an external final examination (*matura* in Polish) in informatics.

Informatics for all students

Again, as in middle schools, the main emphasis is put on problem solving with computers using the methodology described shortly in Section 3.3. Problems may come from various fields, in particular from school subjects, and students may use a variety of informatics tools for solving them.

Students are expected, as outcomes, to be able to:

- discuss and analyze various problem situations;
- develop and formulate specifications of various problem situations;
- design a solution of a problem by choosing a solution method and computer tools, such as a programming language, application or education software;
- run a solution on a computer and test and evaluate its properties such as complexity (efficiency) and correctness with regard to the specification;
- present a solution and discuss its applications to other problem situations.

Additionally to problem solving skills, all students in high schools are expected to publish in the web their own educational content and use e-learning to enhance and enrich their learning environment by including open content and courses.

A new textbook for informatics for all students in high schools [9] will appear in 2012. We propose a project based learning as a working method and computational thinking as an approach to problem solving.

Informatics – elective subject

No significant changes have been introduced to the new curriculum of informatics as an elective subject. A new textbook [10] will be published in 2012 in which computational thinking will be more substantially involved as a working methodology.

3.2.4 Comments on Changes in the Curriculum

The reasons behind the changes described so far and also expectations of real changes in students and teachers behaviour are as follows:

- it is assumed that integration of computers with students activities in grades 1-3 will result in a habit of using computers as tools supporting learning of various subjects and disciplines at next stages of education, formal, non-formal, and incidental in school and at home;
- computer activities in grades 4-6 are supposed to lay down solid knowledge and skills within the range of information and communication technology to be used at the next stages of education, formal, non-formal, and incidental;

- informatics in middle schools is supposed to introduce basic elements of informatics, as computer science, important for at least two reasons: as a starting point for informatics education of all students in high schools and as a pre-orientation for those students who might be interested in choosing a high school which offers a specialization in computer science topics, such as algorithmics, networks, data base, etc.;
- introduction of informatics for all students in high schools has at least two main missions:
  - this subject gives a feeling and touch of informatics as computer science to all students; although most of them will continue education, choose career, and find jobs in other disciplines, more and more careers and jobs become IT professions [5] which require a solid background in computer science and its applications;
  - it is a continuation of pre-orientation, started in middle schools, intended to prepare school students for their choices of future study, career and jobs in computing related disciplines and fields;
- web activities constitute another area of informatics education from which the new curriculum benefits much due to the increasing role of the Internet in all activities: scientific, practical, and personal – it is also expected that high school graduates will be prepared to actively use the Internet as an e-learning environment for their lifelong learning activities.

3.3 Computational Thinking

Our approach to informatics (computer science) education in schools, from the beginning in the mid 60's till the beginning of the new era, was to put the emphasis on algorithms and **algorithmic thinking** as the main components of computer science. We have used a methodology, called **algorithmic problem solving**, for the systematic development of a computer solution for a problem, which covers the entire process of designing and implementing solutions, from beginning to end. This methodology is aimed at generating good solutions, characterised by the three fundamental properties: readability (the solution is understandable to anyone who is familiar with the problem domain and computer tools used), correctness (the solution satisfies the problem specification), and efficiency (the solution doesn't waste computing resources, time and space). The algorithmic problem solving approach consists of six stages and is described in details in [18].

A much wider view on computing competencies has been proposed by Jeannette Wing in her paper on **computational thinking** [19] – it extends algorithmic thinking and fluency in working with information technology to competencies which are built "on the power and limits of computing processes, whether they are executed by a human or by a machine."

Today in our approach to informatics education (see [18] for details) we adopt computational thinking as the main learning and teaching methodology about computer use and applying computers and information technology in solving problems. This approach can help students to add computational thinking to the traditional three Rs: (i.e. **r**eading, w**r**iting and a**r**ithmetic) as an additional basic skill needed by everyone. This approach is also used in our outreach activities described in this paper as the way to better prepare our school students for their future decisions to study informatics related disciplines and to encourage them to consider a future career in computing.

Recently (see [4] and [2]), the computational thinking approach has been adopted as a methodology that can be used across all disciplines to solve problems and improve understanding of the power and limitations of computing in the modern age.

4 Outreach Activities

In Section 2 we have identified some factors which influence the students' attitudes to study computing related disciplines. In response, various outreach initiatives and activities are taken.

In the US, the Computer Science Teacher Association (CSTA) collected data [3] which shows that computer science is on the decline in high school. In the recent report [14], ACM and CSTA call for federal, state, and local actions and together with other parties they have formed a coalition **Computing in the Core** (**CinC**) to address the need to build a K-12 computer science program in the US schools. In November 2010, President Barack Obama announced the launch of several nationwide programs to help motivate students to master in STEM (Science, Technology, Engineering, Mathematics) related subjects, see also [15]. The NSF also has announced in 2010 the **CS/10,000 Project** [12] and proposed a new high school computing curriculum which will be taught by 10,000 newly prepared teachers in 10,000 classrooms across the US. Most recently CSTA has published standards [4] which provide a three-level framework for K–12 computer science education. In particular, the standards in the course *Computer Science in the Modern World* reflect learning content that should be mastered by all students, similarly to the subject informatics for all students in middle and high schools in Poland.

In the next sections we describe the most successful initiatives implemented in Poland in the last 2-3 years. They range from changes in the national curriculum for middle and high schools to formal and informal lectures, courses, and workshops organized by public and private institutions of tertiary education.

4.1 New National Curriculum

Informatics education in the new national curriculum has been described in Section 3.2 where we also emphasise the importance of changes in the curriculum to better prepare students for general education as well as for their future choice of a next step in education and professional life. The outreach activities described in this section quite often refer to the new curriculum by enhancing and deepening students' curriculum achievements and extending them in the case of talented and gifted students.

4.2 Workshops for Students and Teachers

It has been observed that students in middle schools and in high schools during informatics classes spend less time on programming, which is usually more time consuming, than on designing algorithmic solutions. Moreover, they are not encouraged to program by teachers who usually have no sufficient practice in programming.

Regional Informatics Circle (pl. *Regionalne Koło Informatyczne – RKI*), supervised by a group of academic teachers from the Faculty of Mathematics and Informatics, Nicolaus Copernicus University, is a novel approach to increasing programming skills among secondary school students in the Kujawsko-Pomorskie Region. It is fully based on distance learning and individual work of students after regular school hours. In this project the achievements of students are monitored on-line through weekly programming contests, which are supported by a system for automatic correctness verification and timing of students codes. The standardized tests have been developed to monitor students' skills. C (CodeBlocks) and Java (NetBeans) are used as programming languages and environments and the educational platform OLAT is a communication medium in this project.

Almost 1000 students participated in the project in the school year 2009/2010: 776 students participated in Part I (Programming in C or in Java – basic level), 190 – in Part II (Algorithmics – basic level), and 30 in Part III (Algorithmics and programming – advanced level). Detailed analysis of the project´s outcomes will be published elsewhere.

The Department of Informatics and Information Technology Education in the Faculty of Mathematics and Informatics, Nicolaus Copernicus University offers also regular in-service seminars and workshops for computer science teachers from secondary and high schools. Some recent topics of the seminar are: new curriculum, computational thinking versus algorithmic thinking, recursion, text algorithms, teachers' preparation standards, educational platforms, network administration.

High schools in Poland do not offer AP computer science courses. However, some universities encourage school students to participate in university courses counted sometimes as tertiary courses. The Faculty of Mathematics and Informatics, Nicolaus Copernicus University offers informatics courses which are attended by students from GiLA in Toruń, a middle and high school ran by the University. In 2010 the GiLA took the first place in two out of three rankings of secondary schools in Poland.

4.3 Competitions and Olympiads in Informatics

Competitions are typical outreach activities, they are usually ran by parties external to schools. These educational events require knowledge and skills exceeding what is taught at schools. They engage and develop skills necessary in the future professional activities such as: constant self-development, self-discipline, hunger for knowledge, ability to work in a team. No competition, however, is the goal for itself.

Olympiads in Informatics

The achievements of young Poles, school and university students, in international programming competitions in the past 15 years are well known [6]. The Polish experiences are universal enough to be adopted also by other countries and could help to work with students talented in computer science.

The Olympiad conducts intensive educational activities: post-Olympiad materials are published and contain detailed analysis of task solutions; former Olympiad contestants run a portal for beginners in the field of programming and algorithmics [21], finalists of the Olympiad participate in summer camps combining recreation and education. However, talented students are first discovered by their school teachers. The Olympiad organizes also workshops for teachers, where they practice how to work with talented students and prepare them for computer science competitions.

The Olympiad in Informatics for middle schools has been also established in Poland, although students from middle schools may participate in the Olympiad for high schools, and some of them are very successful [13].

The Bebras (Beaver) contest

The idea of Bebras contest was born in Lithuania, by Prof. Valentina Dagiene, where the first contest was organized in 2004. In 2010, Bebras took place in 14 countries, with about 235 000 participants. Some other countries – Israel, Cyprus, Japan, Malta, Russia – are interested to join the contest [1].

The main aim of the Bebras contest is to promote interest in information and communication technologies as well as in informatics (computing) to all school students. Moreover the contest encourages students to use modern technologies in their learning activities more intensively and creatively.

Bebras, like Kangaroo in mathematics, is a one stage contest addressed to school students of all grades. Tasks are on information comprehension, logical and algorithmic thinking, games and puzzles, graphical representations of notions and objects, computer and software functions, etc. Tasks touch also various school subjects and topics.

In ongoing research we want to learn whether and how Bebras results may be used to judge about informatics education and about the development of computational thinking skills through the consecutive stages of school education.

4.4 Project Informatics +

Informatics + is one of the largest outreach projects in Poland, see [11]. It is run by the Warsaw School of Computer Science (WWSI) [20], a private university established in 2000, one of the few private schools which offer a master degree in computer science. The author of this article coordinates scientific and education activities in this project. The project is financed by EU Funds. It is addressed to high school students in five regions (states – *województwo*) in Central and Eastern Poland and it is expected that more than 1000 schools, 15.000 students, and 300 teachers will participate in this project in 2008-2012.

Project goals

The main goals of the project Informatics + are as follows:

- elaborate and implement innovative methods of teaching and learning key competencies in informatics and its applications;
- improve and extend off school students' activities in developing key competencies in informatics and its applications;

- extend students' interests about job market expectations and better preparation for their future choices of professional development;
- extend opportunity talented and gifted students have to improve their informatics interests and competences, in particular those students who are interested in taking part in numerous informatics competitions;
- improve students' school achievements (measured by school grades) in informatics and in other related subjects;
- provide schools with open education content in informatics and its applications;
- introduce school students to an academic type of instruction which differs significantly from school lessons;
- develop teachers' competences in working with students talented in informatics.

Project organization

In this project students may participate in:

- lectures (2 hours);
- lectures (2 hours) followed by computer workshops (3 hours);
- extensive workshops (24 hours);
- competitions, such as: the Informatics Olympiad, Beaver, "Our school in Internet", on 3D graphics, and web contest;
- summer computing camps in an attractive spa – a combination of vacation activities with plenary lectures and discussions, workshops, and on-line competitions.

Moreover, in-service courses are also offered for teachers to improve and develop their competencies in working with students talented, gifted, and particularly interested in advanced informatics topics. Lectures and computer workshops are delivered in WWSI, in one of the five Regional Centers of the Project, and in schools.

The courses are offered on two levels:

- basic – addressed to all students, supposed to extend the curriculum knowledge in various informatics topics;
- extended – these are mainly extensive workshops (24 hours), addressed to students interested mainly in deepening their informatics skills.

The Educational platform Fronter [7] is used in the project as a communication medium, as an element of cloud computing (the platform is hosted in Oslo). It contains all course materials (lecture notes, presentations, education software, programming codes, etc) prepared by teachers and students use the platform to save their works done during workshops. Then students may use all these materials anytime and anywhere when they return home or to school and want to continue their work in class. The platform is also used to build and run tests and to collect students' opinions about the course they attend.

Informatyka + contributes also to the Polish Open Computer Science Platform (*Polska Wszechnica Informatyczna*) which is a collection of more than 60 lectures delivered by well known specialists in various areas of informatics and its applications (WWSI got a prize for this project) http://www.pwi.edu.pl/.

Project topics

The project Informatyka + consists of five thematic modules (we list also titles of some courses within modules):

1. **Algorithmics and Programming:** Searching and sorting – the power of order, Simple computer calculations – can all be computed, Algorithmic techniques, Shortest paths and trees, Data structures and their use (advanced), Advanced algorithms, Matura (final examination) in informatics.
2. **Data Base:** Data base – fundamentals, SQL language (basic and advanced level), XML documents in data base, Technology ADO.Net, Data mining, T-SQL language.
3. **Graphics, Multimedia, Internet techniques:** Graphics editor – GIMP, Working with multimedia, Searching for multimedia in the Internet, Creating dynamic Internet services, Making movies.
4. **Computer Networks:** Computer networks – basic principles of construction and operating, Networks as communication media, Network security, Wireless networks, LAN and WAN.
5. **New Tendencies in Informatics and its Applications:** Algorithms of the Internet, Can computers make business, Concurrency in informatics and in our life, Data exploration, JavaScript, Is P = NP or how to win million dollars in Sudoku, Enigma and contemporary cryptography, Past and the future of informatics – elements of history of informatics, Logic and computers, Introduction to neural networks, Medical informatics.

The courses are prepared and run by teachers from WWSI and from other universities in Warsaw and in Poland. There are more than 60 courses offered. For each course its authors prepare handouts (from 15 pages for a lecture to 50 pages for a 24 hour workshop), Power Point presentation (used during a lecture part of the course), tests and some other materials for students.

Two books will be published: "How to work with students talented in informatics – a guide for teachers" and "Homo informaticus – introduction to contemporary informatics" – it will consists of elementary introductions to various branches of informatics.

First year of the Project

The first year of the project in the school year 2009/2010 appeared to be our great success – 5500 school students participated in the courses: 2214 students – in 88 lectures and workshops (in WWSI), 412 – in 20 afternoon lectures (in WWSI), 2329 – in 47 lectures in schools, 450 – in 37 workshops (24 hours).

In Table 1 we present the results of questionnaires filled in by all participants of the courses, whereas Table 2 contains the results of questionnaires filled in by the students who graduated from vocational schools in June 2010.

The organizers of the project are very satisfied with the students´ opinions about the project, especially with the impact of the project on students' learning and on their positive attitude toward our proposals of courses and other activities.

Table 1. Students' opinion toward usefulness of the courses

Question	Yes definitely	Yes	No	No definitely	No answer
1. Are you interested in studying informatics in the future?	33%	33%	24%	10%	0%
2. Do you think that participation in the project will influence your future decision about your career?	22%	42%	26%	9%	1%
3. Has the course improved your knowledge and skills in informatics?	41%	47%	9%	3%	0%
4. Has the course encouraged you to develop your knowledge and skills in informatics by yourself?	26%	49%	22%	3%	0%
5. Have the materials been useful in the course?	55%	36%	7%	2%	0%

Table 2. Students' opinion toward influence of the courses

Question	Yes	No	NA
1. After taking part in the project, have you improved your grades in informatics?	46%	33%	21%
2. After taking part in the project, have you improved your grades in information technology?	46%	31%	23%
3. Has your choice of informatics related study been influence by the project?	62%	38%	–

Extensive workshops have been organized for contestants of the Olympiad in Informatics 2010. Twenty of them successfully reached the third final stage and two of them will represent Poland in the International Olympiad in Informatics in 2011.

Almost 1000 students participated in the Beaver contest. 5 students won the II Prize and 8 students won the III Prize.

Reflections

As the coordinator of the project I must admit that I am very satisfied with running the project, the enthusiasm of school students and teachers about our offer of courses and activities and the project's impact on schools – they are really interested in improving instruction in schools and giving students new opportunity to learn and develop their skills in the area of informatics curriculum topics and applications.

Personally, let me share one of my experiences. I run some of the algorithmic courses. Once, a group of young girls attended a course on introductory algorithmics. When before the workshop I learnt from their teacher that they have no experience in programming, I thought I would be in trouble but finally those girls were able to understand three simple algorithmic situations (e.g. for given three numbers interpreted as the lengths of triangle sides, find the area of the triangle if it exists) and write in Pascal and run successfully three programs. As one of my colleagues put it: everybody can be taught programming – now I strongly believe him. In fact, computer programming (in any sense) is a tool of computational thinking and as such should be a competence of everyone.

Conclusions

In conclusion, Informatyka + is a valuable project supporting the learning process in informatics and in information and communication technology in schools and helping students to choose their future career.

In the near future we intend to:

- apply to the Ministry of National Education to extend the project to all regions of Poland;
- make the project activities permanent and continues in schools;
- extend the scope of the project by constantly adding new topics, courses, activities.

5 Conclusions

We presented a number of activities in Poland which are outreach projects run nationwide and/or locally. We expect and have gathered some evidence that these activities increase motivation and preparation of school students for their future decisions to study computer science or related fields and become computer specialists.

The approach which we use can be viewed as implementation of computational thinking to teaching and learning informatics (computer science) topics and applications of computing in various areas of students' interests.

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