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## **Novosibirsk Young Programmers' School: A Way to Success and Future Development**

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**Abstract.** When it comes to school informatics, one certainly recalls the name of Andrei Ershov, whose energy and charm guided the first steps in the movement for computer literacy. In the mid-70's Ershov resolutely supported the founders of the Summer Schools of Young Programmers in Novosibirsk. Within the structure of the SB AS Computing Center's Experimental Informatics Department there was founded the first research subdivision with the purpose of formulating the conceptions and developing school informatics software – the Elementary Informatics Group. The guidance seminar “PC and the study process” was started in the Computing Center for the purpose of unification of education with the scientific potential. The ShYuP system, Shkolnitsa, the first textbook in informatics, the first computer study room in School N 166 in Akademgorodok made up of the Soviet-built Agat PCs were parts of a whole – the emerging and rapidly developing school informatics. The Summer School has a lot to be proud of. The Summer School raised and gave a start in life to a great number of programming specialists, who successfully work in the leading research institutes of the SB RAS, and computer and software companies such as Microsoft, Intel, and Excelsior. The early education in informatics, which showed its best in the intensive period of the Summer Schools, illustrates the multiple advantages of this approach. One cannot but mention the skill of naturally and softly use the human factor of working in a team while interacting with the outer world (what later became workshops), concentrating on teamwork under external orders. Another advantage was the chance to communicate with the whole world thanks to the many participants from other cities and countries (Summer Schools with international membership: Czech SSR, Bulgaria, Poland, DDR, France, Hungary). Summer Schools hosted people whose presence and company was a dream; John McCarthy's visit is an example. The pedagogical conception of the Summer School proved its opulence with an almost 35-year history. SB RAS Institute of Informatics Systems cherishes the traditions of Andrei Ershov's school and develops the successful experience of pre-professional programming education of talented youths.

**Keywords:** Computer science, systems programming, educational informatics, academician Ershov, summer school of programming

## **1 Formation**

Since the period of academicians M.A. Lavrentjev and A.A. Lyapunov, much attention was paid to the Siberian schoolchildren who were considered as the main human resource of the Siberian science. The foundation of the physical-and-mathematical school, initiation of the All-Siberian mathematical contest, and the preparation of original teaching courses for secondary school all contributed much to discovering young talent.

Joint efforts of pedagogues, mathematicians, and programmers were aimed at creating an introductory course that should present a computer and basic notions of programming to pupils. During this work, two initiative groups have been formed. One of them was a group on computer science application of the Scientific Council on education problems of the Presidium of the Siberian Branch of the USSR AS. Another was a group of school informatics of the Computing Center of the Siberian Branch of USSR AS (CC); it was a subdivision of the experimental informatics department of CC especially organized for the elaboration of the concept and development of the software support for teaching informatics at school. A specialized seminar titled “Computer and teaching process” also started its work in support of integration between science and education.

## **2 School Informatics – The Beginning**

Whenever we talk about school informatics, we always mention Andrei P. Ershov, a pioneer and leader in this field who headed the movement for “computer literacy”. We can read in his diary [1] about the first contacts of pupils with the researchers of the programming department of the Institute of Mathematics of SB USSR AS in 1961, and in 1964, one of them became a teacher of programming in the 10<sup>th</sup> grade of one of the Novosibirsk schools.

The first lectures of the optional course of programming for pupils and their practical work on computers took place at the beginning of 1960-ties on the base of the school No. 10. The lessons were given by the researchers of the Institute of Mathematics (later they transferred to the Computing Center) with A.A. Baehrs among them.

Programming as a professional orientation course for 9-10<sup>th</sup> grade pupils was introduced into school No. 130 of the Novosibirsk Akademgorodok. We should note that this form of teaching became rather popular in Soviet schools and was in the school program until the 1990s. Several teaching courses were tested within these studies. Thus, at school No. 130, the courses were based on different programming languages such as Algol, Basic, and Fortran. It was also the place for experimental research in computer application to the school teaching process in general such as preparation of tests in English with the use of a computer-aided control system, which recognized the answers in a text form (this is now called the inter-subject relations).

### **3 Young Programmers' Schools**

A.P. Ershov has strongly encouraged those who were the founders of Novosibirsk young programmers' schools. Among his first like-minded colleagues were N.A. Sadovskaya, the post-graduate of the Computing Center, and S.I. Literat, the head of the teaching department at school No. 130, the organizers of the first Young programmers' Summer School held in 1976.

Later, in 1977, A.P. Ershov invited G.A. Zvenigorodsky from Kharkov to participate in activity related to school informatics and, in particular, Young programmers' school (YPS). He was the author of the idea of the first programming environment for teaching process automation, (an applied program package "Shkolnitsa"), as well as the programming languages Robik and Rapira. A.P. Ershov considered the local YPS [2] as the most important form of working with schoolchildren. By 1981, there were about two hundred pupils in it.

Much attention was paid to the teaching plan for the junior (starting from the second grade) pupils. It should take into account not only the requirements to the programming languages but to the software system specially developed for teaching purposes. In addition to two lessons a week on programming theory, there was a possibility to work on computers of the Computing Center in the morning hours on Saturdays and Sundays. The teachers of the local YPS were researchers and engineers of Computing Center, and post-graduates and senior students of the Novosibirsk State University who were specialized in school informatics.

We should note that after a year of studies in YPS, many young programmers were involved in the real production projects. For example, they participated in the development of the system for analysis of primary structures of protein compounds, book exchange system, a tape perforation program for program-controlled embroidery machines, and so on. Besides, they took part in implementation of educational software systems, such as a compiler for Robik and Rapira, of the computer graphics system Shpaga and others.

In September 1979, a by-correspondence school for young programmers was started on the pages of the Kvant journal by N.A. Yunerman (Gein), a new member of the school informatics group just moved to Akademgorodok. Its best pupils were invited to Novosibirsk Summer YPS. Let us provide more details about the Summer YPS, a very important part of the programming teaching system.

### **4 Summer Young Programmers' Schools**

The Summer Young programmers' school (SYPS) has many achievements for which to be proud. The system of informatics lessons for junior pupils clearly presents multiple advantages of this approach [3]. The by-correspondence school (namely, the contest held in the end of each school year) strongly influenced the selection of schoolchildren to be invited for two weeks to participate in SYPS.

After the first five years of holding SYPS, we had elaborated the system of studies. Pupils were separated into three groups: novices, those who knew the basic notions of programming, and young programmers who had some experience. It appeared

actually that two weeks is quite enough for a novice to gain some skills in programming.

The curriculum of SYPS included two conferences. At the beginning, children presented their work implemented at home; the concluding conference was a report on programs written at SYPS. Some of presentations were recommended to be published in *Kvant*.

Among the favorite teachers of SYPS were well-known Soviet specialists and pedagogues like A.N. Terekhov, N.N. Brovin, L.E. Shternberg, O.F. Titov, Yu.I. Brook, and others who worked with enthusiasm on the first lessons of programming. Contacts with children of the same age and interests was very fruitful for everybody at SYPS, including its foreign participants from Czechoslovakia, Bulgaria, Poland, Germany, Holland, France, and Hungary. The visiting lecturers of SYPS were world-known persons, like John McCarthy, a famous American specialist in artificial intelligence. The SYPS had a great impact on the choice of future profession of a large number of its participants who work now in many Russian and foreign IT companies.

## **5 The Ershov Summer School of Young Programmers Today**

Since 2001, SYPS is held during two weeks of July, a very convenient period for invitation of the NSU students and lecturers and the researchers of the institutes of SB RAS to work with schoolchildren. This event now takes place out of town in a tourist camping or a sanatorium in a picturesque place (once in two or three years they hold it in Altai [4]). The main goals of SYPS are the following: to select talented senior pupils interested in programming as their future job; to teach all the participants how to work in a team using modern IT technologies; to encourage junior pupils in their efforts to have more programming practice; to support teachers who are successful in this field.

The participants of SYPS are selected by their results shown at the previous Summer schools or at other events including the team contest in programming, the program “Young Siberian Informaticians”, the contest in programming for the Novosibirsk region schools, the regional scientific-and-practical school conference in informatics and programming, and others. Some of the participants are personally invited by the teachers or by members of an organizing committee.

The members of the organizing committee of SYPS (many of them are researchers of the Ershov Institute of Informatics Systems of SB RAS) work much for the success of SYPS. Information about all abovementioned events is distributed through all possible channels including local newspapers and informative leaflets, the web-page of SYPS (at the IIS web-site), and booklets distributed at schools of Novosibirsk and other cities. Many pupils come from the cities of different Siberian regions, from Kazakhstan, Altai region and European part of Russia (St-Petersburg), even from foreign countries such as Norway.

As usual, SYPS is equipped with twenty-five to thirty computers provided by IIS SB RAS and sponsors. Unfortunately, they sometimes need substantial upgrade. Its participants in their photos and videos highlight school life. The most important breakthrough in the technical equipment of the school was the use of satellite

telephony during the whole working period; it is very promising as a means of distant internet communication with those specialists who have no possibility to attend the school.

## **6 Workshop as a Basis of the Teaching Process**

Since 1989, SYPS in Novosibirsk, in contrast to such schools in other cities, is held as a school with advanced courses in separate school subjects at pupil's choice, and its major goal is professional orientation of senior pupils. For this purpose, they introduce programming as an industrial activity with its problems, methodology, creative and technological aspects. The new notions and objects of studies are software product, the development process, correct problem statement and its formalization, job scheduling, debugging, preparation of documentation, and reporting on the project. For better comprehension of these notions, the teaching process is divided into ten or fifteen workshops of different profiles, according to different components of the software production cycle, where pupils can gain knowledge and skills during their teamwork on a project. The spectrum of topics studied in the workshops is very wide, so that every pupil could find something according to his level and interests.

The work in a workshop is supported with a course of lectures and specialized seminars on programming languages and systems, perspectives and problems in programming, informatics history and other disciplines, which provides pupils with a wide knowledge in computer science and interdisciplinary directions. In addition, there is an everyday "Task of the day" – a contest in solving an algorithmic task. A real pleasure for everybody is a cycle of lectures given by well-known scientists.

The major goal of each workshop is to go through all parts of a separate technological cycle in the framework of the stated problem and to present the results achieved in the process at the concluding school conference. The intensity of work needed to fulfill this task makes the stages of preliminary problem statement and job scheduling much more important. This was attractive for workshop supervisors in the aspect of testing new methods of project management under the permanent deficit of time and computers.

So, professional orientation of pupils of SYPS is directed to the following:

- Extend the knowledge of pupils in IT technologies and their applications;
- Present typical problems and methods to solve them,
- Present the sphere of possible future application of their capabilities,
- Provide pupils with special knowledge and skills of a team work.

## **7 Workshop Life**

Preliminary division of pupils into workshops takes into account the results of interviews and their personal interests in a particular topic presented at the SYPS website. Children work in small groups supervised by experienced programmers on original projects. They become familiar with new computer tools and techniques and

gain an invaluable experience of teamwork. The problem for a supervisor is not only to teach but also to create the atmosphere favorable for further growth of each participant of the project according to his capabilities, interests, and level. This level may vary but the necessary requirement is to know some programming language and to have certain programming skills. Workshops, in turn, are supervised by the head of the “teaching department”.

To estimate the results of workshops’ activity, there is a special jury of SYPS. The jury considers, first of all, the progress in pupils’ knowledge and skills with the main attention paid to their capability to state a problem and to present and justify the results. Next, they estimate the software product qualities such as a convenient user interface, documentation, and presentation. Other parameters of estimation are the quality of report, a pupil’s understanding of the task, and his or her own place in the workshop.

The members of jury give preliminary estimates a couple of days before the end of the school, which allows them to find weak places in the work and to make timely corrections in the teaching process. As usual, all workshops have time to complete demo-versions of their projects, and some of them prepare very good documentation.

The concluding conference of SYPS is keeping the best scientific traditions. The speakers are competent in their presentations, the audience is active and shows its high qualification, and true interest in the results here presented. It is a well-known fact that the decisive factor of success in any job is very often a good presentation of results, so participation in the concluding conference is obligatory for all workshops. All presentations are discussed and the best solutions are chosen. Many recommendations are given on improvement of other products. A very important person is the conference chair who is leading the discussion in a respectful manner.

## **8 Efficiency of the Summer Young Programmers School**

The Summer School is efficient from many points of view. Thus, for the Siberian Branch of RAS, this is a very important mechanism for attracting young talents to computer science and the IT-sphere of national economy. For parents, this is a very good form of a summer recreation combined with obtaining knowledge-on-demand. Children coming from other places have a great opportunity to communicate with their new friends and just to have nice sightseeing.

For the Novosibirsk State University and, in particular, for its departments related to computer science and IT, the school made possible the following:

- Test the methods of teaching informatics to junior pupils,
- Attract to NSU more students interested in programming and IT who can take part in future contests and NSU projects,
- Raise the professional level of students,
- Attract students to teaching activity and to train them as future project managers and analysts (business-informatics).

For the administration of the Novosibirsk region, the experience of out-of-town work with children is very valuable because it can be extended and applied to rural schools, which will increase the quality of school education.

For IIS SB RAS, it is very important that its staff members and post-graduates take part in the experiment on teaching informatics in the form of a workshop, an idea that was suggested and implemented by researchers of this institute. They found that young people are interested in new forms of experimental work in the area of informatics systems. An experiment is in progress on organizing a programming school (Sundays, evenings, and distant learning) for advanced workshop teams during the school year; the theme "Investigation of informatics foundations and methods of teaching informatics and programming", which is in the research plan of IIS, is being developed. For the Novosibirsk IT-industry, the mechanism of SYPS provides an opportunity of early professional orientation of schoolchildren.

Almost thirty years of history of the summer school has proven that it is a consistent pedagogic idea. IIS SB RAS is carefully keeping up the traditions of Ershov's school and it is working for further progress in teaching informatics and programming.

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