Preparing for the IOI through Developmental Teaching

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Abstract. The upbringing of future winners of the IOI is a difficult task with many aspects. The best teachers and coaches in many countries are struggling to solve it. Up to now, ready-made recipes have not been offered. The experience gained in some countries could help to identify patterns of working with talented children, which have a significant impact on their success, combining the development of talent with the specifics of the child's age. This article describes the methods of preparation of Russian students for informatics olympiads, including the IOI, which have proved their efficiency for many years. Particular emphasis in the preparation of students rests on the development of their talent, not on solving many competition tasks. On this basis, the most appropriate ways of training gifted students, as well as the used information resources and modern information technologies, are described.

Key words: informatics, computer science, secondary school education, informatics olympiads, IOI, preparation for informatics olympiads, methods of work with talented children, reproductive teaching, developmental teaching, anticipatory teaching, Internet resources for informatics olympiads, self-study work of gifted students.

1. Introduction

There is no doubt that a significant success in the IOI can be achieved only by students who are gifted by nature. Along with the necessary knowledge and the skills required for solving non-standard tasks, such students have important personal qualities – self-improvement abilities, self-confidence, striving for success, etc.

Since the IOI is an objective estimation of the degree of gifts possessed by its participants, all of the above should be voiced in the development of talent through preparation for the IOI. Clearly, in this case the process of personal development must be organized in a way, which organically combines mastering of knowledge and cognitive methods, skills formation and development of creative activity; defined by the content of the IOI. From the other side, it is necessary to include, in all topics of the IOI content, elements that promote the development of personal qualities such as concentration on goals, perseverance to achieve results, responsibility and self estimation, mutual help and support in team-

work, friendliness, empathy to the opponent, self confidence, focus on high achievement, an adequate level of claims, etc.

Russian specialists have accumulated considerable experience in the identification and development of gifted students in informatics and information technologies within the Russian Olympiad in Informatics (RusOI). They use specific methods that encourage creativity, based on a system of tasks, which require problem-oriented, retrieval, heuristics, research and project-oriented working, both as individuals and in a team. These methods have highly informative and motivating potential, which corresponds to a higher level of cognitive activity and interests of gifted students.

And more, the recent forms of organization for working with gifted children, especially in the training for informatics olympiads, has undergone strong renewal under the rapid development of education and information technologies and scientific knowledge. A particularly strong influence on this has been the emergence of the Internet on the life of schools, children and families, because the students get real access to resources that help to demonstrate their talent. In this paper we consider in details how this affects the preparation for programming contests, including the IOI.

In Section 2 different traditional models for organization of students' preparation are considered. Section 3 is devoted to creative development of talents in the process of preparation. Different methods and forms for preparation for the IOI are presented in Section 4 and Section 5, and some conclusion – in Section 6.

2. Traditional Models of Preparation for the IOI

Recently, widespread opinion has been that the more competition tasks a students have solved in the preparation process, the more chances they have to succeed at the IOI. Moreover, the process of preparation is structured in such way that, first, the student solves the proposed tasks, and then, after evaluation of the solution, looks for mistakes with the help of a coach or the available resources, including Internet resources. When the students are not able to produce solution, the coach explains to them one possible algorithm, and the student memorizes that algorithm.

This approach, founded on reproductive teaching, is popular due to habit. Its basic disadvantage is the absence of a developmental aspect, as it is constructed on a reproduction of patterns. Because of their extraordinarily ability, gifted child cram into memory patterns for various difficult tasks and the techniques to solve them, subsequently reproducing the stored solutions (Fig. 1). We will call such a model the "Reproduction of patterns with support of memory". In this case, development of theoretical knowledge and technological abilities is subordinated to features of the tasks and aimed at accumulation, not on discovering the underlying problem-oriented situation.

Another way to apply the above mentioned model is the participation in as many different programming contests as possible, which are currently carried out often enough, especially on the Internet, with subsequent analysis of unsolved or partially solved tasks. Certainly, participation in programming contests is necessary, and it has a lot of positive
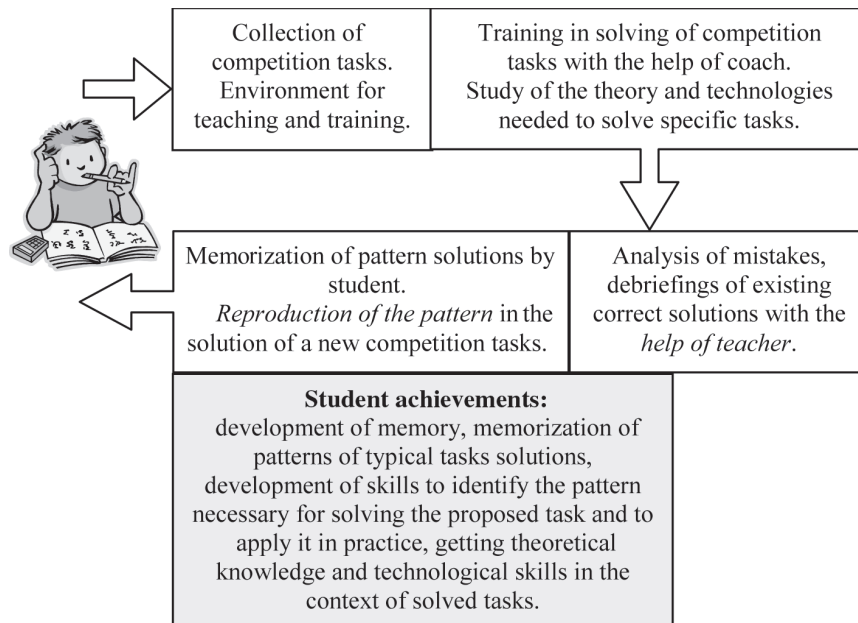
Collection of competition tasks. Environment for teaching and training.	Training in solving of competition tasks with the help of coach. Study of the theory and technologies needed to solve specific tasks.
Memorization of pattern solutions by student. *Reproduction of the pattern* in the solution of a new competition tasks.	Analysis of mistakes, debriefings of existing correct solutions with the *help of teacher*.

Student achievements:
development of memory, memorization of patterns of typical tasks solutions, development of skills to identify the pattern necessary for solving the proposed task and to apply it in practice, getting theoretical knowledge and technological skills in the context of solved tasks.

Fig. 1. The model "Reproduction of patterns with support of memory".

aspects: it teaches the mobilization of forces, persistence, and forms the ability to sustain long time pressure. But competitive activities are only implementation and demonstrate only the already achieved capabilities of students. In this case, considering participation in programming contests as preparation for the IOI would be not quite correct. In this case a gifted students fall into the training environment imposed by the specific competition, where they could not choose new trajectories or discover more useful topics and tasks. New knowledge is perceived in the context of the proposed tasks. It is formed haphazardly and is not fixed as a private intellectual achievement of the student.

It is possible to emphasise positive influences of the reproductive approach to memory development and acquisition of experience in specific field. Its disadvantages are the lack of focus on creativity and the search for non-standard solutions, on novelty of ideas, on raising the desire to seek own solutions and striving for self-discovery of truth (possibly well known for the teacher, but new for the student).

Clearly, the reproductive approach aims not at developing of talent but at intensive training on the basis of another's solutions or solution patterns. It displaces the emphasis of teaching from the development of talent to the intensive practice and memorization. This leads to insufficient study of the theoretical bases of trained topics, and as a consequence – decreases the potential for the generation of new ideas.

When in a competition task set there is a task which the students have not solved earlier, they do not find in their memory a pattern for reproduction, become stressed and lose belief in their forces; as a result – refuse to think out an original solution. This precisely shows how the violation of rules of development of talent leads to decrease of creative activity and volition of the student, so necessary during the competition. Results of partic-

ipants prepared in such a way at the IOI are often rigidly differentiated: 80–100% of the points if the pattern of a solution is known or 0–30% if the pattern is not known. Moreover, such students demonstrate best result in their last school year, which is quite natural.

The model of reproduction of patterns with a support of memory justifies itself only in a case when a gifted student, for some reason, has not been involved in olympiad movement early and his preparation is limited to last 2–3 years (grades 9–11) of specialized school. It demands intensive work and endurance, does not give steady results on competitions and leads to stress.

Further development of the above model is based on the formation and phase expansion of the so-called in Russian pedagogy *the zone of nearest development* of the student, which is an area of further in-depth and phase learning topics in informatics required for olympiad preparation and interesting to student. Such approach gives students the support to move towards the new knowledge and skills independently, to the discovery of new ideas and solutions without the help of a coach, that is, to create a product of their creativity.

In this context, solving competition tasks has to play the role of mediator, leading the talent on a trajectory of development. Analysis of another's solution can be a valuable pedagogical tool only if it is based on a partial student's solution and preliminary independent analysis and search for mistakes. Such analysis of a difficult task solution becomes not a pattern, but a support in teaching. If, after an analysis of a correct solution, the students can find their own original solution or can create a task with similar solution and develop tests for it, then it is possible to say that reproductive teaching is built in competently in the development system and provides good results (Piaget, 1983). Such methodology is based on the productive activity of the student and called the Model of productive teaching "Stages of development" (Fig. 2).

Certainly, using this model, it is possible to reach a certain level of qualification, and even to show good results in some competitions. However, it does not guarantee success at the IOI, especially when the goal is the gold medals. The results of the IOI participants prepared using this model usually range from 30% to 60% of the points for complex tasks and grow gradually with the maturity of the student. The model justifies itself in a case when the gifted students are involved in regular preparation, from 7th to 11th grade, studying informatics at school with obligatory regular additional preparation in a system of elective courses in informatics and mathematics.

"Stages of development" is the traditional model of preparation in Russia today. It requires regular attended classes, work with a coach in a group, home self-preparation and use of resources on the Internet. It should be emphasized that it is a teaching model with elements of development, but it is still not a development teaching system acting in harmony with the growth of gifted students and not even an individual plan for harmonious development embedded in the educational environment at school.

To achieve stable progress in the development and manifestation of the talent for solving complex tasks, it is necessary to enrich the "Stages of development" model with developing approaches and, first of all, to move from a rigid binding to competition tasks only, to someone else's solution and to an age threshold of complexity in informatics

3. Productive stage of expansion of the zone of nearest development
Self- study work:
solving of competition tasks with self-produce full solutions by own original way, developing like tasks and tests for them.

Student achievements:
discovery of new knowledge, progress in obtaining of new information technology skills and ability to develop of products of creativity.

2. Reproductive stage in the zone of nearest development
Teaching with teacher:
analysis of the pattern of complete solution, identifying needs in the theoretical and technological preparation and study identified shortages.
Self-study work:
repeated multiple approach to solving of tasks and obligatory obtaining a complete solution.

Student achievements:
receive a full solution of competition tasks with support on the pattern, acquisition of new knowledge and new information technology skills.

1. Productive stage in the zone of nearest development
Self-study work:
solving of competition task, the multiple approach to solve them with the possibility of obtaining partial solutions, analysis of mistakes.

Student achievement:
maximum progress toward the complete solution using partial solutions tasks with support on current knowledge.
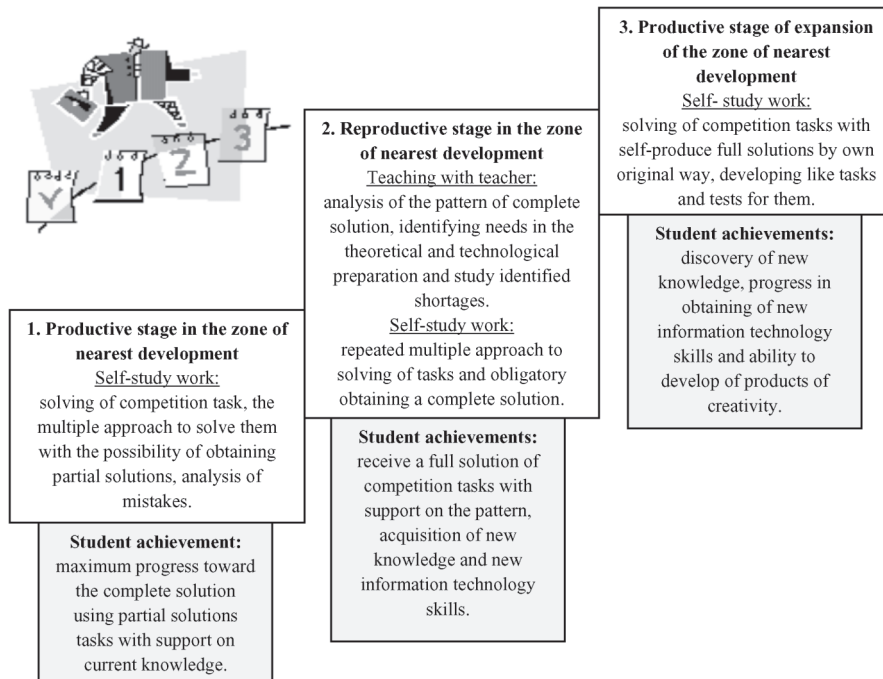
Fig. 2. Model of productive teaching "Stages of development".

teaching at school. It is important to refocus on the discovery of new knowledge by the students themselves through a wide range of courses in topics that help the development of talent. It is necessary to ask the students to search for original solutions to difficult tasks and to encourage them to compose their own tasks on the basis of patterns. It is also important to expand preparation, applying informatics in educational projects of school, which help students' development with a combination of new knowledge and skills, placing them in an area of the nearest development. In other words, it is necessary to provide the formation and expansion of an individual student's development horizon in the frame of the olympiad preparation system prevailing today.

3. Creative Development of Students in Olympiad Preparation Environment

In Russia, for the development of creative abilities of students, the theory of *developmental teaching* offered in the 30 years of the twentieth century (Vygotsky, 1991) is widely used. According to this theory, the leading aspect of methods for development of creative ability of children is the shift from a teaching process to a process of learning and development. Another aspect of applying this theory, reflecting the orientation of modern society to the knowledge processes, is the assimilation of new scientific and technological achievements, particularly in the field of informatics and information technologies, and their introduction into the context of the lives and studies of gifted students.

In preparing students for the IOI attention should also be given to practical skills. From participants of the IOI it is required not only to generate ideas and to develop algorithms for the solution of a competition task, but also to implement it correctly in the given programming environment. This presupposes for IOI participants not only the knowledge of one programming language, but also ability to work with corresponding operating system, compiler, debugger and the other software available during the competition. It is no less important for the IOI participants to possess the technology for testing programs, including the development of tests and auxiliary programs for the testing of their solutions, because tests development could be quite complicated itself and also requires a creative approach.

As experience has shown, work with gifted students in the process of preparation for the IOI determines the basic principles of *cooperative pedagogy* that characterizes the work of teachers and coaches. Such pedagogy assumes the refusal of intellectual slavery and is implemented on the experience both of the student and the teacher. Implanting another's ideas, even of great people, is still not a key to independent thinking. To build up a student's inner world, to express it through words and good deeds, that is the essence of creative activity of the student, and the role of teachers or coaches is to help as much as possible for resolving this problem.

Such support from a teacher or coach allows the student to find original ways for solving tasks, often not known by professionals. Such small achievements of gifted students also bring their unique contribution to the work of adults, opening up for them new aspects and ways to approach competitive tasks. And this is the invaluable effect of cooperative pedagogy for coach and student: each contributes to the development of creative potential of the other.

Applying the area of the nearest development concept in preparation for the IOI allows reaching the nearest border of developmental teaching – a complexity threshold. The first steps in the manifestation of student's talent can be regarded as overcoming this threshold. In combination with additional (individual or in small groups) teaching, advancing teaching of gifted students in the area of their cognitive interests forms a development horizon of a particular gifted student, which is called the "mental horizon" (Dewey, 1990) – the upper bound of developmental teaching during the given age period. Naturally, the development horizon is extended in the process of the student's growth and increasing of their individual achievements in the area of the nearest development. Thus, movement toward the development horizon is going on at an individual pace on complexity thresholds, each of which has their own area of the nearest development. Advancement to the individual development horizon with a teacher or coach is fully implemented in solving of competition tasks. Competition tasks in this sense are advancing tasks, and various programming contests represent the complexity thresholds for the student. Undoubtedly, they make a basis of anticipatory teaching model which could be called "Development horizon" (Fig. 3).

This model of training gifted students, based on anticipatory teaching, should be applied from early childhood. This will allow the building of the development horizon of a gifted student, constantly expanding the area of the nearest development, solving difficult tasks, and even creative and research tasks, challenging unique student abilities to
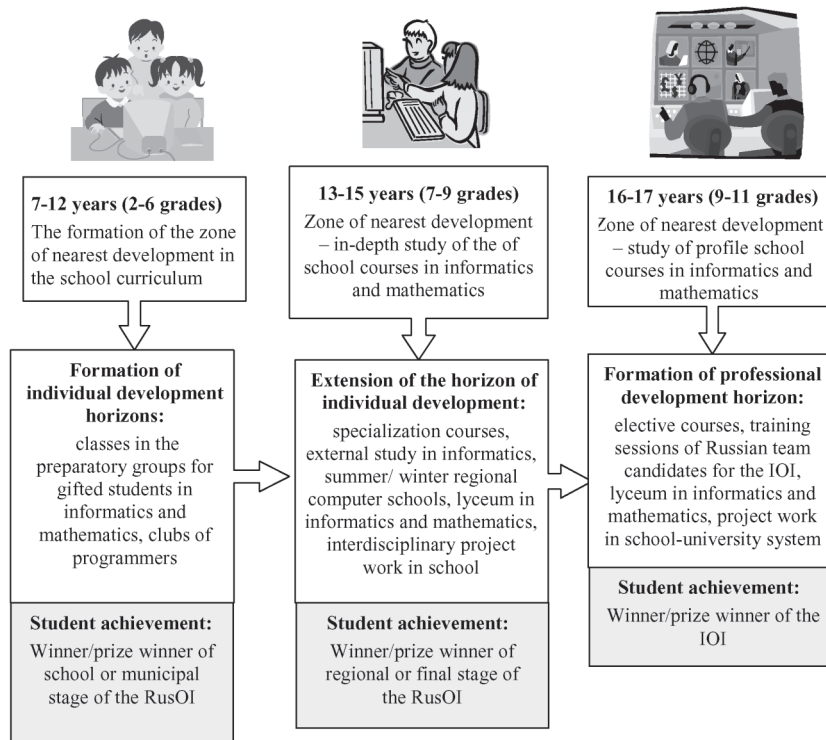
7-12 years (2-6 grades) The formation of the zone of nearest development in the school curriculum	13-15 years (7-9 grades) Zone of nearest development – in-depth study of the of school courses in informatics and mathematics	16-17 years (9-11 grades) Zone of nearest development – study of profile school courses in informatics and mathematics
Formation of individual development horizons: classes in the preparatory groups for gifted students in informatics and mathematics, clubs of programmers	**Extension of the horizon of individual development:** specialization courses, external study in informatics, summer/ winter regional computer schools, lyceum in informatics and mathematics, interdisciplinary project work in school	**Formation of professional development horizon:** elective courses, training sessions of Russian team candidates for the IOI, lyceum in informatics and mathematics, project work in school-university system
Student achievement: Winner/prize winner of school or municipal stage of the RusOI	**Student achievement:** Winner/prize winner of regional or final stage of the RusOI	**Student achievement:** Winner/prize winner of the IOI

Fig. 3. Anticipatory teaching model "Development horizon".

apply the knowledge in practice. It is possible not only to solve competition tasks but also to work with hypotheses, to explore different methods of getting knowledge, to feel the necessity for the generation of ideas, for mastering unique technologies of working with information.

It is important to note that the identification of gifted students in the domain of informatics should begin as early as possible, and for that purpose contests in primary school can be used, which also must be focused on the development of algorithmic thinking, mathematical ingenuity, and the desire to use computer as an assistant in searching for task solutions and implementing ideas. In this case, their development horizon is the desire to become a winner of contest for their age group.

For enthusiastic students of grades 5–6 the dominating areas of nearest development are the areas of school course and out of class study group, and the development horizon is an additional group of teaching upon students' request. This teaching is carried out by a teacher with the use of the tasks from the school and municipal stage informatics olympiad. Development horizon in this case is the achievement of a winner diploma at the school stage of the RusOI.

For students of grades 7–9 the area of the nearest development dominates, which is determined by electives courses in informatics for small groups of students and these are carried out by school teachers. These elective courses are supplemented by school

informatics courses, and the development horizon is an individual teaching with tasks from the municipal and regional stages of the informatics olympiad. This teaching is carried out by the regional coach. Development horizon in this case is the achievement of the winner diploma at the municipal and regional stages of the RusOI.

For students of grades 9–11 the horizon of development dominates, and it is complemented by the area of the nearest development: elective courses and profiled high-school courses in informatics, carried out by school teachers. Horizon development is the individual self-preparation, using tasks from the final stage of the RusOI and the IOI with the support of regional coaches, as well as regular participation in specialized team practice session. The development horizon in this case is the achievement of the winner diploma at the RusOI final stage and motivation to participate in the IOI.

As seen from the description of this environment, it guarantees successful promotion of a gifted student to the highest results. Success is ensured by the quality of school education, possibility for profiled education in informatics, cooperation between schools and universities in the individual preparation of talented students, as well as access to resources for self-preparation.

Practical usage of the development horizon model has allowed the defining of five methodical supports, based on this model, which are characteristic for training gifted students in their preparation to the IOI:

The support on individual culture consist of speed of thinking and reaction, speed of reading, speed of typing, and so forth. All these qualities could be developed from an early age, which certainly allows students to show talent with a higher effect. It is easy to check the level of development of these qualities because they indirectly affect speed of execution of any creative tasks.

The support on heuristic knowledge is the ability of a student to approach complex topics by solving tasks and to apply knowledge in practice. For estimation of achievement of this support, the brainstorm method for search of original solution of complex tasks is proposed. In this case it is important that a students find alone the idea of the solution of a problem, formulate and prove hypothesis, using their experience of discovery. The higher achievement here is the usage of all knowledge for composing competition tasks and approaches to their solution.

The support on technology consists of an excellent knowledge of the competition environment and ability to use it for implementing ideas of solution in practice, which also requires skilful use of the computer. In order to implement their discovery in practice, the students should be able to competently use a given programming system, to implement the algorithm in a program, to search for and eliminate syntax errors in the program, to tune the program and to achieve the best possible result. Here important qualities such as the ability to work with the task statement, to construct a formal description of the task, to search or choose ideas for the solution and a method for appropriate implementation first as an algorithm and then as a program. In addition, an important aspect of technological effectiveness is the ability to debug/test the solution.

The support on systematic is based on the usage in teaching of such tasks which require comprehensive application of all three above-mentioned supports. This requires

a specially selected system of competition tasks sets for a particular student. Thus, it is possible to use already available complete sets of IOI competition tasks. To assess achievement of support on systematic it is necessary to verify a student's ability to analyze the obtained task solutions, to achieve systematically smooth and high results on each set of tasks, and also to develop independently similar competition tasks with the full system of description including not only the task statements, but also formats of input and output data, descriptions of algorithms corresponding to each level of complexity for the task and set of tests.

The support on creative activity is based on the development of the students' desire to share their creative experience with others. It is possible to form such qualities on the basis of student performances after competition with analyses of tasks solutions and preparing lectures on topics which they have thought up creating their own tasks. But most important is involving the students in scientific research where their talent could be used in solving real research problems. Early entrance of the gifted students in the scientific community, participation in research or other scientific work will enable them to see themself in science and profession, find horizons for practically using their talent in various fields of knowledge. Omission of such work with student leads to deformation of their talent, concentrating only on competitions, solving problems in the name of gaining points, which restricts the personal development of the gifted students and usage of their talents in the profession. To assess the level of student creative activity it is possible to use the traditional forms for the assessment of achievements of young scientist.

4. The Modern Forms of Preparation for the IOI

Forms of preparation for the IOI are always influenced by objective factors: information resources accessible to the school and the family; professional skills of teachers and coaches; level of development and distributions among teachers and coaches of modern educational techniques for training gifted students, and especially the new information technologies.

Along with traditional forms of preparation for the IOI there are now are actively developing network forms. Development of network forms of training begun with the creation of network olympiad communities all over the country. These network communities had no territorial borders and were closely connected with the student's teams that regularly participate in ICPC, from Russia and the world. Additional to the process are the regional communities of teachers and coaches, which also began to appear on the Internet. It is obvious that the inherited dissociation of training of gifted students will pass gradually away.

Openness and accessibility of the Internet immediately stepped up the work on development of methodical digital collections for support of the olympiad communities. For a short time various websites appeared that contain materials useful for training contestants at different levels. Now there are many of those websites that are used actively by the students in preparing for the IOI.

Another new form which begun to actively develop recently is the organization of on-line programming contests. Each student can participate in those contests; it does not mater where they study or reside. This gave, from one side, an impulse for development of new forms of self-preparation and, on the other side, created the necessary conditions for all contestants to demonstrate objectively their abilities and afford themselves to the olympiad community.

An important consequence of the appearance of on-line programming contests is the formation on the Internet of a distributed portfolio of each student. Such a portfolio is a personal folder of the students with their competition tasks solutions and their rating in the databases of participants in the various programming contests, including the IOI. It allows the creation of new and unique approaches for selection of gifted students and presenting them to community of coaches, irrespective of their residing place.

Now the network forms of training gifted students and their preparations for the IOI continue to develop. These also include distance teaching (schools with remote access, remote teachers, distant centres of additional education, etc.), the creation of Internet resources that contain a large number of competition task and real time evaluation systems, and other services such as video web sessions. This will eliminate the unequal conditions for tutorship, will allow students to use video resources on the Internet with lectures given by leading teachers and famous scientists and also to work with them in a remote mode. Development of such forms will continue, because expanding the number of contestants leads to shortage of qualified teachers and coaches, but the appropriate expanding of the number of specialized schools and communities of qualified teachers and coaches, obviously, is not possible.

Considering the development of forms for preparation for the IOI it should be noted that the appearance of new forms does not deny all existing forms, especially those that prove themselves in practice. Moreover, such forms could be integrated with new ones, providing an evolutionary transfer from one form to another.

5. Self-Preparation for the IOI – Individual Horizon of Development

For any forms of training gifted students in their preparation for the IOI, self-preparation remains one of the most important components of success. It does not matter how talented or gifted is the student by nature, only an intensive self-preparation and devotion will allow them to go to the top of the informatics olympiads. The most important component of teachers or coaches work here is to identify an individual learning trajectory for each gifted student and organize their self-preparation.

Development of Internet technologies and their widespread use at schools provides students with excellent possibilities for self-study work in their preparation for the IOI. This concerns the choice of school for further studying, the choice of education institution for extracurricular activities or coach, and the choice of methodical and/or teaching materials, proposed in printed or electronic form. This also applies to teachers or coaches who have the opportunity to identify talented students and organizations working with them in a remote mode by using the possibilities of the Internet.

The basis of self-preparation for the IOI and constructing individual trajectories of such preparation consists of the following methodological and didactic materials on informatics olympiads:

- IOI Syllabus (Verhoeff *et al.*, 2006) and Complex Curriculum of Olympiad in Informatics Preparation (Kiryukhin, 2007, 2009) that define the content of preparation;
- materials for theoretical preparation, presented in printing or/and electronic forms, including video lectures;
- collections of competition tasks of all levels of complexity and topics, with short methodical instructions for their solutions (Kiryukhin and Okulov, 2007; Kiryukhin, 2008, 2009, 2011);
- websites with competition tasks collections and the possibility of automatic on-line evaluation of submitted tasks solutions;
- websites providing regular on-line programming contests.

Informatics olympiad contests are the basis for the development of trajectories for individual preparation for the IOI. This concerns both theoretical preparation and building of individual strategies on tasks solving that allow the covering all topics and didactical units of contents.

Despite the availability of sufficient number of digital educational resources on the Internet, students should focus on working with books. Reading books deepens and expands knowledge acquired by students in the classroom, promotes mastery of the methods of solving olympiad tasks and the application of knowledge in complex and non-standard situations. A culture of working with a scientific book thoughtfully and recording the facts, necessary for solving a task, in a notebook is an essential part of the general culture of students' self-preparation.

Now in Russia there are many published books that can be of great benefit to students, preparing themselves for the IOI as well as to teachers and coaches working with these students. First of all we have to mention the series on informatics olympiads by the publishing house "BINOM" (BKL, 2006) and by the publishing house "Prosveschenie" (Prosveschenie, 2010).

Among students the opinion criculates that books have already passed away and all necessary information for olympiad preparation can be found on the Internet. But this is not true, because the book remains the only source where the information is systematically presented, methodically supported and the reliability of information contained therein is carefully verified at all stages of preparing book by a publishing house. Moreover, necessary and useful information is contained in the book in a compact form. A book is always available, easy to work with, and does not require long search on the Internet.

Internet resources with collections of competition tasks are very popular among students, teachers and coaches, as many programming contests in informatics summarize their results immediately after the event and publish them on the Internet. From one side it is good to have all this information available, but from the other side, it seriously complicates the process of students' preparation for informatics olympiads. It is important not to solve tasks in accidental order but to build the most effective trajectories of tasks, covering the modern contents of informatics olympiads.

It is important to note, that IOI competition tasks are specific. Most of them aim to evaluate the creative potential of students supposing a lack of professional knowledge and skills. This is achieved through the multilevel character of such tasks, but not in terms of task statement, but in terms of variety of possible algorithms for solving them. In this case, the size of the possible input and run time limit defined in the task statement determine its complexity. Evaluation of a solution takes into account not only the total but also any partial (incomplete) solutions, i.e., solutions able to solve the task, inside the time limit, on smaller than specified in the task statement size of the input. So, competition tasks with the same statements as in the IOI, but with smaller sizes of the input, could be solved by beginners. That is why an important aspect of self-preparation for the IOI is the ability of the students to analyze their own solution and to decide whether it is partial or complete.

A very important role in the process of evaluating of solutions belongs to the set of test cases because each test or group of tests tries to prove correctness and efficiency of the solution and has its own "weight" in the evaluation criteria. That is why contestants have to be ready to generate their own test cases during the contest. Generating appropriate test cases is neither easier nor less interesting than creating the solution of a competitive task. The opposite, it is quite a difficult problem, which the IOI participants have to solve during the competition also. And corresponding abilities have to be formed in preparation time.

Ten years ago the task evaluation process was a great challenge both for the students and teachers or coaches. The introduction of automated evaluation systems has drastically changed the situation for the better. Now, there are many websites on the Internet with the functionality to evaluate the solutions of students online. Developing Internet resources with collections of competition tasks and the possibility of automatic evaluation of task solution is difficult enough and a time-consuming problem. But it is important that the number of such resources is increasing. Work in this direction is very important, because increasing the enrollment of students by the olympiad movement leads to the problem of a shortage of qualified teachers and coaches working with them, and to endlessly increase the number of qualified teachers, coaches and special schools is not possible.

An important component in self-preparation of students for the IOI is the participation of students in the online programming contests that take place regularly all over the world. Participating in these competitions, students gain experience, can monitor their and level of preparation and can correct the trajectory of their further preparation. Something more, they could periodically compare their results with the results of their rivals from other countries, receiving in such way an impulse to develop and search for more effective forms of self-preparation for the IOI. On the other hand, teachers or coaches that train gifted students have the possibility to observe the progress of the best students from other countries and regions. As a result, this contributes to creation of new and unique approaches for selection of gifted students and introducing them in the community, regardless of their country and residence.

6. Conclusion

There is no doubt that success at the IOI is strongly determined by the existence in each country of a system for identifying talented young people and developing their abilities, both within the schools and within the system for additional education. The common approach, based on solving as many competition tasks as possible and participating in as many competitions as possible, is most suitable for the university students, because participation in competitions and regular solving of olympiad tasks is a good supplement to lectures and practical training at the universities. For the participants of the IOI to learn informatics in accordance with the university curriculum is almost impossible, and the goal of school is quite different. Therefore, it is necessary to teach the students to solve competition tasks not just from the positions of studying the theoretical knowledge used in the IOI. We need to focus on the development the students' ingenuity, the desire to make discoveries, and generate non-standard ideas, which can only be developed and not trained. There is an important role to play here for the techniques of preparation for the IOI, based on early (starting in primary school) development of gifted students, and on the modern education and information technologies.

Techniques for the development of gifted children have appeared at the beginning of the last century but with the development of information and education technologies they have been significantly updated and took on new forms for their implementation. They are especially important for informatics olympiad movement and, in particular, in preparation for the IOI. The main goal now is to adapt traditional techniques to the modern conditions of the development of society and education. Any experience in this direction is important and deserves our attention.

Of course, very talented children are born in each country and traditional teaching methods allow them to achieve high results at the IOI. For these results to be stable, it is necessary to use in preparation for the IOI developmental teaching methods and forms, which were discussed in this article. These techniques have proved themselves well in the preparation of Russian students for the IOI, and the authors hope that they may be useful to the teachers and coaches from other countries too.

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