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PROBLEMS OF JUNIOR CONTESTANTS TRAINING FOR PARTICIPATION IN NATIONAL AND INTERNATIONAL PROGRAMMING COMPETITIONS

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Abstract. In the article it is made an analysis of current situation in preparation of young (junior) students for participation in Informatics national and international competitions. There are identified problems of qualitative preparation and models of solutions for these problems. In the same time there are classified decisive factors in future extension of juniors preparation.

Key words: Programming, Juniors competitions, specific competences, training cells, didactic strategies.

PROBLEME IDENTIFICATE ÎN CADRUL PREGĂTIRII JUNIORILOR PENTRU CONCURSURI NAȚIONALE ȘI INTERNAȚIONALE DE PROGRAMARE

Abstract. În articol se face o analiză a situației actuale în pregătirea elevilor de vârstă școlară mică (juniori) pentru participarea la competiții naționale și internaționale de informatică. Sunt identificate probleme ce apar în pregătirea calitativă a juniorilor și modele de soluții pentru aceste probleme. În același timp, sunt clasificați factorii decisivi pentru viitoare aextinderea în pregătirea juniorilor.

Cuvinte cheie: programare, competiții pentru juniori, competențe specifice, celule de antrenament, strategii didactice.

Introduction

In the last decade there has been a significant increase in the number of programming contests at all levels: from institutional to international ones. There are several reasons for this growth: expanding the role of digital technologies in human activity; modernization of national curricula; the introduction of new school disciplines oriented towards the development of digital skills, including in primary school; the emergence of a large number of specialized educational resources, adapted to target groups of different ages; development of web platforms for automatic evaluation.

The increase of the number of programming competitions leads to the involvement of an increasing number of participants, who have different levels of training in the Informatics field, but also a significant age gap. The increase of the number of participants leads to an increase in the complexity level of the proposed problems. At the level of international competitions this means solving an identical set of problems by the participants between the ages of 15 (or even less) and 19 years, where, obviously, the participants of younger age are disadvantaged compared to their older colleagues. Increasing age differences imply reverse processes - reducing complexity or dividing competitions into sections for seniors (16 - 19 years) and juniors (pupils with the age up to 15.5 years).

Statistical data

If the training methodologies of the seniors are well defined and tested at national level for about 30 years, the preparation of the juniors for competitions of different levels is at the moment spontaneous and little organized.

Thus, a statistics of the juniors' participation in the official international competitions in the period of 2015 denotes an acute insufficiency of the pupils who possess a sufficient training level for these competitions (the Balkan Informatics Olympiad for juniors - diagram 1; the European Informatics Olympiad for juniors - diagram 2)

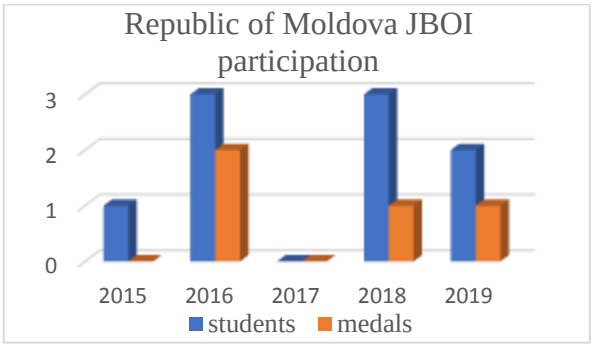

Diagram 1: Statistics of pupils' participation from the Republic of Moldova in the Balkan Informatics Olympiad for Junior, 2015 - 2019

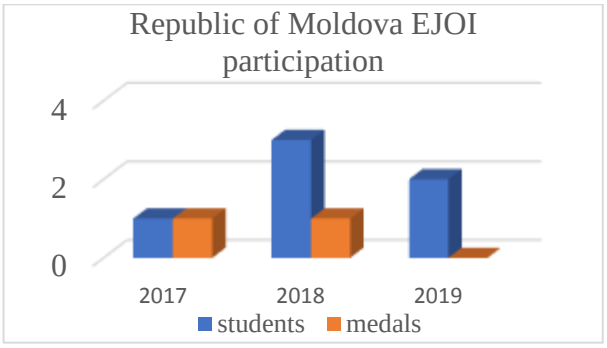

Diagram 2: Statistics of pupils' participation from the Republic of Moldova in the European Informatics Olympics for Junior 2017 - 2019

The comparative analysis of the number of participants in the Republican Informatics Olympiad shows a significant difference between the number of senior and junior participants (diagram 3). An additional problem is the participants' age limit in the programming competitions for juniors: most juniors with high scores reach the age limit in the period between the national competition and the period of international competitions, thus becoming ineligible to participate in the latter.

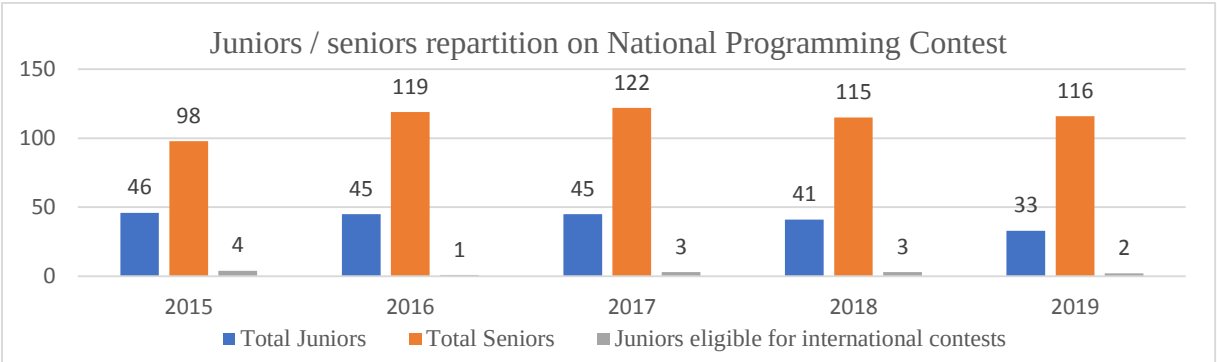

Diagram 3. Number of senior participants (grades 10-12) and juniors (up to grade 9), including eligible ones for the participation in international programming competitions for juniors

Why so few juniors?

The main reasons:

• Studying the programming elements starting with the 9th grade (according to the Informatics curriculum in force during the analyzed period);

• the "expert" of the performance training in other real disciplines (Physics, Chemistry, Biology) who selects the pupils starting with grades 5 - 6.
• the level of teachers' training and their ability to perform the training performance**.**

What to do?

a. Modernization of the curriculum - offering the possibility to include modules for the development of algorithmic thinking and programming skills in a high level language from an early age. Created preconditions: the inclusion of the Digital Education discipline in the primary education, with the visual programming module "Gândim Digital?Thinking digitally" (2018), the modularization of the curriculum in the Informatics discipline in the gymnasium grades with the option of choosing the programming modules starting with the 7th grade (2019). The programming modules form a continuous series of training, starting from the programming of the elementary algorithms and to the techniques and complex data structures, in the XII th form: My first programs (grade VII at choice), *Algorithms and executors, implementation of algorithms (grade VIII at choice), Implementation of algorithms, structured data processing (grade IX at choice), Programming languages, data, elementary data structures (grade X), Principles of computer systems design (grade XI), Subprograms, programming techniques, modeling and numerical calculation (grade XII).* The new curriculum also involves the integration of programming elements into educational activities in other real disciplines, in particular - Mathematics and Physics, in order to demonstrate the necessity, applicability and importance of programming in the digital society. The sensitive component of this curriculum is the didactic framework, which can "avoid" the programming modules in grades VII - IX, these being optional, in favor of the application modules, close to the field of digital technologies: editing different types of digital content, using office applications, and so on.

b. For **the teachers'active involvement,** a new approach of their training is needed, both of the teachers in the educational field, and of the students from the profile faculties. For the first category, it is necessary to include in the training program the type modules: fundamentals of programming and competitive programming. The training of the students from the profiling faculties, both at the first cycle, and second cycle-Master, can benefit from the extension of the range of compulsory and optional courses (modules), which contain both motivational pedagogical elements and programming elements of different complexity levels.

c. Creation of early training centers in the field of Informatics, which may include programming courses, oriented to the age category of 11-14 years. Identification of mentors for the programming modules, activities, psycho-pedagogical approaches for the initial students' motivation and training of self-motivation capacities, the competitive character and the critical thinking. Achievements: Based on the resources

of the Technical University of Moldova and the ICT Tekwill performance center, the *"Programming fundamentals" and "Competitive programming*" courses have been launched, to which students from Chisinau educational institutions have access. In the development process: launch of the TCPAD Center (Training Center in Programming, Algorithmics, Data) for the creation of an ecosystem of mentors - students - pupils - ICT companies, in which to develop young IT talents. The activity of these performance centers is to be guided by the international performance curriculum in Informatics (for seniors and juniors separately [4]).

d. Elaboration of educational resources that should allow both teacher (mentor) -assisted learning and self-instruction. Certainly, the resources will be adapted to the age category, to which they are addressed. In the development process: TwentyTu Moldova project, which intends to develop national resources for the courses: *Procedural programming in C / C ++; Algorithms & Data Structures; Programming in Python; Artificial Intelligence etc.* The resources developed will correlate with the requirements of the national curriculum in the discipline, but may include much wider areas of knowledge, for those pupils who want an active participation not only in national competitions but also in international ones.

e. Promotional activities and events. The increase of the number of participants in the programming contests for juniors will only be possible if all the activities launched or designed previously will involve a sufficiently large number of children aged 11-14, who, in fact, form the target group. For this, it is necessary to organize periodic discussions, lessons, practical sessions and microcompetitions of programming for beginners, managed locally by Informatics teachers, pupils from the upper classes or students - graduates of the educational institution. These will be followed by unofficial regional competitions dedicated specifically to this age category. Partnerships between school institutions and IT companies can solve logistical and financial problems related to the organization of competitions of this kind. The emergence of a "critical mass" of junior prepared for the participation in regional and national programming competitions will certainly be an argument for the Olympic Informatics Council to launch the necessary steps to modify the model of selection of participants for national competitions and selection of Olympic groups of seniors and especially - of juniors, so that the number of junior participants in national Informatics competitions is at least equal to that of the participants from the high school classes.

f. Identification of sustainable financing sources. The realization of the proposed projects involves significant costs, which cannot be fully covered only by educational institutions. The need to identify external financing is an open problem that, at the moment, is trying to be solved with the help of IT companies (example of the Tekwill Center, the TwentyTu project, the Orange foundation, etc.) but their opening for the collaboration with educational institutions is insufficient to solve this problem.

Conclusions

The juniors' training for performance in Informatics is a process of major importance and is the foundation of the pupils' successes in the national, regional and international programming competitions. Although the first steps to systematize the training process have already been taken, there are several problems that can be solved only in time, through the joint effort of educational institutions, performance educational centers, universities, ICT companies as well as through the effort of teachers and parents. Among these:

- Ensuring equal and free access to universal educational resources for the pupils of all ages and from all localities. The universal resources involve not only the support in training and self-training, but also possibilities to practice and simulate competitions on web platforms, with automatic evaluation of the results.
- Creating performance cells within educational institutions (local target group) or universities (regional, national target group), training mentors to administer the cells, providing the necessary logistical, didactic, methodological support.
- Active involvement of ICT companies in organizing events and activities to promote IT performance, programming competitions for juniors, organizing thematic trainings for training programming skills and developing algorithmic thinking.
- Elaboration of national documents for performance training - Curriculum - separately for juniors and seniors.
- Modification of the model for admitting junior students to local, regional and national competitions in order to reduce the numerical gap and increase the number of juniors eligible for training within the camps for the Olympic groups and participation in international programming competitions.

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