Sex-age dynamics of development of technical giftedness' signs

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Abstract. The authors investigate the issue of diagnostics and development of technical giftedness at school age. Theoretic part is devoted to the description of structural components of technical giftedness of a person. Empirical part contains the results of authors' study of sex-age dynamics observed in development of technical giftedness' characteristics. Socio-pedagogical stereotype is identified: it seems that boys manifest signs of technical giftedness more often and in greater extent than girls do.

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Introduction

Change of the paradigm of social development and our country's entering information-technical space of modern century have formulated new educational activity field of Russia. Improvement of education system in the country to a great extent depends on social order of society for creative, active personality able to manifest itself in non-standard conditions, flexibly and independently use obtained knowledge in different life situations.

In order to organize education process with highest efficiency in regard to gifted children's development a teacher must possess high professional competence. In T.P. Abakirova's opinion [1], professional competence of a teacher can be described by the following psycho-pedagogical knowledge, abilities and skills which appear as a result of active learning psychology and pedagogy of giftedness: knowledge about giftedness, its kinds, psychological foundations, criterion and principles of identification, knowledge about psychological particularities of gifted children, their age and individual development; knowledge about particularities of professional qualification of specialists needed for work with gifted children; knowledge about directions and forms of work with gifted children; about principles and strategies of development of programs and technologies for teaching gifted children; abilities and skills in the sphere of development and implementation of methods intended for finding out of gifted children on the base of giftedness' signs; didactical skills and methods of teaching of gifted children with due regard to the types and particularities of giftedness of learners; their cohesive and specific conditions of learning; skills of psychological-pedagogical consulting of gifted children; their parents and other members of their families.

Building trajectory of psychological-pedagogical support of gifted child a teacher must involve him into different activities corresponding to his interests and inclinations, to perform analysis of real achievement of gifted children (participation in Olympiads, contests, school conferences, festivals, public showings etc.) [2]

Methods

Methods used by us are as follows: Bennet mechanical intellegence test, intellect structure test of R. Amthauer (subtest #7 for spatial perception), intellectual lability test. Respondents: schoolchildren of 6-11 grades from general education schools who participated in 5th Interregional contest "Creative labour of schoolchildren" organized by engineering-technological faculty of Elabuga institute of Kazan federal university.

Fort the purposes of the study we made 2 samples: 1st included adolescents, 2nd – young boys and girls (senior-pupils) (older than children from the 1st sample).

Statistical analysis of empirical data was performed with the use of SPSS program.

Main part

Problem of giftedness is in the focus of pedagogical and psychological sciences: the content of the concept "giftedness" is identified; factors influencing development of gifted person are defined, diagnostics tools intended for solution of the problem of early identification of giftedness and its development are developed; education models are formed which facilitate realization of intellectual abilities and creative potential of a gifted person.

K. Heller defined giftedness as individual (cognitive and motivational) personal preconditions of high results in one or more disciplines [3].

Particularities of psycho-social development of gifted children in the process of social adaptation are analyzed by M. Gross. He compared mathematically "moderate" and very gifted children

and found that moderately gifted children can adapt themselves to environment better than very gifted ones [4].

E. Merzon, A. Panfilov and O. Shterts [5] offers multi-factorial pedagogical model of development environment of gifted children and young people which is experimentally implemented by Elabuga institute of Kazan federal university.

This model must solve the following tasks: to form its own scientific school in the sphere of pedagogics of giftedness; increase efficiency of pedagogical, psychological and social work in order to identify in time, develop and support giftedness of children and young persons; provide objective sociological and statistical information for solution of tasks of children giftedness; to construct, test experimentally and implement teaching and education technologies which create conditions for development of giftedness in children and young persons in schools and universities.

In the process of empirical study E. Merzon, O. Shterts and A. Panfilov have established that [6] specialized educational environment facilitates development of technical giftedness and its professional self-determination.

Technical abilities are is those which are manifested in work with machines, tools, equipment and their components. It is taken into account that such work demands special intellectual abilities and high level of development of sensor-sensory-motor abilities, adroitness, physical force.

A.V. Karpov [7] pointed out to such particularities of professional technical thinking as purposefulness, lability, comprehensiveness, fluency and flexibility: they characterize intensity of thinking and other features.

T.V. Kudryavtsev [8] suggested that the uniqueness of productive-technical labour actuates predominant development of specific aspects of thinking.

T. M. Khrustaleva and Yu. A. Shevchenko offered model of technical giftedness which includes technical intellect, technical creativity, activity component of technical abilities and specific motivation of personality.

Our study involved participators of Interregional contest “Creative labour of schoolchildren” organized with the purpose of stimulation of interest of learners in educational sphere "Technology".

Key tasks of the contest: identification and encouragement of giftedness in students; support of young people in schools and universities in their professional self-determination; popularization of technical education among students; study of intellectual and creative potential of learners in educational sphere "Technology".

The contest is traditionally held in two disciplines: “Technical labour” and “Servicie labour”, and is divided into 2 stages.

1st stage: contest participators do tests in all sections of the discipline “Technology”. 2nd stage of the contest (“Practical work”) is devoted to performance of planning and practical creative activity related to material processing technologies. The participators who joined direction “Technical labour” are offered tasks on manual and machined processing of wood, metal, electrical technologies, Those who chose “Service labour” must do tasks in processing fabric, leather, fur, paper-plastic etc.

3rd stage which is called “Creative contest” the schoolchildren are offered tasks which suggest creative approach. Popularity of the contest "Creative labor of schoolchildren is out of question. The number of participators says for itself: (in 2009 - 61 schoolchildren, 2013 - 174 schoolchildren) and their accompanying teachers (in 2009 - 56 teachers, 2013 - 83 teachers).

Participants in the contest are those students which manifest their creative abilities in mechanics and technologies - children with signs of technical giftedness. Quiz of teachers who prepared participators for this contest in 2013 showed that all respondents (100%) are interested in development of technical giftedness of their students.

To the question “By which methods and ways can we develop technical giftedness of the learners?” 78% of teachers answered that it must be contests and Technology Olympiads. The same number of participators in the quiz believe that giftedness can be improved by project method. 60% of teachers believe that development of technically gifted schoolchildren is facilitated by their research activity, and 56% of teachers are sure that participation in different exhibitions also develops technical giftedness of children and young persons.

K.A. Heller [10] in the process of longitudinal study arrived at conclusions that girls, in teachers' opinion, are more rarely included into the group of the most intellectually gifted children and girls showed better results in school disciplines except for mathematics and physics. Before empirical research the quiz of contest participators was performed: 85% of respondents (students) answered that boys are more developed in components of technical thinking than girls; 71% of teachers were of the same opinion.

In the process of empirical study we obtained the following results which are shown in Table 2.

Table 2. Comparative analysis of the level of manifestation of technical giftedness' components exposed by adolescents and senior pupils

	Bennet test					Intellectual lability			Spatial perception (subtest№ 7 Amthauer)		
	Very low	low	medium	high	Very high	low	medium	high	low	medium	high
adolescents	0%	39%	32%	29%	0%	0%	100%	0%	17%	78%	5%
Senior-pupils	0%	7%	34%	55%	4%	0%	89%	11%	11%	89%	0%

The diagnostics' results have shown that the level of technical thinking of senior pupils is higher than with adolescents. In the sample of senior pupils only 7% has low level of technical comprehension, apart from adolescents (39%); and 55% and 4% of senior pupils showed high and very high results. 29% of adolescents have high level of development of technical thinking and 0% have very high level. Therefore senior pupils who participated in the contest can cope with tasks related to technical activity better than adolescents, in particular, they do better construction (design) and technological tasks, they can set the target and want to get specific result, able to read drawings and diagrams, know technical language.

Comparative analysis with the use of Student's t-criterion showed that statistically significant differences in the level of development of technical comprehension in the samples of adolescents and senior pupils: ($t=3,10$ with $p\leq0,01$). So, level of development of technical thinking is higher with early young age. Results of the study of technical comprehension are determined, in our opinion, by the fact that senior pupils study more deeply such specialized disciplines as physics, chemistry, geometry which in turn facilitate development of technical thinking. Besides that many senior pupils have already chosen their future profession.

We can suggest that senior pupils are more quick in shifting of attention from one object to another and in solution of geometrical tasks; they have constructive (design) practical skills. However statistically significant differences in the level of intellectual lability and spatial perception were not found by us.

We analyzed results of the study in the samples with focus on sex (Table 3, 4). In adolescents' sample technical comprehension is more developed with girls than with boys. In particular, in girls' sample 41% have high value in the level of development of technical thinking, only 7% of tested boys showed high level.

Statistical analysis by Student's t-criterion showed that by this parameter there are statistical differences on the level of $t=2,38$ with $p\leq0,05$. In our opinion it is determined by the fact that physiologically girls at this age develop more quickly and accordingly their brain structures which are responsible for formation of verbal-logical thinking and technical intellect are completed earlier than with boys. Besides that adolescent girls treat every task more responsibly. In indicators of intellectual lability and spatial perception there were no statistically significant differences.

Table 3. Comparative sex analysis of the level of technical giftedness' components of adolescents

	Bennet test					Intellectual lability			Spatial perception (subtest№ 7 Amthauer)		
	very low	low	medium	high	very high	low	medium	high	low	medium	high
boys	0%	64%	29%	7%	0%	0%	100%	0%	22%	71%	7%
girls	0%	25%	34%	41%	0%	0%	100%	0%	15%	81%	4%

Table 4. Comparative sex analysis of the level of technical giftedness' components of senior pupils

	Bennet test					Intellectual lability			Spatial perception (subtest№ 7 Amthauer)		
	very low	low	medium	high	very high	low	medium	high	low	medium	high
boys	0%	10%	40%	50%	0%	0%	100%	0%	30%	70%	0%
girls	0%	7%	31%	56%	6%	0%	80%	20%	0%	100%	0%

While analyzing results of the level of manifestation of technical giftedness' components depending on sex in senior pupils sample we did not find statistically significant differences.

Table 5. Dynamics of development of technical giftedness components with boys

	Bennet test					Intellectual lability			Spatial perception (subtest№ 7 Amthauer)		
	very low	low	medium	high	very high	low	medium	high	low	medium	high
adolescents	0%	64%	29%	7%	0%	0%	100%	0%	22%	71%	7%
Senior-pupils	0%	10%	40%	50%	0%	0%	100%	0%	30%	70%	0%

However analysis of obtained results allows to say that girls are more inclined to identify and project structural-functional systems, combine spatial visual images of technical parts and devices, they are more attentive.

Relying upon the dynamics of development of technical giftedness' components of boys at adolescent and young age we can conclude that at young age boys solve design tasks more actively and better, their analytical-synthetic thinking and their theoretic and practical skills are better developed. However the level of spatial perception is reduced a bit in comparison with adolescent boys. We suggest that adolescent boys have richer imagination and their

visual-active thinking is better developed as well. In our opinion these results of empirical study is related to the fact that boys at early young age when solving practical and theoretical tasks rely upon verbal-logical thinking. It must be mentioned that statistically important differences were found by us only in regard to the level of technical comprehension (t=1,6 with p≤0,05)

Table 6. Dynamics of development of technical giftedness' components with girls

	Bennet test					Intellectual lability			Spatial perception (subtest№ 7 Amthauer)		
	very low	low	medium	high	very high	low	medium	high	low	medium	high
adolescents	0%	25%	34%	41%	0%	0%	100%	0%	15%	81%	4%
Senior-pupils	0%	7%	31%	56%	6%	0%	80%	20%	0%	100%	0%

Comparative analysis of developmental dynamics of technical giftedness' components with girls at adolescent and young age showed that there are statistically important differences on the level (t=2,24 with p≤0,05) in regard to the level of technical comprehension. Young girls experience abrupt jump in development of skills in technology and design sphere, they are able to choose optimal solution from many offered variants of solutions for design tasks.

Conclusions

Giftedness is a system characteristic of personality which is not static and reveals dynamics of development.

Positive dynamics of development of technical giftedness' components is shown by young boys and girls; this fact, in our opinion, is determined by maturity of brain structures responsible for thinking operations, by professional self-determination of personality.

In adolescent age the level of development of technical giftedness' components is more manifested with boys than with girls. Purpose-oriented work intended for actualization of motivational component of technical giftedness among adolescent boys will facilitate development of technical intellect.

Technical giftedness of children and adolescents is improved due to preparation and participation in contests and technology Olympiads where they have opportunity to check their skills, to obtain new knowledge in the sphere of technical activity.

It is necessary to overcome socio-pedagogical stereotypes based on the idea that technical thinking of boys is better developed than of girls.

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