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Comparative Analysis of Development of Technical Giftedness of a Person Depending on its Engagement into Specialized Educational Environment

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Abstract: The article is devoted to empirical research of technical giftedness in children and young men depending of the extent of their engagement into specialized educational environment. Theoretical part gives a review of available concepts of giftedness and describes structural components of technical inclinations of a person. Giftedness is defined as systematic attribute of personality which is characterized by development dynamics. Practical part gives the results of comparative analysis of level of technical thinking, spatial thinking and imagination, professional inclinations of teenagers, students of high schools and of higher education technical institute. The results of research have shown that level of technical comprehension, spatial thinking and imagination is higher with students of technical institute of higher education than with children. Comparative analysis has shown that educational environment of a technical institute facilitates development of technical skills of a person, allows to achieve higher than average results in the sphere of construction and technologies.

Key words: Giftedness · Technical inclinations · Technical intellect · Technical skills · Spatial thinking and imagination · Factors influencing development of giftedness · Specialized social environment

INTRODUCTION

Innovative economy and its effects, industrial modernization and implementation of modern IT-/bio-technologies, result in high demand for engineers. Therefore for training high-quality specialists for industries we need a system of selection, support and development of young men with technical skills.

State documents adopted recently - Message of the President of RF [1], Federal law "On education in RF" dated December 29, 2012 [2], national educational initiative "Our new school" set task of building multi-branch (diversified) system for search and support of talented (gifted) children and follow-up of them for the whole period of personality formation, including initial stage of professional activity.

The problem of giftedness is actively studied by psychology and pedagogical sciences: the notion "giftedness" is defined, factors influencing development of a gifted person are found, diagnostics tools for early finding and development of giftedness are developed; educational models which provide for realization of intellectual abilities and creative potential of a gifted person are formed.

Among modern concepts of a gifted person the model developed by B. Teplov should be emphasized, theory of adult giftedness of N.Leites, concept of a gifted person of M.Kholodnaya, dynamic concept of giftedness of Yu. Babaeva, "working concept of giftedness of Babaeva, Bogoyavlenskaya, Druzhinin, Ilyasov and Leites", Gilford's intellect structure model, theory of giftedness of Torrence Matyushkin's concept of giftedness, Renzulli's human potential model, Heller's Munich model of giftedness are also important.

All given above concepts are based on the idea that a gifted person was not born as such, but he becomes gifted in the process of development of his abilities. Systematic development of abilities will determine possibility to reach higher results in one or several activities in comparison with other people.

Yu Babaeva [3] views giftedness not as constant personal but as constantly developing potential which can exist only in dynamics and evolution and therefore is

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constantly changing. Factors of giftedness accordingly to Renzulli are: intellect, creativity, motivation [4]. He proposes to use an ajective "gifted" not as statement of a fact but as characteristic of future development. Because otherwise society will be strictly divided on those with gifts and other, non-gifted persons.

Munich model of Heller [5] emphasizes a number of different aspects of development of giftedness in childhood. These characteristics are: high intellectual abilities; prominent creative abilities; quicker mastering ability and prominent memory, intellectual curiosity and ambition to obtain knowledge, internal locus of control and high personal responsibility, confidence in one's own effectiveness, independence of assumptions, adequate self-evaluation. Therefore we can admit that all small children are gifted persons having productive thinking and creative potential. To promote their abilities and make them achieve the level of giftedness special educational environment must be formed which will facilitate this process and form motivation for success.

S. Moon while making report in Annual conference of European Commission on High Abilities points out to special role of educational environment for development of a gifted person. She also believes that a gifted person must develop not only his talents but social skills as well, using indirect methods of learning [6]. Therefore in curriculum there must be such disciplines which will provide for development of self-consciousness, techniques of self-regulations, targeting, ability to make right decisions and manage one's career.

In the same time T.M. Newman, W. Brown, L. Hart, D. Macomber, N. Doyle, S.A. Kornilov, L. Jarvin, R.J. Sternberg, E.L. Grigorenko point out the educational system often do not identify and support those students which have simultaneously high abilities and some problems in learning. The authors developed special program named Leonardo Laboratory intended to find out those students which have difficulties in learning [7].

Big contribution into differentiation of giftedness was made by H.Gardner. His theory of multiplicity of types of intellect considers interaction of such types of intellect as linguistically, logical-mathematical, spatial, musical, muscular-motor, communicative [8]. The types of intellect emphasized by Gardner are analogous to kinds of giftedness, which are admitted by today's psychologists. Gardner's concept demonstrates general trend to differentiation of giftedness, to finding out and development of various types of it.

Methodology: We used the following methods: Bennet mechanical comprehension test, Amthauer intellect structure test (subtest #7 for spatial imagination, subtest #8 for spatial generalization), Klimov's differential and diagnostics check-list (DDC). As experimental sample to be tested we chose students of 7-8 gfrades of ordinary schools, reference sampling was done by students of Kazan national research technical university named after A.Tupolev.

To process data statistically we used SPSS-program.

Main Part: Planning our research we believed that giftedness is a complex poly-functional term contents of which can be defined as some quality of a man which is developing for the whole life and determines achievement of higher non-ordinary results in one or several activities in comparison with other people, when special educational environment is created.

The purpose of our empiric research is comparative analysis of development of technical giftedness of a person depending on extent of its engagement into specialized educational environment.

Technical skills are those which manifest themselves in work with equipment or its parts. Here it must be taken into consideration that such work demands special intellectual abilities as well as sensor-motor skills, physical force, adroitness.

Structure of technical skills which depend on psycho features includes: technical attentiveness, developed technical thinking; developed spatial thinking; ability to combine, personal skills (interest in machinery, curiosity, persistence, activity); ability to take into consideration the parameters of materials, items, forms used.

Earlier the issues of technical giftedness, technical intellect and its structure were studied by G. Bennet, A. Bine, M. Kholodnaya, A. Loseva, T. Khrustaleva, Yu. Shevchenko, V. Shadrikov.

A. Loseva [9], depending on manifestation of gifts in some sphere of activity, points out to the following measures of successful realization of a person in technical area: interest in machinery and mechanisms, constructing activity, ability to do manual work well, ability depict sketches on paper, creativity and flexibility of thinking.

T. Khrustaleva and Yu. Shevchenko proposed model of technical giftedness in the form of 4 circles: technical intellect, technical creativity, activity component of technical skills and specific motivation of personality. Technical intellect is characterized by technical

comprehension of mechanical and technical ratios, particularities of representation of physical phenomena, spatial phenomena and interactions.

E. Merzon, O. Shterts and A. Panfilov have found that one of the measure of technical giftedness is lability and flexibility of thinking [10].

Having analyzed professiograms of engineers (engineer-designer, engineer-technologist and others) we arrived at the conclusion that professionally important for all mentioned specialists are the following qualities: technical mind; developed spatial thinking and imagination; high level of distribution, concentration and switching attention from one thing to another; plasticity of thinking, ability to judge distances visually. Therefore if these abilities are developed to a great extent in a child we can talk about potential ability of development of technical giftedness provided that appropriate developing activity is provided.

Theoretical foundation for our research: Munich model of giftedness of K. Heller. He defined giftedness as individual (cognitive and motivational) pre-conditions of high achievements in one of more spheres [11]. He pays attention not only to cognitive pre-conditions (in our case level of technical intellect) but also non-cognitive personal factors, namely motivation for achievement and socio-cultural conditions. As motivational factor we take inclination of a person to mastering of technical specialties, socio-cultural factor - special educational environment – higher education institute - intended for training of technical specialists.

We share Khrustalev's and Savchenko's opinion that cognitive factor is technical intellect, which includes technical set of mind, developed spatial thinking and imagination.

At initial stage of research we tried to find out motivation component by means of differential diagnostics check-list method (DDC) of E. Klimov. Table 1.

Analysis of data drives us to conclusion: in schoolchildren's sample there is a big diversity in professional preferences. Reference sample of institute students demonstrates that most of them (62%) have inclination to master their profession of "man-machinery" type. Therefore we can conclude that most students have made final deliberate decision and are motivated to master technical specialty.

At the second stage of empirical research we tested spatial thinking and imagination, level of development of technical comprehension of a person Table 2.

The results show that this measure is a little bit higher with students than with children. We made comparative analysis by Student criterion (t=4,79 where p=0,05) and found that students solve geometrical problems better than schoolchildren of 7-8 grade, they have richer spatial imagination, constructive practical skills, ability not only to operate with spatial images but to generalize their relationship.

In the process of correlation analysis we have not found statistically reliable relationship between types of professional inclination of a person and the level of development of spatial thinking and imagination.

As we see, level of technical students is a bit higher than with schoolchildren. In particular we observe increased middle (50% of all members of sample) and high (25%) level of development of technical thinking. Statistical analysis by means of t-criterion of Student proved that there are statistically reliable differences between two samples (t=2,24 where $p \leq 0,05$). Therefore we

Table 1: Diagnostics of professional inclination of a person among students of secondary high schools and higher education institutes.

	Man-nature	Man - machinery	Man - man	Man - artistic image	Man - digit system
Students of high school	18%	27%	9%	36%	10%
Students of institute	0%	62%	12%	19%	7%

Table 2: Diagnostics of spatial thinking and imagination of a person among schoolchildren and institute students

	Low	Middle	High
Students of high school	32%	68%	0%
Students of institute	22%	60%	18%

Table 3: Level of development of technical thinking among students of secondary high schools and institute students

	Very high	High	Middle	Low	Very low
Students of high school	13%	23%	23%	32%	9%
Students of institute	13%	25%	50%	12%	0%

can arrive to conclusion that educational environment promotes technical abilities growth and facilitates in achieving non-ordinary results in technological sphere in comparison with other people who do not have special training in this area.

Pearson's correlation analysis also has shown that there is moderate positive correlation (r=0,27 where $p \leq 0,05$) in reference sample of students between professional inclination of a person to mastering profession of type "man-machinery" and the level of development of technical comprehension. The more individual likes engineering and is interested in professional growth here, the more he wants to clarify and know machinery and mechanisms. Correlation between these two in the schoolchildren sample was not found. It can be explained by the fact that professional self-determination of a person starts to actualize only in the end of teen-age period. Therefore, creation of specialized educational environment intended for actualization of technical skills will deepen this trend and facilitate development of technical giftedness of a person and its professional self-determination.

Inference:

- Giftedness is a systematic personal attribute (feature), not static and it has dynamics of development.
- Giftedness reflects potential of achieving by person a success, high results in some area.
- Specialized educational environment facilitates development of technical skills of a person and, as an effect of it, giftedness
- Wish of a person to master technical specialities results in increased level of technical thinking (technical comprehension).

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