Developing Girls' Technical Giftedness and Supporting Their Resilience

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ABSTRACT
The article considers the problem of diagnosis and development of technical giftedness of girls. In the practical part, the results of a study of sex and age dynamics of the development of signs of technical giftedness are presented. It is established that in early adolescence the signs of technical giftedness are more developed than in adolescence. An empirical study showed that it is necessary to overcome gender stereotypes that boys have better developed technical thinking than girls. Using same-sex educational environment to reveal the technical abilities of girls and support their resilience in general has been put forward as a proposal.

CCS Concepts
• Social and professional topics

Keywords
technical giftedness; gender; technical thinking; same-sex educational environment; resilience.

1. INTRODUCTION
A paradigm shift in social development and entry into the information and technical space of this century have formulated a new field of educational activity in Russia. The improving of the entire educational system in the country is provided by the social order of society for a creative, active person who can prove himself in unusual conditions, flexibly and independently use the acquired knowledge in various life situations.

A feature of the modern traditional school is the presence of gender stereotypes in identifying the success of children in the study of some subjects. So, according to the prevailing opinion, along with "masculine" subjects (mathematics, physics, computer science) there are also "feminine" ones (foreign language, native language and literature, music, art). The results of the international study of mathematical, reader and science literacy PISA show just such results. (Source http://www.oecd.org/pisa). In 6 out of 10 countries boys continue to perform better in mathematics than their female peers. 2 in 3 girls vs 1 in 2 boys report often worrying that it will be difficult for them in mathematics classes. In 5 countries girls outperformed boys in math. In 25 countries the results for boys and girls were the same. In all countries girls outperform peers in reading. Overall, at age of 15 60% of the lowest achievers in mathematics, reading and science are boys, 40% are girls.

The above suggests that there are prevailing gender stereotypes in most countries, but the presence of facts about the superiority of girls in mathematics in a number of countries shows the need to reconsider approaches to education.

In order to organize the educational process with the greatest efficiency in the development of children, the teacher must have high professional competence. The following psychological and pedagogical knowledge, skills and abilities resulting from the active assimilation of psychology, pedagogy and physiology can be attributed to professional competence: knowledge of the psychological characteristics of children, their age and individual development; knowledge of the psychophysiological characteristics of boys and girls.

Building a trajectory of psychological and pedagogical support of a gifted child, the teacher needs to involve him in various activities that correspond to his interests and inclinations, as well as analyze the real achievements of children (participation in competitions, school conferences, sports competitions, festivals, shows, etc.).

The issue of supporting girls' resilience to achieve better results is also relevant. In a general sense, resilience is an individual resilience that manifests itself in critical circumstances [16], it is a synonym for self-regulation, which manifests itself regardless of life circumstances. The role of the four key defense mechanisms is important [18]. They represent the maximum protection of the child from harm and the reduction of damage caused by adverse conditions, increasing self-esteem and self-efficacy through the development and strengthening of competencies, skills to successfully solve problems and a number of activities that contribute to the full development of the personality.

2. METHODS
Signs of giftedness encompass two aspects of the behavior of a gifted child: instrumental and motivational. Technical component; advanced technical thinking; developed spatial imagination. We conducted a study on the instrumental aspect of technical giftedness. The identification of the instrumental feature of technical giftedness was aimed at determining the level of development of mechanical intelligibility, spatial imagination.

The following methods were used: Bennett's mechanical comprehensibility test, R. Amthauer's intelligence structure test (subtest No. 7 spatial imagination). Bennett's mechanical

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comprehensibility test is focused on revealing the technical abilities of subjects, both adolescents and adults. The methodology contains 70 physical and technical tasks, which are presented in the form of drawings. Time to complete tasks is 25 minutes. R. Amthauer's intelligence structure test consists of 9 subtests, but based on the objectives of our study, we used only 7th subtest aimed at studying spatial imagination. Spatial imagination includes the ability to solve geometric problems. Subtest No.7 includes 20 geometric problems, which are presented in the form of drawings. Time for tasks is 7 minutes.

The empirical sample of the study was made by 6–11 grades' students who took part in the 5th Regional competition "Creative Work of Schoolchildren".

Based on the objectives of the study, two samples were constructed: the first sample included children of adolescence, the second included children of early adolescence or high school students. In order to identify gender differences in the manifestation of signs of technical giftedness, the sample of adolescent children was also divided into two subsamples. The first subsample (A) included teenage boys, the second subsample (B) included teenage girls. The same principle was used to divide the sample of young children (high school students). The first subsample (C) included early adolescent boys (high school students), the second subsample (D) included early adolescent girls (high school students).

At the first stage of the study, we diagnosed the level of development of mechanical understanding and spatial imagination in samples of children of adolescence and early adolescence. At the second stage, we processed the results of an empirical study using a quantitative and qualitative analysis of the diagnostic results, first in the research samples by the age principle (we analyzed and compared the research data in a sample of teenage and young adolescent children), and then analyzed the data in subsamples (A), (B), (C) and (D) depending on gender (the results of teenage boys and girls were compared and the results of early adolescent boys and girls were compared). For a statistical analysis of the results of an empirical study, we used the SPSS computer program and Student t-test, which allows us to identify statistically significant differences in the situation of testing the hypothesis about the differences between two dependent samples and independent samples. At the third stage of the study, we interpreted the results of the study and formulated conclusions using the structural method of research, which allows us to identify structural horizontal relationships between the samples of the study.

The problem of giftedness is actively developed by pedagogical and psychological science: the content of the concept of "giftedness" is revealed; factors are determined that influence the development of a gifted personality; developing diagnostic tools aimed at solving the problem of early detection and development of giftedness; educational models are created that contribute to the disclosure of the intellectual abilities and creative potential of a gifted person.

Giftedness is determined by Heller as individual (cognitive and motivational) personality prerequisites for high achievements in one or more areas.

The peculiarities of the psychosocial development of gifted children in the process of social adaptation are devoted to the study of M.Gross. Comparing mathematically moderate and extremely gifted children, he found that moderately gifted children adapt better in the environment.

Technical abilities are abilities that manifest themselves in working with machines, tools, equipment, or parts thereof. It is taken into account that such work requires special mental abilities, as well as a high level of development of sensorimotor abilities, dexterity, and physical strength.

Heller in the process of conducting longitudinal research concluded that girls, according to teachers, are less likely to belong to the group of the most gifted intellectually, and girls had better results than boys in school subjects, with the exception of mathematics and physics. Before an empirical study, we conducted a survey among the participants in the competition. During the survey, more than 80% of respondents said that in boys the components of technical thinking are more developed than in girls.

3. RESULTS

In the process of empirical research, we obtained the following results (Figure 1). The level of development of technical thinking is more developed in high school students than in adolescents. In the sample of high school students, only 7% of children have a low level of technical understanding, in contrast to adolescents (39%), as well as 55% and 4% of high school students have correspondingly high and very high results. In the sample of adolescents, only 29% of students have a high level of development of technical thinking and 0% has a very high level. Therefore, senior pupils participating in the competition are better than teenagers can solve problems related to technical activities, in particular, design and technological tasks, they can set a goal and strive to get a specific result, they can understand drawings and diagrams, they know the language of technology.

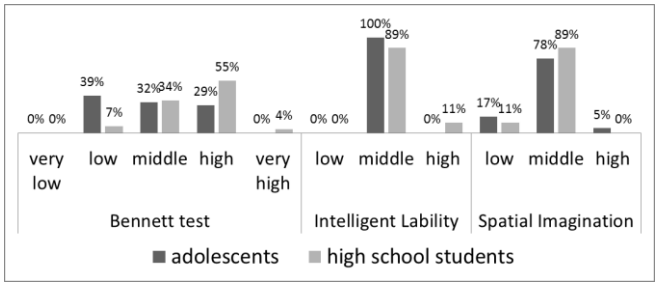

Figure 1. Comparative analysis of the level of expression of the technical giftedness components in adolescents and high school students.

A comparative analysis conducted using Student's t-test showed that there are statistically significant differences in the level of development of technical understanding in the samples of adolescents and high school students. Thus, the level of development of technical thinking is higher in children of early adolescence. The results of a study on technical understanding, in our opinion, are related to the fact that high school students are more deeply taught such specialized subjects as physics, chemistry, geometry, which, in turn, contribute to the development of technical thinking. In addition, as a result of professional self-determination, many high school students have already decided on their future profession.

Based on the visual presentation of the results, it can be assumed that high school students are slightly faster able to switch attention from one object to another and solve geometric problems, they

have constructive practical abilities. However, we did not reveal statistically significant differences in the severity of intellectual lability and spatial imagination.

Based on the objectives and goals of our study, we analyzed the results of the study in samples depending on gender. When comparing the research results of a technical understanding in subsamples (A) and (B), we found that among adolescents technical understanding is more developed in girls than in boys. In particular, in the sample of girls, 41% have a high indicator of the level of development of technical thinking, and in boys only 7% of the tested had a high indicator (Figure 2).

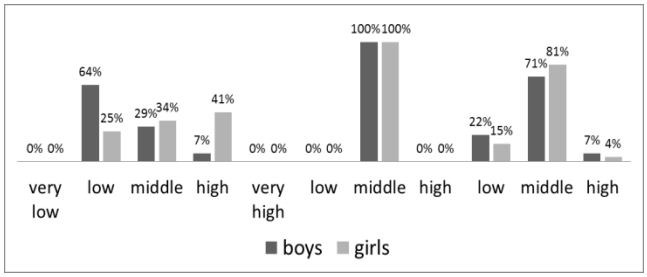

Figure 2. Comparative analysis of the level of expression of the technical giftedness components in adolescents depending on gender.

A statistical analysis using Student's t-test showed that there are statistical differences for this parameter. In our opinion, this is due to the fact that physiologically, girls in adolescence develop faster and, accordingly, the brain structures responsible for the formation of verbal-logical thinking and technical intelligence mature earlier than in boys. Teenage girls are more responsible for performing any activity than teenage boys. In terms of the level of development of spatial imagination, we did not obtain statistically significant differences.

Analyzing the results of the level of severity of the technical giftedness components depending on gender, in the subsamples (C) (young boys) and (B) (young girls), we did not obtain statistically significant differences. However, according to the visual analysis of the results we can say that girls are more likely than boys to identify and design structural and functional systems, to combine spatial visual images of technical details and devices, they have more stable attention.

Based on the results of the dynamics of the development of technical giftedness components in boys in adolescence and youth, we can conclude that in adolescence, boys better and more actively solve design problems, they have developed analytical and synthetic thinking, as well as theoretical and practical abilities. However, the level of development of spatial imagination is slightly lower than that of teenage boys. We are inclined to assume that adolescent boys have a richer imagination and better developed visual-active thinking. In our opinion, the results of empirical research are due to the fact that boys in early adolescence rely on verbal-logical thinking when solving practical and theoretical problems. It should be noted that statistically significant differences were obtained only relative to the level of development of technical understanding ($t = 1.6$ at $p \leqslant 0.05$).

A comparative analysis of the dynamics of the development of components of technical talent in girls in adolescence and youth showed that there are statistical differences in the level of development of technical understanding ($t = 2.24$ for $p \leqslant 0.05$). That is, girls at a young age show a jump in the development of abilities in the field of technology and design, they are able to choose the most optimal solution from the many proposed options for solving design problems.

4. CONCLUSION

Giftedness is a systemic personality trait that is not static, but has developmental dynamics.

Positive dynamics in the development of technical giftedness components is observed among boys and girls, which is associated with the maturity of brain structures responsible for mental operations, and with the formation of professional personality self-determination.

In adolescence, the level of development of components of technical talent is more pronounced in girls. Focused work on updating the motivational component of technical talent among male adolescents will contribute to the development of technical intelligence.

It is necessary to overcome gender stereotypes associated with the fact that boys have better developed technical thinking than girls.

The development of the technical talent of girls and the support of their resilience could be facilitated by a same-sex educational environment in which they would have the opportunity to test their abilities, free themselves from gender stereotypes and feel more confident.

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