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PSYCHOMETRIC MEASUREMENT OF ABILITIES AS THE BASIS OF AN INDIVIDUAL INTELLECTUAL RESOURCE OF A STUDENT

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ABSTRACT

The authors considered the main approaches of the category of intelligence: its essence, types, methods of development and the main approaches to the study of the problem of individual intellectual resource of the individual. The basic ideas about the nature of conceptual thinking and conceptual (including semantic, categorical and conceptual) abilities, their development and influence on various aspects of intellectual activity were analyzed, developed and tested a program of empirical research of conceptual abilities as the basis of individual intellectual resources in senior and junior adolescence using adequate psychodiagnostic techniques and statistical data processing procedures.

Key words: Analytical Intelligence, Individual Intellectual Resource, Intelligence, IQ, Nonverbal Creativity, Psychometric Measurement, Student, Verbal Creativity

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1. INTRODUCTION

The features of the intellectual development of the personality have been the subject of various psychological and interdisciplinary studies for many decades, but recently, interest in this problem has grown significantly and has become a steady tendency. This can be explained by changes in modern society, where it is the human intellectual resources that acquire the main value that can qualitatively change and accelerate the development of the whole society as a whole (Gryshchenko, 2010,2012; Kichuk, 2017; Prokopenko, 2018).

The role of enterprises in preparing students is growing, as the digital age imposes certain requirements on future workers (Illiashenko, 2015; Koziuk, 2019). The world economy at the end of the 20th century entered the post-industrial stage of development. This is primarily due to trends in the increasing role of innovation, new scientific knowledge and information. The intellectualization of the economic environment, innovative entrepreneurship, the degree of mastery of information resources in the 21st century became a necessary basis for the existence of a highly efficient economy. Today, about 30% of all jobs in the most developed countries are already occupied by "intellectual workers" – creative, motivated, with developed intellect, capable of independently searching and analyzing huge amounts of information.

The 21st century has been declared by UNESCO as the “Century of Education” (Morrisson, 2019). Knowledge, intelligence, culture, comprehensive education, intelligence should be a priority in the life of mankind. The education system and intellectual development are strategically important areas of human activity, the importance of which is steadily growing (Gontareva, 2019; Tkachenko, 2019).

The concept of the formation of the content of education and teaching methods has led to the fact that the quality of knowledge and the level of development of a significant part of specialists are insufficient to occupy a worthy place in the economy of the 21st century. At the same time, the level of assimilation of knowledge substantially depends on the individual characteristics and intellectual abilities of youth, and the traditional educational system inhibits its intellectual development.

2. THE ESSENCE OF INTELLIGENCE AND INDIVIDUAL INTELLECTUAL RESOURCE

2.1. Intelligence and its Types

There are many explanations for this term: the ability to think; characteristics of rational mental functions of the human psyche; holistic characteristics of human cognitive processes; a person's ability to act intelligently, think rationally and cope well with life circumstances; the structure of mental abilities of the individual.

A more comprehensive definition: intelligence is a system of mental processes that allow a person to use their abilities to assess the situation, make rational decisions and organize appropriate behaviour in a changing environment.

The following definition is also acceptable: intelligence – mental ability, which, among other things, includes the ability to think, plan, solve problems, think abstractly, comprehend complex ideas and learn from experience, the ability to use different forms of reasoning to find the right solution. The work of the intellect is a guarantee of a person's personal freedom and self-sufficiency of his destiny. The more a person uses his intellect to analyze and evaluate what is happening, the less susceptible he is to any attempts to manipulate him from the outside.

According to the theory of Howard Gardner (psychologist, author of the concepts of "multiple intelligence") distinguish the following types of intelligence (Fig. 1).

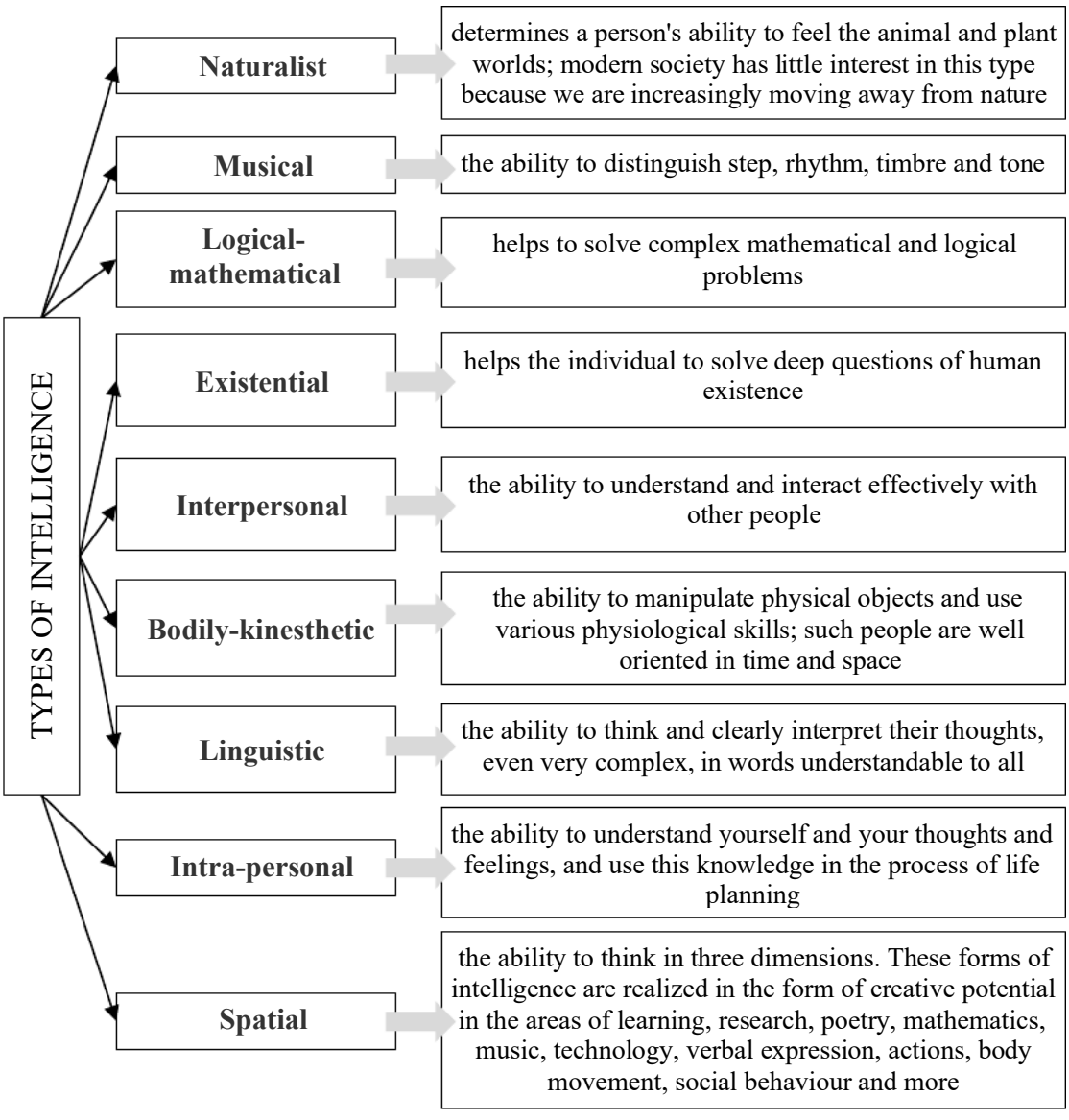

Figure 1 Types of intelligence according to Howard Gardner (compiled according to Gardner, 2011)

2.2. Intelligence Assessment

Intelligence is assessed using the "IQ - Intelligence Quotient", which allows you to correlate the level of the intellectual capacity of the individual with the average of their age and professional group. IQ tests are designed so that the results are described by a normal distribution with an average IQ of 100 and so that 50% of people have an IQ between 90 and

110 and 25% below 90 and above 110. The average IQ of graduates of American universities is 115, excellent students – 135-140. An IQ of less than 70 is often classified as mental retardation.

Scientists set a task to answer the question: what was the IQ of prominent people of the past who did not pass the test. Indirect methods of intelligence assessment have been proposed. The Swenson-Crane method, for example, analyzes behaviour and verbal expressions.

2.3. The Need to Develop the Intellectual Potential of the Population

In modern conditions, the intellectual potential of the population – along with demographic, territorial, raw materials, technological parameters of society – is the most important basis for its progressive development. One of the decisive factors of economic development now is intellectual production, and the key form of ownership is intellectual property. According to some analysts, we can now talk about the global intellectual redistribution of the world, which means a fierce competition of individual states for the predominant possession of intellectually gifted people – potential carriers of new knowledge.

Classical studies linking intelligence to income were conducted by K. Jencks (Jencks, 1972). He assessed the correlation between intelligence and income in the United States (0.35) and argued that the relationship is causal; namely, differences in intelligence make a significant contribution to differences in income. He also concluded that because intelligence is highly hereditary, differences in income are determined by genetic factors. K. Jenks' findings were confirmed by some further studies in the United States (e.g., Newstead and Murray, 1998; Zax and Rees, 2002), as well as in Sweden (Zetterberg, 2004) and the United Kingdom (Irwing, Lynn, 2006). The explanation for the positive relationship between intelligence and income is that people with higher IQs work more efficiently and provide higher quality goods and services than people with lower IQs, and therefore may have a higher income.

Explanation of the dependence of economic and social development of countries on the intelligence of their population in the following. The introduction of innovative technologies that significantly improve the conditions of production, or act as a commodity, faces the problem of their widespread use. Overcoming obstacles in this direction depends on the level of development of the intelligence of workers, which, in turn, is determined by ways of thinking.

2.4. Methods of Intelligence Development

Highly effective methods – studying mathematics, exact sciences. This contributes to the development of a range of mental qualities, namely, logical and abstract thinking.

Reading fiction. Good books broaden the horizons, promote emotional development, shape the personality. Denis Diderot said: "People stop thinking when they stop reading. Only those who do not read think about nothing".

Teaching. The unique ability of the brain is the ability to learn new skills, obtain new information, comprehend, process it and apply it. Learning contributes not only to the fact that a person acquires knowledge that may be useful, or may not be needed at all. The value is not only in the knowledge itself but in learning as such, in which intellect and thinking develop effectively. It is necessary to clearly distinguish between these two concepts. Thinking is a process of mental activity, and intellect is the ability to do so. The difference between intelligence and thinking is huge. Thinking is considered as a set of innate active cognitive processes: associations, perception, attention, analysis, as well as the ability to reason. And intelligence can be both developed and lost. Intelligence is a set of abilities to carry out the

mental process, the ability to learn something new, solving problems and stepping over obstacles.

In the process of developing intelligence and the development of thinking, because these are closely interrelated concepts. There is one way to succeed – it's to work on your intellect. The first step to improving your mental abilities is to realize that you need to learn all your life. Only then does a person become inquisitive and open to everything new and unknown. Consciousness, thinking, and intelligence will grow if they are trained continuously. The basis of the content of education should be established subjects of basic sciences, as well as subjects that shape the worldview of man and prepare him for future life. Even if knowledge never agrees in life, learning it, a person strains his mind and memory, learns to concentrate. The more a person learns, the easier it is to learn new knowledge. In this process, along with intellectual development, a person learns to learn. In people who have stopped studying, the IR decreases. On the contrary, those people who are constantly busy learning new knowledge, the level of mental abilities increases.

3. METHODOLOGY

For the purposes of our study, the concept of "individual intellectual resource" is of particular interest, associated with the peculiarities of the organization of mental (including cognitive, conceptual, metacognitive, intentional) personality experience and determining the productivity of intellectual activity. However, as it was revealed, the concept of the intellectual resource is relatively new in modern scientific psychological literature and often does not differentiate from the concepts of "intellectual potential", "intellectual giftedness", "intellectual competence" and other related terms. We have shown that intellectual competence is a manifestation of intellectual giftedness in its real expression, in turn, intellectual competence acts as the basis of an individual intellectual resource, which can be considered as the most important component of an individual's intellectual potential. The formation of an individual intellectual resource is especially important to study in adolescence and youth, as these age periods are characterized by the intensive development of the intellectual sphere.

Description of the sample and study procedure. Series 1. The program of empirical research of conceptual abilities as the basis of an individual intellectual resource in younger adolescence. The test subjects were young students studying at universities, upon admission to which a sufficiently high level of cognitive development is required and the training in which has a complicated and enriched character. In total, 87 people took part in the study: 1-2-year students (age 17-18 years), 53 girls and 34 boys from universities in Cherkasy, Kyiv, Lviv, Ternopil.

Series 2. The empirical study of conceptual abilities as a basis of an individual intellectual resource in senior adolescence. In total, 124 people took part in this series of research: 3-5-year students (age 19-22 years), 75 girls and 49 boys from universities in Cherkasy, Kyiv, Lviv, Ternopil. The methodology diagram is presented in Fig. 2.

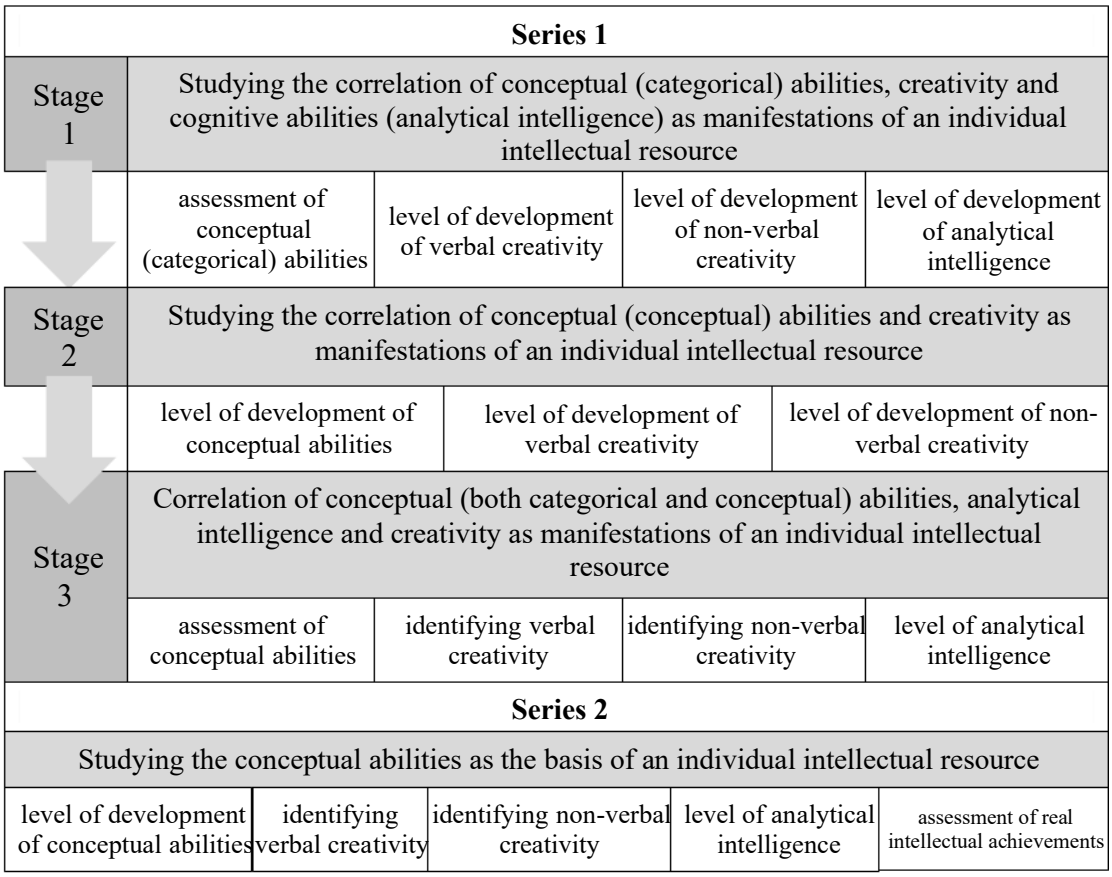

Figure 2 Empirical research stages

At the first stage, the relationships between conceptual (categorical) abilities (in terms of indicators of the "Three words generalization" methodology), cognitive abilities (level of development of analytical intelligence), verbal and non-verbal creativity as manifestations of an individual intellectual resource were investigated.

At the second stage, the connections between conceptual (conceptual) abilities were studied (in terms of indicators of the "Problem Formulation" and "Verbal-figurative translation" methodology indicators), the level of development of verbal and non-verbal creativity as two aspects of an individual intellectual resource.

At the third stage, we expanded the set of methods to conceptual (categorical and conceptual) abilities in order to examine their interconnections with other manifestations of an individual intellectual resource in more detail and from different angles.

The consolidated program of empirical research of conceptual abilities as the basis of an individual intellectual resource in younger and older adolescents is presented in Table 1.

Table 1 Consolidated program of empirical research of conceptual abilities as a basis of an individual intellectual resource of the student

Series	Stages of empirical studies	Characteristics of participants	Estimated indicator
Younger adolescence (Series 1)	1. Studying the correlation of conceptual (categorical) abilities, creativity and cognitive abilities (analytical intelligence) as manifestations of an individual intellectual resource	32 people (57% female, 43% female, 1-2-year, 17-18 years old, Cherkasy, Kyiv, Lviv, Ternopil)	Verbal creativity
			Nonverbal creativity
			Analytical intelligence
			Conceptual categorical abilities
	2. Studying the correlation of conceptual (conceptual) abilities and creativity as manifestations of an individual intellectual resource	81 people (61% female, 39% female, 1-2-year, 17-18 years old, Cherkasy, Kyiv, Lviv, Ternopil)	Verbal creativity
			Nonverbal creativity
			Conceptual categorical abilities
	3. Correlation of conceptual (both categorical and conceptual) abilities, analytical intelligence and creativity as manifestations of an individual intellectual resource	56 people (60% female, 40% female, 1-2-year, 17-18 years old, Cherkasy, Kyiv, Lviv, Ternopil)	Verbal creativity
			Nonverbal creativity
			Conceptual categorical abilities
			Conceptual abilities
			Analytical intelligence
Senior adolescence (Series 2)	Studying the conceptual abilities as the basis of an individual intellectual resource	124 people (60% female, 40% female, 3-5-year, 19-22 years old, Cherkasy, Kyiv, Lviv, Ternopil)	Analytical intelligence
			Nonverbal creativity
			Conceptual categorical abilities
			Conceptual abilities
			Evaluation of real intellectual achievements

The data obtained were processed using correlation analysis (according to Spearman) and factor analysis (the method of principal components with varimax rotation). It was used the computer program for processing data - PSPP.

4. RESULTS AND DISCUSSION

At the stage of correlation analysis (according to Spearman), significant relationships were identified (Fig. 3):

- variable, categorical generalization with fluency and sophistication (non-verbal creativity); the level of analytical intelligence;
- variable design (non-verbal creativity) with indicators of resistance to closure (non-verbal creativity) and the effectiveness of analytical intelligence.

In addition, connections were found "inside" the indicators of verbal and non-verbal creativity:

- variable fluency (verbal creativity) with variable flexibility and originality (verbal creativity);
- variable flexibility (verbal creativity) with variable originality (verbal creativity);
- variable fluency (non-verbal creativity) with variable resistance to closure (non-verbal creativity).

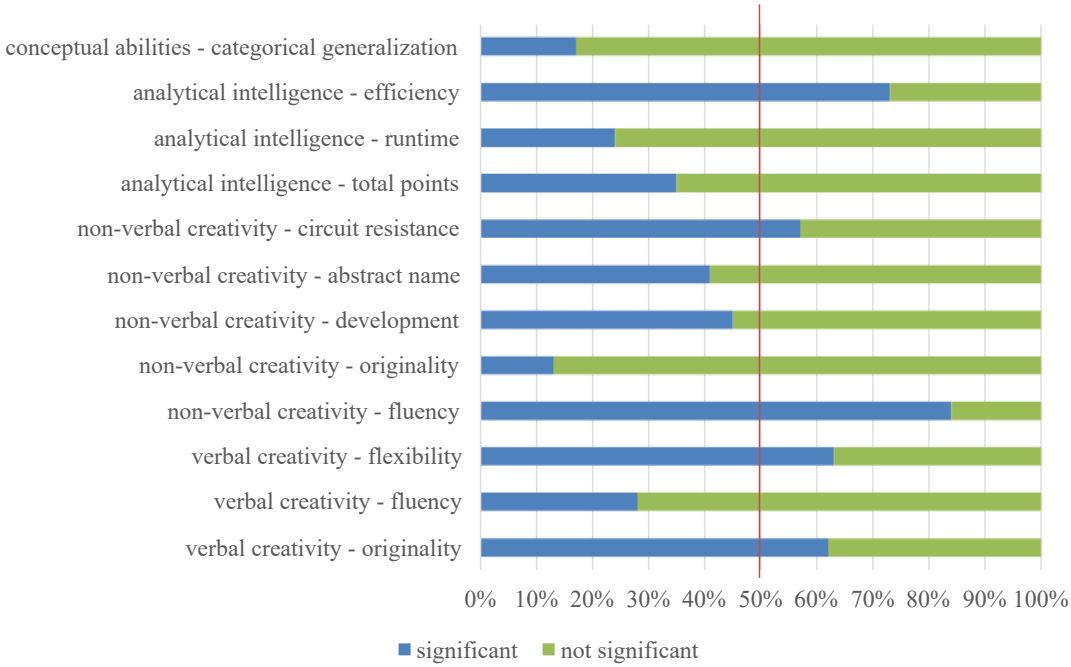

Figure 3 Significant relationships between indicators of conceptual (categorical) abilities, verbal and non-verbal creativity

It should be noted that significant relationships between the categorical ability indicator and non-verbal creativity were identified precisely with the analytical intelligence performance indicator, and not with the level of intelligence (number of points). That is, a high level of intelligence in itself does not yet determine the success of the process of generating creative ideas, the ability to activate your intellectual resources in short periods of time, which is indicated by the efficiency indicator of analytical intelligence, is necessary. The connection of the categorical generalization indicator with the developed indicator (non-verbal creativity) shows that with a high level of development of categorical abilities, the ability to more differentiated and variative analysis of the "empty" perceptual stimulus is formed. Thus, the identified relationships between indicators of categorical abilities, the effectiveness of intellectual activity and non-verbal creativity allow us to conclude that they play an important role in the structure of an individual intellectual resource. Verbal creativity, according to the results of correlation analysis, is not related to indicators of intelligence and non-verbal creativity, which may indicate a manifestation of the disintegration of the intellectual sphere and, accordingly, a decrease in intellectual resource in adolescence.

At the second stage of the correlation analysis (according to Spearman), significant relationships were identified (Fig. 4):

- variable complexity of the formulated problems with variables fluency, flexibility, originality (verbal creativity) and variable closure resistance (non-verbal creativity);
- variable productivity of figurative translation with variables elaboration and resistance to closure (non-verbal creativity).

Between themselves, the variables of the complexity of the formulated problems, the productivity of figurative translation are also related.

In addition, connections were identified "inside" the indicators of verbal and non-verbal creativity:

- variable fluency (verbal creativity) with variable flexibility and originality (verbal creativity);
- variable flexibility (verbal creativity) with variable originality (verbal creativity);
- fluency variable (non-verbal creativity) with fluency variables (verbal creativity), and with all other variables of non-verbal creativity.

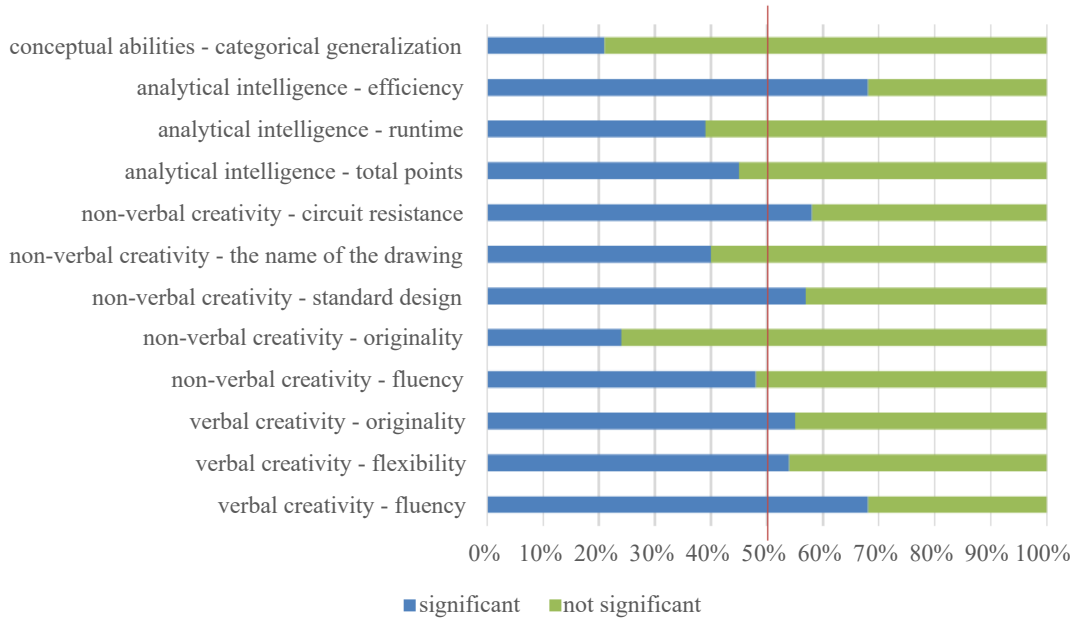

Figure 4 Significant relationships between indicators of conceptual (categorical) abilities, verbal and non-verbal creativity

Thus, one of the indicators of conceptual abilities - the complexity of the problems formulated – is associated with manifestations of both verbal and non-verbal creativity: the wider the connection between the conceptual structure and other semantic areas, the higher the indicators of verbal and non-verbal creativity.

In turn, another indicator of conceptual abilities - the productivity of figurative translation (in the form of the presence of generalized images) - is associated only with manifestations of non-verbal creativity: the more generalized images are actualized when conveying the concept's content, the more complex are the visual transformations of the stimulus as the basis for generating the idea.

5. CONCLUSION

The problem of personal intellectual resources is becoming an increasingly relevant and popular topic of psychological and interdisciplinary research, as it is directly related to the level of well-being of society. Our theoretical analysis of the main approaches to studying this problem allows us to conclude that the most promising approach, from our point of view, is to consider an intellectual resource as a qualitative characteristic of individual intelligence since this takes into account not only information processing processes, but also motivational and regulating the components of intellectual activity related to the characteristics of the organization of the mental experience of the individual. In further studies, it is advisable to

change the age composition of the sample to study the role of conceptual abilities in the structure of the individual intellectual resource of a person at different stages of life.

In addition, it seems necessary to further improve and standardize the methods of studying conceptual abilities, developing on their basis a program for the development of conceptual abilities. Finally, the study of the interconnections of conceptual abilities with personal characteristics, in particular the specifics of a person's motivational sphere, is relevant.

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