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## Correlate's calculation of the educational activities success while schooling

**Abstract.** The article considers the correlation model of the success of school activities. The relevance of the chosen topic, according to the author, is directly related to the change in the type of intelligence of adolescents. The need to analyze the indicators of success of educational activities is also due to a negative trend: according to many domestic researchers, the development of basic intellectual abilities, namely conceptual abilities (or the ability to conceptual thinking), is not ensured in the learning process. In this regard, a study was conducted in which 158 older schoolchildren (15–17 years old) took part. Methodological basis of the research: «Conceptual synthesis», «Visual semantics», «Generalization of three words», «Progressive Raven matrices», electronic journal of academic performance. To process the results obtained, the author chose Spearman's correlation analysis, since this method works with both parametric and nonparametric statistical packages. The results allow us to conclude that during the correlation modeling of the success of school activities, we identify a model consisting of variables representing semantic, categorical and conceptual abilities and intelligence (Crow). The most significant correlate of academic performance in school subjects is categorical abilities. The next largest is the indicator of conceptual abilities. The psychometric measured intelligence indicator ranks only third. Completing the list of significant correlates of school performance is the indicator of the ability to generate semantic features of indeterminate visual images. This assessment of students' knowledge correlates with the basic and most fundamental conceptual abilities, which indicates their fundamental importance for successful activity.

**Keywords:** correlation analysis; school performance; conceptual abilities; intelligence; intellectual success; categorical abilities; psychometric intelligence; regression modeling; semantic abilities

### Introduction

L.A. Yasyukova made the following conclusion: «...at the turn of the 2000s, there was a qualitative change in the type of intelligence of adolescents: the logical systematization of information, based on conceptual thinking, was replaced by formal-figurative generalizations, in which the essence of the phenomena is not distinguished and not understood, although in memory large amounts of

information can be retained».<sup>1</sup> In other words, there is a certain negative trend in the modern Russian school: in the learning process, the development of basic intellectual abilities, namely, conceptual abilities (or the ability to conceptual thinking), is not ensured.

Along with this alarming situation, modern social and educational policy redirects the labor market and employment of the population to the formation of flexible and mobile meta-abilities. It is assumed that the place of knowledge about the subject should be taken by the ability to use knowledge and experience in various (new) situations, the possibility of combining them depending on the changing conditions of the situation [1].

Many scholars and education experts agree that the current educational system is not up to the task of developing the basic intellectual abilities of students. Instead of developing a wide range of knowledge and abilities among students, the educational process is focused on the assimilation of specific facts and materials, which does not provide an opportunity for the development of critical thinking, analytical and creative skills necessary in modern society.

In order to understand why the educational system fails to develop the basic intellectual abilities of students, it is necessary to pay attention to how learning takes place. At the moment, curricula are more focused on the issuance of knowledge than on the development of students. The curriculum is often a list of topics that need to be covered in a certain period of time, and not ways to help the student learn the material and develop their intellectual abilities [2].

However, recently new methods and approaches to teaching have begun to appear, which are more focused on the development of the intellectual abilities of students. One such method is the «reverse classroom», which involves students studying the material on their own before class, and the lessons are used to discuss the learned material, solve problems and teach new skills. This method allows students to develop their intellectual abilities such as critical thinking, independence and problem-solving skills [3].

Especially important for the formation of intellectual abilities is the development of conceptual abilities that allow students to more deeply understand and analyze the world around them. These abilities include understanding abstract concepts, logical and analytical thinking, the ability to draw conclusions and generalizations, and evaluate and analyze information. Without the development of these abilities, students will not be able to effectively apply their knowledge in real life and successfully cope with tasks [4].

In order for the educational system to effectively develop the intellectual abilities of students, it is necessary to use methods and techniques that contribute to the development of understanding, abstract thinking and reflection [5]. These can be various games, trainings, exercises and tasks aimed at developing these abilities. A variety of methods helps students to better absorb and understand the material, as well as develop their intelligence.

However, not all methods are equally effective, and some may be more appropriate for specific age groups or educational levels. Therefore, it is important to select methods and techniques, taking into account the individual characteristics of each student and their needs in the development of intellectual abilities [6].

The problems of the development of intellectual abilities in the educational system are not new, and various studies continue to look for ways to solve this problem. This may include changes in curricula, the use of new technologies and teaching methods, as well as a better understanding of how children's intellectual abilities develop and which methods and techniques are most effective in this process. The development of intellectual abilities is an important task of the educational system, and

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<sup>1</sup> Yasyukova A.A. Patterns of development of conceptual thinking and its role in learning. SPb: GP IMATON. (2005).

it is necessary to give it sufficient attention and effort. Only then can students reach their full potential and become successful and productive members of society.

It is important to remember that the amount of material that needs to be learned is not always the main indicator of the effectiveness of the educational process. It is necessary to focus on the quality of the learned material and on the development of the intellectual abilities of students. Thus, it is possible to make the learning process more efficient and useful for all participants [7].

It is also important to note that the educational system must be adapted to the needs of modern society and the labor market. There are many professions and specializations that require from a person not only knowledge, but also the ability to quickly analyze and solve problems, work in a team, and also have a creative and creative approach to solving problems. In this regard, it is very important that the educational system pays great attention to the development of these skills so that graduates can successfully integrate into modern society and the labor market.

Thus, the development of intellectual abilities is a key task of the educational system, and it is necessary to continue to work on its improvement and improvement [8]. Focusing on the quality of education, the use of innovative methods and technologies, as well as taking into account the needs of modern society and the labor market will help achieve this goal.

Accordingly, the study of the psychological mechanisms of a person's intellectual achievements in the conditions of his real life shows the need to study the complex of abilities and other individual resources of a person's intellectual activity.

Answering the question about what characterizes the real school productivity, I highlighted several options. Grades at school, practice<sup>2</sup>, a high level of development of conceptual abilities<sup>3</sup>, motivation to learn (cognitive need); constant feedback on the assessment of the correctness of their actions or their erroneousness (criticality, reflexivity)<sup>4</sup>; depth and thoroughness of material processing; initiative, intellectual competence and independence of judgment and others. However, which particular component of intellectual activity is most correlated with the success of (split) intellectual activity — this question remains open. It is for this purpose that the present study was undertaken: to carry out correlation modeling of successful school activity.

Theoretical hypotheses of this study:

- school performance indicators are linked to conceptual ability;
- indicators of school success are associated with indicators of psychometric intelligence.

Research hypothesis: conceptual abilities and indicators of psychometric intelligence are related in relation to the level of formation of intellectual success in school.

The subject of the research is the indicators of the real school performance of older adolescents. The object of the research is the older adolescents of secondary schools.

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<sup>2</sup> Kholodnaya M.A. Psychology of intelligence, paradoxes of research: a textbook for bachelors and graduates. 3rd edition revised and enlarged. Moscow: Yurayt Publishing House (2019).

<sup>3</sup> Practical intelligence / Ed. Robert Sternberg. St. Petersburg: Peter (2002).

Kholodnaya M.A. Psychology of intelligence, paradoxes of research: a textbook for bachelors and graduates. 3rd edition revised and enlarged. Moscow: Yurayt Publishing House (2019).

Kholodnaya M.A. The psychology of conceptual thinking: from conceptual structures to conceptual abilities. Moscow: Institute of Psychology RAS (2012).

<sup>4</sup> Raven J. Competence in modern society: identification, development and implementation (translated from English). Moscow: Cogito Center. (2002).

Purpose of the study: disclosing the specifics of school intellectual performance in older adolescence using a statistical analysis.

To achieve this goal, the author has solved a number of tasks:

- to highlight the main components of intellectual success;
- to study possible connections of conceptual abilities of adolescents;
- to determine the methods of conducting the study.

## 1. Methods and materials

Students of secondary school took part in the study (totaling 158 older teenagers at the age from 15 to 17).

When writing a scientific publication, the author used the following methods:

### 1. Methodology for diagnosing conceptual abilities. «Conceptual synthesis».<sup>4</sup>

The material of the methodology «Conceptual Synthesis» consists of three triads that are not related in the meaning of words, namely:

- a shell — a paper clip — a thermometer;
- computer — tornado — pin;
- planet — electrical outlet — hourglass.

We give instructions where we ask you to make as many meaningful sentences as possible with the obligatory use of all three words. We provide one triad of words on A4 format forms and read the instructions orally, in accordance with which we suggest that the research participants establish different options for semantic relationships between these three words, write each option in the form of one or two sentences. The time of work with each of the triads is 3 minutes.

We evaluate each answer according to the following criteria: 0 points — no written proposals; lack of established semantic relationships or the use of only two words; 1 point — a simple enumeration of words in a sentence; 2 points — creation of a context within the description of a specific situation; 3 points — drawing up a sentence using comparisons and analogies, combining all three words on the basis of a generalizing category or detailed cause-and-effect relationships. We sum up the scores for all the triads and set the total score.

Indicator: the level of formation of conceptual abilities (the success of constructing really absent connections between concepts).

### 2. Modified method «Visual semantics».<sup>5</sup>

According to research by E.Yu. Artemyeva<sup>5</sup>, there is a mechanism that naturally «packs» the experience of human interaction with the world into some special structures, which E.Yu. Artemyeva called «semantic-perceptual universals»<sup>6</sup> [9].

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<sup>5</sup> Artemyeva E.Yu. Fundamentals of the psychology of subjective semantics. / Ed. I.B. Khanina. Series: Fundamental Psychology. Moscow: Science; Sense. (1999).

Artemyeva E.Yu. Psychology of subjective semantics. Moscow: Moscow University Press (1980).

<sup>6</sup> Artemyeva E.Yu. Fundamentals of the psychology of subjective semantics. / Ed. I.B. Khanina. Series: Fundamental Psychology. Moscow: Science; Sense. (1999).

Respondents performed two tasks concerning each presented, vague visual figures. First, it was necessary to answer the question: «What is it? What does this object look like?» (The respondent wrote down one or several answer options). Then immediately, the respondent answered the following question: «What properties are inherent in this object, according to your impression?» (Respondents write down one or some list of signs). The following are stimulus patterns (vague visual figures) [9].



*Figure 1. A set of vague visual figures (compiled by the author [9])*

We identify the following indicators while assessing visual meanings (first task) [9]:

1. The total number of meanings.
2. The number of meanings of the geometric type (circle, ball, polygon, geometric figure, the intersection of lines, eight triangles).
3. The number of meanings of the subject-descriptive type (visual meaning as a direct projection of the shape of the figure — the sun, ball, carpet, maple leaf, mask, dog's head, cactus, hook, snowflake, star).
4. The number of meanings of the subject-contextual type (the meaning builds on a broad, meaningful interpretation of the visual figures — a black hole, a well, a piece of leather from a boot, a slice of cheese, a ghost, ancient weapons, a samurai, metro lines, a schedule of functions).

Based on the analysis of the protocols, we identified several types of semantic signs characterizing different modalities of individual mental experience (second task) [9]:

1. The total number of signs.
2. The number of signs of exteroceptive modality (colorful, bright, small, blue, huge, round, sparkles, etc.).
3. The number of signs of Proprioceptive modality (racing, jumping, fast, tight, can explode, active, spin, fall, etc.).
4. The number of signs of apperceptive modality (complex, untidy, fluid, rumped, fragile, reliable, melts, etc.).
5. The number of signs of emotional modality (kind, ugly, cheerful, sad, affectionate, gentle, intimidating, proud, etc.).

Indicator: the ability to generate semantic signs and meanings when describing indefinite visual forms (semantic ability\_signs; semantic ability\_meanings) [9].

3. Techniques for identifying categorical abilities. Methodology «Generalization of three words» [9; 10].

Respondents searched for generic categories based on identifying a common essential trait between three complex concepts in the technique. We present ten triad words, such as «lighthouse, newspaper, bonfire, «icon, map, decoration» «gamma, beads, stairs» etc. [9].

Indicator: the sum of points characterizing the level of formation of categorical abilities [9].

4. Raven's test. Scale of progressive matrices. Raven Progressive Matrices. Methods for diagnosing intelligence.<sup>4</sup>

John Raven (together with L. Penrose) developed the «Scale of Progressive Matrices» technique in 1936 for diagnosing the level of intellectual development and assesses the ability for systematic, systematic, methodical intellectual activity (logical thinking).

The author of the methodology created a test that would be theoretically justified, unambiguously interpretable, and the assessment of which would minimally depend on differences in education, origin and life experience of people.

There is an adult and children's version of Raven's tests. We used in this study a variant of the Raven Progressive Matrices (RPM) test for examining adults (age range from 14 to 65 years).

The test consists of 60 tables (5 series). Each series of tables contains tasks of increasing difficulty. At the same time, the complexity of the type of tasks from series to series is also characteristic.

We limited the test time in this study to 20 minutes.

Indicator: the level of intellectual development and the ability to systematized, planned, methodical intellectual activity (logical thinking) — «Psychometric intelligence».

5. Electronic journal of student progress.

Indicator: the grade point average in school for the trimester.

We used the Statistica SPSS 19.01 to process the results.

## 2. Results and discussion

Despite the large sample size of the study and the possibility of using parametric methods of correlation analysis, we chose the Spearman correlation analysis for further work. This was done due to the fact that even in the case of an abnormal distribution of any of the studied variables, the results obtained would be valid, since this method works with both parametric and nonparametric statistical packages [11].

Correlation analysis of the components of intellectual success (generalizing, categorical and semantic components) and indicators of psychometric intelligence.

The correlation analysis of the data was carried out in order to study the possible connections of conceptual (generalizing, categorical and semantic) abilities for the manifestation of successful intellectual (school) activity. For the analysis, I took the indicators of generalization, categorical and semantic abilities, the results of the intelligence test (the Raven method) and school performance indicators.

The results of this analysis are presented in table 1.

Table 1

### Correlation links of indicators of academic performance, generative abilities, categorical abilities, indicators of semantic abilities and indicators of logical thinking

Variable	Academic performance	Generative abilities	Categorical abilities	Semantic features
Academic performance	1,000			
Generative abilities	0,224**			
Categorical abilities	0,367**	0,287**		
Semantic features	0,208**	0,256**	0,223**	
Psychometric intelligence	0,211**	0,246**	0,275**	0,087

As can be seen from the results presented in table 1, the most significant correlate of academic performance in school subjects is categorical abilities. Next in size is an indicator of conceptual abilities. The psychometric measured intelligence indicator (Progressive Raven's Matrices) appears only in third place. Completes the list of significant correlates of school performance completes the indicator of the ability to generate semantic features of indeterminate visual images (variations on the theme of the circle).

It is noteworthy that there were no significant correlations between the success of school activities and indicators of the ability to form semantic interpretations. The latter fact indicates that in the process of getting a school education in high school, such a primitive way of processing information as semantic interpretations is no longer relevant. It becomes so collapsed and automated that it can no longer be extracted arbitrarily.

Returning to the main results obtained in our study, we should especially emphasize the fact that it is the conceptual abilities of a high degree of generalization and synthesis that correlate with the success rates in the subjects of the school curriculum, outstripping the indicators of psychometric intelligence in importance.

### Conclusion

Thus, in the course of regression modeling of the success of school activities, one model was identified. The resulting model consists of variables representing semantic, categorical and conceptual abilities, as well as a raw intelligence test result (Raven). The most significant correlate of academic performance in school subjects are categorical abilities. Next in size is an indicator of conceptual abilities. The psychometric measured intelligence indicator appears only in third place. Completes the list of significant correlates of school performance completes the indicator of the ability to generate semantic features of indeterminate visual images.

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## **Корреляционный анализ показателей успешности учебной деятельности в школе**

**Аннотация.** В статье рассматривается корреляционная модель успешности школьной деятельности. Актуальность выбранной темы, как утверждает автор, непосредственно связана с изменением типа интеллекта подростков. Необходимость анализа показателей успешности учебной деятельности обусловлена также негативной тенденцией: по мнению многих отечественных исследователей, в процессе обучения не обеспечивается развитие базовых интеллектуальных способностей, а именно понятийных способностей (или способности к понятийному мышлению). В связи с этим было проведено исследование, в котором приняли участие 158 школьников старшего возраста (15–17 лет). Методологическая база исследования: «Понятийный синтез», «Визуальная семантика», «Обобщение трех слов», «Прогрессивные матрицы Равена», электронный журнал успеваемости. Для обработки полученных результатов автором был выбран корреляционный анализ Спирмена, так как данный метод работает как с параметрическими, так и с непараметрическими статистическими пакетами. Результаты исследования позволяют сделать вывод, что в ходе корреляционного моделирования успешности школьной деятельности мы выявляем модель, состоящую из переменных, представляющих семантические, категориальные и концептуальные способности и интеллект (Ворон). Наиболее значимым коррелятом успеваемости по школьным предметам являются категориальные способности. Следующим по величине является показатель концептуальных способностей. Психометрический измеряемый показатель интеллекта занимает лишь третье место. Завершает список значимых коррелятов школьной успеваемости показатель способности генерировать семантические признаки неопределенных зрительных образов. Эта оценка знаний учащихся коррелирует с основными и наиболее фундаментальными концептуальными способностями, что свидетельствует об их принципиальной важности для успешной деятельности.

**Ключевые слова:** корреляционный анализ; школьная успеваемость; концептуальные способности; интеллект; интеллектуальная успешность; категориальные способности; психометрический интеллект; регрессионное моделирование; семантические способности