



## Conceptual Predictors of The Adolescents With Different Cognition Types Intellectual Activity

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**Abstract:** Such predictors of intellectual activity as categoric, conceptual and semantic ones are analyzed in the article; the analysis is aimed at defining structural peculiarities of the adolescents' conceptual predictors exemplified by the adolescents with open-minded, closed-minded and neutral (mixed) cognition. Design of the research can be defined as a deductive-correlated one. The research is based on mixed-method studies, containing qualitative and quantitative methods of the data processing and interpreting. Principal Component analysis (PCA) as well as the Kruskal-Wallis rank sum test (IBM SPSS Statistics) allowed us to find out peculiarities of the adolescents with different cognition types intellectual activity conceptual predictors. The average value of the factor structures summary dispersion and differences in predictors significance values from  $p \leq 0.01$  to  $p \leq 0.05$  reflects the veracity of the research results. The research proves that adolescents with open-minded cognition are characterized by well-developed long-term semantic memory, i.e. they are able to generate more ideas ( $H_{emp.} = 12.082$ ,  $p \leq 0.01$ ), their categoric abilities are highly developed ( $H_{emp.} = 13.764$ ,  $p \leq 0.01$ ). Factor structure in this group of adolescents is a sign of conceptual abilities and conceptual predictors systems integration. The level of cognition openness is one of the basic characteristics of intellectual success. The attained statistic results prove that there are great differences between structural peculiarities of the adolescents with different cognition types intellectual activity conceptual predictors; the results of the research are as well indicatives of the fact that intellectual activity of adolescents with different cognition types is conditioned by the conceptual predictors structure.

*Keywords:* conceptual structures, intellectual activity, cognition, adolescents.

### Introduction

Intellectual activity determines success of a person at all stages and in all spheres of life: beginning with playing in early childhood, then while studying at school and university as well as in a period of building a career in adulthood. Challenges and success of intellectual activity management are related to a person's metacognitive experience. Metacognitive experience, containing effortful and involuntary control, metacognitive awareness and open-minded cognition (defined as a component of person's intellectual resource), determines regulation of the intellectual activity. Studying the roles of metacognitions in condition of education digitalization taking place nowadays is of great importance and especially relevant, because the regulatory aspects of educational activity are important predictors of this activity being successful and effective; they are insufficiently studied as well. The research shows that the students with high metacognitive awareness are characterized by higher indices of internal motivation in studying, as well as by being much more successful in meeting the challenges in creative thinking, which is an important factor of studying being successful (Norman and Furnes, 2016). Generally speaking, metacognitive experience is considered by researchers as the basis of creative activity (Volkova, 2016) and intellectual competence. Thus, comparing highly-qualified specialists (teachers of Physics) and newcomers (students) it was found out that professional success is connected and interrelated with intellectual competence only in case of all metacognitive experience structures being well-developed (Savin, 2004).

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Well-developed metacognitive characteristics of experience (e.g., awareness of one's own process of thinking and the content of one's own representation system as well as a cognitive process active monitoring) are quite universal and act as predictors of effective solving problems in various fields of knowledge (Schuster et al., 2020; Litvinov and Ivolina, 2013).

One of the key components of the metacognitive experience is cognition defined as the way of analyzing the circumstances and current situation, being ready to perceive new information and being open for new experience. The cognition is studied as an important condition of person's success in one's own intellectual activity and in life in general, because person's being flexible in interacting with the surrounding world and being ready to process even paradoxical information in rapidly changing world is of great importance. Cognition as a peculiar type of cognitive attitude to the world around is subdivided into different types: open-minded, neutral/mixed and closed-minded. If studying person's success, open-minded cognition is of great research interest; this kind of cognition is characterized by the following features (Kholodnaya, 2019): realizing that there may be different points of views on the same phenomenon; ability to percept and use different types of describing the phenomenon and to switch from one method of describing to another one fluently; decentralizing as the ability to take other point of views into account; readiness to conceptualize any unusual phenomena and contradictions in an objective way; flexibility of individual judgments; being open for experience as the ability to accept even the most unusual and inconceivable events.

Open-minded cognition is a resource of cognitive, personal and social success of human. If speaking about personal and social success of a human, one's own being open for experience (as a sign of open-minded cognition) reveals as a resource of being satisfied with own life. People open for new experience can benefit from the personal growth opportunities offered in this very period, i.e., they are able to meet their own needs (Stephan, 2009). Success in meeting the challenges is connected with cognition openness and genius of a person: gifted adolescents are more likely to have open-minded cognition and unidimensional coping-strategies with their adaptive types prevailing (Klimontova, 2010).

Open-minded cognition is an important indicator of human being cognitively active, creative and effective. So, generating new ideas is a result of person being open for new experience interrelation with high cognitive interest. This fact helped researchers and practical persons in Psychology to identify employees with creative potential and to optimize their activity to develop this potential (Madrid and Patterson, 2016). Studying the ability to solve divergent problems showed the connection between person being open for new experience and creative assessments as well as the significance of the identified strengths and weaknesses of the decisions made. The researchers also found out that the open-minded cognition makes significant additional contribution to creative assessments. This cognition turned out to be an important predictor of generating and assessing the ideas (Puente-Díaza et al., 2022). Personal need in cognition (i.e. tendency to search actively, being engaged into activity and enjoy this activity) is a sign of an open-minded cognition; it affects person being internally motivated and highly involved in studying. Students with low need in cognition (closed-minded cognition) are on the contrary (Lavrijsen et al., 2021).

Thus, open-minded cognition is an effective cognitive method of processing information and one of the measures of metacognitive experience formation, person's intellectual development level and being successful in intellectual activity (Kibal'chenko and Eksakusto, 2020).

Effective intellectual activity is a factor of cognitive, personal and social success. Cognitive abilities and intellectual stimulation as well as other factors (being involved in activity, inspiring motivation and individual attention) have an influence on leadership efficiency (performing leading functions) and success in any project implementing as well as on eliminating the potential losses and unnecessary failures (Shanqaiti and Farea, 2021).

Moreover intellectual activity and its being successful (as well as the internal locus of control, various experience conation) leads to personal and general human's abilities development (Austerberry et al., 2021; Ackerman, 2017; Shadrikov, 2019) and has an influence on professional thinking development (Levich, Marchenko and Filippova, 2019), self-acceptance intensity and self-esteem. Intellectually gifted students are characterized by a higher self-actualization (statistically insignificant); while students whose self-actualization is just developing are specified by internal locus of control and need to be motivated and have different experience (Pufal-Struzik, 1995). Positive correlation between integral self-esteem and creativity (as a cognitive ability) is identified by researchers (Pavlova, 2018).

The degree of intellectual activity efficiency is a determining factor for academic achievements/success. There are lots of studies proving these persistent connections. General (i.e. intelligence, creativity) and specific (speed of information processing, memory, thinking, attention, imagination and speech) cognitive predictors determine academic success at the beginning of studying and at other stages

of getting education and define an ability to establish logical connections as well as an ability to identify what is critically important and what is merely a detail (Postavnev et al., 2020; Larkina and Anufriev, 2021).

Thus, it is obvious that intellectual activity is helpful to the person being successful in life; this fact proves the necessity of studying the predictors stipulating intellectual activity. Intellectual activity (expressed in solving wide range of cognitive and personal problems) predictors are defined as factors predicting the success of this activity. It should be as well emphasized that the predictor is much more informative if it includes two or more factors, i.e. is complex in nature; this fact is taken into account at the empirical stage of the research (Maryutina, Ermolaev and Trubnikov, 1998).

There are many studies nowadays that analyze cognitive and personal predictors of the intellectual activity success (Hülür et al., 2018; Veenman and Verheij, 2003; Vladimirov, Podshivalenko and Smirnitckaya, 2021). Personal predictors of the intellectual (educational and cognitive in particular) activity and its being successful are as follows: motivation, self-esteem, self-efficacy, idiosyncrasy, individual character and personal traits (e.g., responsibility, emotivity, etc.), "Big five" factors and individual regulatory features (Zirenko, 2018; Kholodnaya, 2019). Thus, the success of students in Mathematics (as a sign of intellectual success) is correlated with regulatory indices. This success is significantly correlated with a "models building" index, determined as a variable reflecting the ability to identify significant conditions for achieving goals both in current situation and in future. Therefore it is quite evident that "models building" is connected with the cognitive activity being successful (Morosanova, Fomina and Kovas, 2014).

General abilities (i.e. intelligence and creative abilities) are analyzed on the basis of intelligence tests fulfillment; cognitive predictors of these abilities development level are as follows: cognitive control, information processing speed and the sense of number (Tikhomirova, Misozhnikova and Malykh, 2020; Goryunova and Druzhinin, 2000; Shcheblanova, 2011)

Indices of emotional intelligence and intellectual humility (i.e. being able to change one's opinion in case of evidence of another point of view, being open for new facts, experience and information) are cognitive predictors of successful intellectual activity. The higher these indices are, the more successful the student in a process of studying is. In other words, if a student is able to accept ideas contradicting own principles/knowledge and is open for them, he/she will be able to solve challenges of different levels of complexity and cope with problems in future life efficiently (Ratu, Ra and Savitri, 2021).

It should be also pointed out that conceptual thinking (Kholodnaya, 2012) performing a peculiar function in an intellectual activity regulation, is a form of cognitive predictors and cognitive structures integration. According to M. A. Kholodnaya, the success of conceptual thinking as well as of different types of cognitive activity of conceptual nature is based on conceptual abilities. Conceptual abilities can be defined as specific mental peculiarities that cause intellectual activity success by forming semantic nets, using categories of various generality degrees, interpreting, making hypotheses and substantiations (Kholodnaya, 2019). The level of conceptual abilities development and a high level of these abilities correlation can identify that all intellectual abilities of a person are highly-developed, i.e. intellectual activity is efficient (Kholodnaya, 2015; Kholodnaya et al., 2019). More to the point, the structure of conceptual abilities is heterogeneous and includes the following abilities: semantic (verbal signs assimilation, storage and updating); categoric (defining and using categoric signs of generalization of different degree); and conceptual ones (generating new mental content). Conceptual structures include three types of conceptual abilities mentioned above; but only in case of conceptual structures being well-developed the unique ability to conceptualize (which is the basic ability of human intelligence) can be formed (Kholodnaya, 2012; Kholodnaya, 2019).

The research carried by M. A. Kholodnaya and Y. I. Sipovskaya proving the fact that the intellectual ability efficiency correlates with conceptual abilities. This research provides the data on sensory-emotional experience in a process of describing fuzzy visual images; as well as on this experience being connected with the level of conceptual (i.e. categoric and generative) abilities. Generative abilities, comparing to categoric ones, play a leading role in defining the degree of modalities variety and the level of their being expressed while visual images forming. The generative abilities represent the highest level of personal conceptual experience organization; this experience becomes multimodal thanks to integrity of conceptual (generative) structures. In other words, conceptual (generating) structures determine the form of top-down" conceptual representations (Kholodnaya and Sipovskaya, 2021).

Conceptual thinking and abilities are formed in a period of adolescence; they ensure qualitative changes in all cognitive processes and intellectual activity; these abilities are the factors of cognitive sphere integrating and human holistic intelligence structure forming (Kholodnaya, 2015; Kholodnaya et al., 2019). Specific functions of conceptual thinking, necessary for intellectual resources development, are formed by the time of adolescence. These functions include developing, integrative, predictive, conceptual and generating ones.

Thus, the levels of conceptual thinking, conceptual abilities structure and conceptual system formation are included in a generalized system of intellectual activity conceptual predictors and serve as predictors of intellectual resources development. The conceptual system is studied as a form of cognitive structures integration.

Theoretical analysis showed that the coverage of cognition and intellectual activity separate predictors is of different aspects, and peculiarities of cognition multiple links with semantic, categoric and conceptual abilities characteristics is still an open issue. The research is of great current interest for studying intellectual activity of adolescents. Studying the specificity of cognitive structures and the signs of their differentiation and integration may complete the scientific facts of adolescents' intellectual activity conceptual predictors; this fact will help to define the most effective technologies and methods of teaching adolescents.

It is fair to assume that specificity of the adolescents' (characterized by different cognitions) intellectual activity conceptual predictors lies in abilities (semantic, categoric and conceptual) development level and peculiarities as well as in structural connections between these abilities. Specific character of adolescents (characterized by different cognitions) intellectual activity conceptual predictors formedness correlates with the level of its openness. These very assumptions defined the purpose of this study.

## Materials and Methods

The design of the research is defined as a deductive-correlated one including such qualitative and quantitative methods (Briggs et al. (eds.), 2012) and techniques of the data processing and interpreting as Principal Component analysis (PCA) and the Kruskal-Wallis rank sum test (IBM SPSS Statistics); "Perfect computer" was used to study cognition of students; "Generalization of three words" was aimed at defining the level of categoric generalization (abilities); "Conceptual synthesis" helped to identify the degree of connections and conceptual abilities complexity; "Concept cognitive content" is used in order to test adolescents' awareness of the concept content (semantic abilities) based on activating a long-term semantic memory (Kholodnaya, 2015; Kholodnaya et al., 2019); "Words free sorting test" by V. A. Kolga helped to define concept style as a form of involuntary intellectual control (Kholodnaya, 2019).

The results statistic processing included Kruskal-Wallis one-way dispersion analysis, helping to compare the average values in three groups or more; factor analysis (principal component method) allowed to study correlations between variables characteristics (IBM SPSS Statistics). Correlating variables ( $r \geq 0.5$ ) were included into one factor. The number of observations in each group (32 students with closed-minded cognition, 72 students with neutral cognition and 36 students with open-minded cognition) exceeded the number of variables (13) more than twice.

One hundred and forty students took part in the research. Average age of the respondents was 15.5 years (14-17 years old). Forty-nine comma eight per cent male and 50.2 per cent female students.

## Results

As a diagnostic was carried out at the first stage of the research, 140 adolescents were subdivided into three groups:

First group: adolescents characterized by a closed-minded cognition; this group includes 32 students (23 per cent);

Second group includes 72 adolescents with neutral (mixed) cognition (51 per cent);

And third group consisting of 36 open-minded cognition students (26 per cent) (see Figure 1).

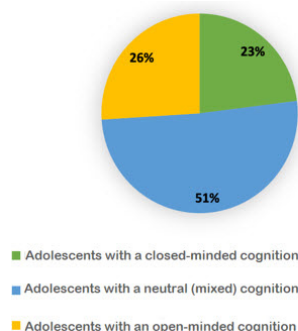


Figure 1. Grouping of adolescents with different cognition types

Basic method used for differentiating was “Perfect computer” and its cognition openness measure. Three groups of adolescents with open-, closed-minded and neutral cognition were compared to specify differences between them; this comparison was carried out on the basis of indices mean values, characterizing the level of cognition openness. (Table 1).

**Table 1**  
*The results of variables (characterizing the level of cognition openness in groups) statistic processing*

Variables	Kruskal-Wallis coefficient value	H <sub>emp.</sub>	Accepted hypothesis, significance value
1. Objectified questions	42.087		H1, p≤0.01
2. Subjectified questions	53.526		H1, p≤0.01
3. Categoric questions	54.153		H1, p≤0.01
4. Substantial questions	39.727		H1, p≤0.01
5. Total	0.6567		H0

Thus, significant (p≤0.01 p≤0.05) quantitative and qualitative differences between the groups of adolescents were identified. There were no significant differences between the groups in a quantity of questions, i.e. adolescents create almost equal quantity of questions. But we should point out that if speaking about the group of adolescents with an open-minded cognition, the quantity of questions they create is characteristic of the intellectual activity speed; contrariwise: the quantity of questions asked by the adolescents with a closed-minded cognition shows their intellectual activity being impulsive.

Intellectual activity signs analysis let us suppose that its conceptual predictors in groups of adolescents with different cognition types are described as a system of conceptual abilities (semantic, categoric and conceptual), i.e. as an individual conceptual system. This supposition specified the following step of the research.

#### **Categoric abilities of adolescents with different cognition types**

Studying students' categoric abilities (categoric generalization) score the following results:

Nineteen adolescents (60 per cent) in a closed-minded cognition group showed thematic generalization based on associative coupling, 11 (34 per cent) of them are characterized by analytic generalization; only 2 students (6 per cent) had the signs of class-descriptive category. I.e. this group is notable for thematic generalization based on associative coupling predominance; this fact is a sign of a low level of categoric abilities formedness.

Analyzing the group of adolescents with neutral (mixed) cognition helped to get the following results: 20 (28 per cent) of these students showed thematic generalization based on associative coupling, 48 (67 per cent) – analytic generalization and 4 (5 per cent) using class-descriptive category. Analytical generalization based on specific sign defining predominates in this group.

If speaking about the group with an open-minded cognition, 7 adolescents (19 per cent) are characterized by thematic generalization based on associative coupling, 19 students (53 per cent) are specified by analytic generalization and 10 (27 per cent) of them are able to use class-description. So, statistic processing of the categoric generalization (categoric abilities) results acquired in groups with different cognition types showed significant differences of this variable (H<sub>emp.</sub> = 13.764, p≤0.01).

On the assumption of the results we can note that the more open cognition is, the higher the level of categoric generalization is.

The number of students included into an open-minded cognition group, who are able to define the signs using categoric generalization (high level of categoric abilities), is higher than in two other ones. Categoric abilities correlate with conceptual abilities.

#### **Conceptual abilities of adolescents with different cognition types**

Statistic operating of conceptual abilities mean values received by using “Conceptual synthesis” method showed that the more open the cognition is, the more ideas adolescents create and the more complex these ideas are. This fact can prove that the open-minded cognition formedness level correlates with conceptual abilities.

Adolescents included into a group with a closed-minded cognition create fewest number of ideas (mean value is 2.72), and the range and depth of these ideas and their connections are focused on peculiar situations and simple calculating, but not on cause-and-effect links. Nineteen per cent of students included into this group are characterized by a low level of conceptual synthesis formedness; they use

meaningless words combinations while making sentences. Conceptual synthesis average formedness level is characteristic of 15 adolescents (47 per cent) in this group. Complexity level of the connections established by these students is concentrated on peculiar situations, simple words enumerations or uncreative oppositions. Eleven (34 per cent) of adolescents are notable for having an above-average level and are able to make phrases with given words, including them into peculiar situation description, and find the cause-and-effect links as well.

Statistically meaningful differences in “ideas quantity” and “the level of the established links complexity” were obtained in three groups of adolescents with different cognition types (see Table 2).

**Table 2**  
*The results of conceptual abilities variables statistic processing*

Variables	Kruskal-Wallis H <sub>emp.</sub> coefficient value	Accepted hypothesis, significance value
1. Quantity of ideas (min=3)	10.27	H1, at p≤0.01
2. The level of the established links complexity	9.97	H1, at p≤0.01
3. The level of conceptual synthesis formedness	2.77	H0

Conceptualization style diagnostic resulted in absence of meaningful differences between indices characterizing conceptualization style as a form of involuntary intellectual control in groups of adolescents with different cognition types.

### **Semantic abilities of adolescents with different cognition types**

Then the research concentrated on analyzing mean values of indices, characterizing semantic abilities of adolescents.

Those of them included into an open-minded cognition group are notable for having the biggest concept indices quantity (mean value = 8.42); by comparison, a mean value of these indices in a group of students with a neutral (mixed) cognition is 8.06, in a group of adolescents with a closed-minded cognition this value is 5.09. These values can be facts of extensiveness escalation, awareness on the concept content (“Knowledge”) followed by the students’ cognition becoming more open.

Analysis of the results characterizing the level of verbal and speech, emotional and other modalities being included into cognitive concept content (integrity) opened up statistically meaningful differences in a positive modality index (Hemp. = 23.630, p≤0.01). Negative and neutral modalities as well as a “Knowledge” cognitive concept content integrity have no differences statistically; but if comparing average results of three groups (closed-minded cognition group – 2.66, neutral (mixed) one – 4.88 and an open-minded cognition group – 4.97) there is a tendency of conceptual abilities being formed better in a group of students with an open-minded cognition. There are some signs of cognitive mechanisms interaction while information processing and using different modalities for concept content description. The adolescents use sensory and emotional coloring for concept, as well as show complexity of the “Knowledge” concept cognitive content.

These results of the research become bases for further studying, i.e. defining structural features of adolescents with different cognitions conceptual abilities.

### **Features of adolescents with different cognition types conceptual abilities factor structures**

The research is aimed at defining conceptual abilities (conceptual structures) factor structures in groups of students with different cognition types.

The study is focused on adolescents with a closed-minded cognition conceptual abilities factor structures (see Table 3).

**Table 3**  
*Adolescents with a closed-minded cognition conceptual abilities factor structures*

Variables	Component				
	1	2	3	4	5
1. The level of generalization	.19	-.08	.02	.29	-.86
2. The quantity of ideas	-.07	.12	.04	.89	-.19
3. The level of the links complexity	<u>.39</u>	<u>.38</u>	<u>.24</u>	<u>.39</u>	<u>.02</u>
4. The level of conceptual synthesis	<u>.60</u>	.33	.23	.59	.07
5. The quantity of the concept indices	.34	<u>.79</u>	.45	.08	-.04
6. Concept indices negative modality	.23	<u>.86</u>	-.16	.14	.00
7. Concept indices neutral modality	.27	.40	<u>.69</u>	-.03	-.28
8. Concept indices positive modality	.27	<u>.73</u>	.21	.11	.25
9. Concept indices integrity	.09	<u>.71</u>	.59	.19	.028
10. The quantity of the words groups	.12	.14	<u>.75</u>	.17	.47
11. Characteristics improving the group of words description	<u>.91</u>	.22	.29	.07	.10
12. Characteristics impairing the group of words description	<u>-.93</u>	-.16	.20	.04	.21
13. Categorization coefficient	<u>.96</u>	.19	.07	.10	-.07
Percentage load	25.87	42.73	59.52	70.69	81.09

NB: the most important variables, included into corresponding factor are underlined in the Table. Color marking means the lack of variable No. 3 in a factor structure (The level of the established links complexity).

Summary dispersion is 81.09 per cent, i.e. the factor structure defined in the research is significant. The links here are generally direct, but inverse correlations can be found here as well. This structure is incomplete and characterized by the lack of the third variable (i.e. "The level of the established links" ("Conceptual synthesis")). This variable is connected with such characteristics as ingenuity and fluency.

**First factor** is a crystallizing one with a load of 25.87 per cent, ambivalent, including four correlating variables; three of them are directly correlated and one of them has an inverse correlation.

The directly correlated variables are as follows: The level of conceptual synthesis formedness ("Conceptual synthesis") (0.60); characteristics improving the group of words description ("Words free sorting test") (-0.91); categorization coefficient ("Words free sorting test") (0.955). The variable "characteristics impairing the group of words description" is inversely correlated variable ("Words free sorting test") (0.93). This inversely directed variable means that the oftener the characteristics impairing the group of words description appear, the lower the level of characteristics improving the group of words description becomes and vice versa. The variables of semantic abilities are not presented in a key factor. This is a sign of the lack of integrity in conceptual abilities structure in a group of students with a closed-minded cognition.

**The second factor** with a cumulative load of 42.73 per cent includes four following co-directional variables: the quantity of concept indices ("Cognitive concept content") (0.79), concept indices negative modality ("Cognitive concept content") (0.86), concept indices positive modality ("Cognitive concept content") (0.73), integrity ("Cognitive concept content") (0.71).

**The third factor** is characterized by cumulative load of 59.52 per cent and includes two correlated variables: concept indices neutral modality ("Cognitive concept content") (0.69) and general quantity of the words groups ("Words free sorting test") (0.75).

**The fourth factor's** cumulative load is 70.69 per cent; this factor includes one variable: the quantity of ideas ("Conceptual synthesis") (min=3) (0.89).

**The fifth factor** has an 81.09 per cent cumulative load. One inversely directed variable is included into this factor; this variable is the level of generalization ("Generalization of three words") (-0.859), indicating the categoric abilities characteristic. This fact can be a sign of low categoric abilities formedness level (if speaking about adolescents with a closed-minded cognition).

The factor structure including 5 factors was figured out as a result of factorization and rotation in a group of adolescents with a neutral cognition (see Table 4).

**Table 4**  
*Adolescents with a neutral cognition conceptual abilities factor structures*

Variables	Component				
	1	2	3	4	5
1. The level of generalization	-.14	.58	-.12	.23	-.15
2. The quantity of ideas	-.07	.56	.48	.01	.41
3. The level of the links complexity	-.021	.05	.35	.19	.87
4. The level of conceptual synthesis	.00	-.09	.08	.12	.91
5. The quantity of the concept indices	.89	.13	.11	.12	.32
6. Concept indices negative modality	.59	.49	-.12	-.03	.027
7. Concept indices neutral modality	.86	-.17	-.04	.15	-.01
8. Concept indices positive modality	.47	.08	.29	.09	.44
9. Concept indices integrity	.74	.12	-.04	.09	-.16
10. The quantity of the words groups	-.11	-.06	.93	-.08	.21
11. Characteristics improving the group of words description	.08	-.06	.76	.54	.26
12. Characteristics impairing the group of words description	-.20	.02	.12	-.94	-.09
13. Categorization coefficient	.13	.02	.25	.90	.16
Percentage load	21.21	36.93	52.61	66.99	80.61

Summary dispersion in this structure equals 80.61 per cent. Direct correlation prevails here, but there is a factor with inverse correlation as well. The structure is also incomplete and notable for the lack of the 8th variable (concept indices positive modality) ("Cognitive concept content"). This variable is correlated with positive emotional attitude to studying and a meaning of getting education. These results are characteristic of some challenges connected with cognitive sphere and intellectual success of students included into a neutral cognition group.

Cumulative load of **the first factor** is 21.21 per cent, co-directional and includes four following variables: the quantity of concept indices ("Cognitive concept content") (0.89), concept indices negative modality ("Cognitive concept content") (0.59), concept indices neutral modality ("Cognitive concept content") (0.86), integrity ("Cognitive concept content") (0.74). The variables reflecting semantic and conceptual abilities characteristics are the core indices of the factor structure in this group of adolescents.

**The second factor** with cumulative load of 36.93 per cent is directly correlated, includes two variables: the level of generalization ("Generalization of three words") (0.58) and the quantity of ideas ("Conceptual synthesis") (0.55). This factor is formed by the variables describing separate indices of categoric and conceptual abilities integration and is characteristic of a neutral cognition group.

**The third factor's** cumulative load is 52.61 per cent; it includes the following co-directed variables: total quantity of groups ("Words free sorting test") (0.925), characteristics improving the group of words description ("Words free sorting test") (0.755).

**The fourth factor** includes two ambivalent variables: categorization coefficient ("Words free sorting test") (0.90) and characteristics impairing the group of words description ("Words free sorting test") (-0.94). Cumulative load here is 66.99 per cent. Presence of the "characteristics impairing the group of words description" variable proves that the more often it appears, the lower the level of notions categorization coefficient is and vice versa. This fact is theoretically grounded.

**Fifth factor** has an 80.61 per cent cumulative load and includes two directly correlated and mutually complementary variables: the level of the links complexity ("Conceptual synthesis") (0.87) and the level of conceptual synthesis formedness ("Conceptual synthesis") (0.91).

Factor structure containing 4 factors is formed as a result of data factorization and rotation in a group of adolescents characterized by an open-minded cognition (see Table 5).



**Table 5**  
*Adolescents with an open-minded cognition conceptual abilities factor structures*

Variables	Component			
	1	2	3	4
14. The level of generalization	.64	.43	-.07	.29
15. The quantity of ideas	-.21	.19	.85	-.12
16. The level of the links complexity	.36	-.17	.89	.04
17. The level of conceptual synthesis	.70	-.36	.14	.17
18. The quantity of the concept indices	-.19	.89	.24	-.14
19. Concept indices negative modality	-.37	.44	.72	-.26
20. Concept indices neutral modality	-.24	.83	-.09	.07
21. Concept indices positive modality	.63	.38	.05	-.25
22. Concept indices integrity	-.41	.69	.36	.10
23. The quantity of the words groups	.09	.05	-.06	.93
24. Characteristics improving the group of words description	.89	.04	-.04	.35
25. Characteristics impairing the group of words description	-.87	.01	-.02	.45
26. Categorization coefficient	.90	-.08	-.14	-.25
Percentage load	24.03	42.49	60.29	76.37

*Summary dispersion in this group is 76.37 per cent. Direct correlation prevails in this complete structure.*

**First factor:** cumulative load is 24.03 per cent; the factor includes six variables, five of which are directly correlated; one of them is inversely correlated, this correlation is theoretically grounded.

The variables with direct correlation include: the level of generalization (“Generalization of three words”) (0.64); the level of conceptual synthesis formedness (“Conceptual synthesis”) (0.70); concept indices positive modality (“Cognitive concept content”) (0.63); characteristics improving the group of words description (“Words free sorting test”) (0.89); categorization coefficient (all groups total points divided into the number of groups) (“Words free sorting test”) (0.90). Inversely correlated variable is “characteristics impairing the group of words description” (“Words free sorting test”) (-0.87) in case of characteristics improving the group of words description occurrence frequency increasing.

Crystallizing factor is formed by variables proving the fact that categoric, conceptual and semantic abilities of the adolescents included into this group are well-formed. This is the sign of conceptual abilities structure being integral.

**The second one** is notable for cumulative load of 42.49 per cent, co-directed and includes three following factors: the quantity of concept indices (“Cognitive concept content”) (0.89), neutral modality (“Cognitive concept content”) (0.83) and integrity (“Cognitive concept content”) (0.69).

**The third factor** of this group is characterized by cumulative load of 60.29 per cent; it includes three correlated variables: the quantity of ideas (“Conceptual synthesis”) (0.85), the level of links complexity (“Conceptual synthesis”) (0.89) and concept indices negative modality (“Cognitive concept content”) (0.72).

The cumulative load of **the fourth factor** equals 86.11 per cent; there is only one variable in this factor: total quantity of groups (“Words free sorting test”) (0.97). This factor expresses the significance of analytical conceptualization style formedness for adolescents. As this factor includes only one variable, it can be called instable, i.e. conceptual system is to be further developed as a factor of intellectual success.

## Discussions

First of all, the measure of cognition openness was revealed in a group of adolescents; this measure helped to subdivide students into three groups, each group is characterized by: open-minded cognition, neutral (mixed) cognition and a closed-minded one.

The results of the cognition openness average values showed that adolescents included into a closed-minded cognition group (22.9 per cent) put forward a significantly larger number of ideas comparing to the adolescents from other groups. However this fact is a sign of their being impulsive, because the

ideas they suggest are noncognitive and are concentrated within the boundaries of individuals' personal situations.

If speaking about the adolescents with neutral (mixed) cognition, they are characterized by a significant predominance of objective and practical ideas and questions; but these students put forward subjective ideas as well. These results prove that these students are characterized by imprecise differentiation of the surrounding world. Their questions fall into ambivalent categories. On the one hand, most of ideas and questions generated by the students of this group are objective and connected with the reality knowledge updating. On the other hand, they do relate to specific actual experience. So, the results obtained in this research prove that adolescents included into this group are specified by intellectual potential at the stage of open-minded cognition (as an intellectual success descriptor) forming.

The adolescents (25.7 per cent) with an open-minded cognition ask objectified and categoric questions (e.g., "What is truth?", "What is the meaning of human life?", etc.). Although nowadays open-minded cognition of adolescents is a reference point for modern education system, it is still poorly studied. These results corroborate M.I. Zalegay's research clarifying the fact that an open-minded cognition is a type of cognitive attitude to the surrounding world characterized by positive emotional attitude to studying, by realizing the significance of studying for self-actualization; by readiness to accept unusual information and phenomena as well as to assess this information and phenomena flexibly (Zalegay, 2014).

So, adolescents with an open-minded cognition show positive emotional attitude to studying, educational activities make sense to them. They realize the importance of studying for life and professional self-actualization. They are ready to accept unusual information and phenomena, try to assess them flexibly, but still it does not always happen like this. These results in groups of adolescents are indicators of an intellectual activity success as well as reflect some struggles. This fact is the indicative of the problem being currently topical and further research being important. For example, the level of cognitive synthesis being formed has no statistic differences, but the results indicate that the adolescents with open-minded cognition tend to conceptualize; this conceptualization is expressed (more often than in other groups) in a cause-and-effect link between the words in a sentence. The student included into an open-minded cognition group put forward nonsignificantly more ideas than the students of neutral cognition one; but the students of neutral cognition group suggest more ideas than those from closed-minded cognition group. It is noteworthy that there are no students characterized by a low level of conceptual synthesis among the adolescents with an open-minded cognition.

Significant differences between indices, characterizing conceptualization style as a form of involuntary intellectual control and categoric abilities were not found in groups of adolescents with different cognition types. However, the groups differ in categoric abilities while analyzing the names of groups created by the adolescents from stimulus words. It should be noted that the more open cognition is, the more accurate and full the description and analysis of word groups is.

The results of adolescents' semantic abilities showed that the more open cognition is, the more concept features adolescents create on the basis of long semantic memory activating ( $H_{emp} = 12.082$ ,  $p \leq 0.01$ ). These results are compliant to the modern researches carried out by M. A. Kholodnaya, A. V. Trifonova, N. E. Volkova and Ya. I. Sipovskaya (Kholodnaya, 2015; Kholodnaya et al., 2019); these researches studied the fact that conceptual thinking and abilities are formed during teenage and adolescence period. Conceptual thinking and conceptual abilities are interconnected and provide qualitative changes in all cognitive processes and intellectual activity.

The research identified a number of differences that allowed defining structural peculiarities of the adolescents with different cognition types conceptual abilities as well as their intellectual abilities predictors peculiarities. The factor structure in a group of adolescents with closed-minded cognition is incomplete and is characterized by direct correlation prevailing, although inversely correlated factors can also be found here. These structure peculiarities reflect the ability of students to create lots of similar/homotypic ideas and topics, generally characterized by neutral correlation. This fact may indicate a vaguely general level of awareness, low level of categoric abilities maturity as well as gaps in a system of intellectual activity conceptual predictors development.

The factor structure of conceptual abilities of adolescents with neutral cognition is characterized by generally direct correlation; the structure is incomplete, this fact reflects a problem in cognitive sphere and intellectual success. Factor structure in this group has the signs of theoretically justified combination of conceptual system characteristics as well as the signs of consistency and integration of semantic, categoric and conceptual abilities. While comparing the adolescents with neutral and closed-minded cognition, this factor structure reflects both advantages of conceptual predictors (emotional attitude to studying, realizing the aim of educational activity) of adolescents with neutral cognition and disadvantages of conceptual predictors (studied as the factor of cognition maturity and intellectual success) formation

level.

The factor structure in a group of adolescents with an open-minded cognition is full and is characterized by direct correlations. This factor structure is a sign of conceptual abilities structure being integrated. This group is notable for a well-formed conceptual predictors system aimed at intellectual activity qualitative changes. The results of the study reflect correlation of intellectual activity efficiency and conceptual (categoric and generative ones in particular) abilities. Generative abilities express the top level of personal conceptual experience organization and the integrity of conceptual (generative) structures. These changes are reflected in a significant intellectual activity characteristic, i.e. open-minded cognition, which is coherent with an opinion that intellectual humility determines the efficiency of fulfilling tasks of different complexity degrees and intellectual activity in general (Ratu, Ra and Savitri, 2021).

The obtained results corroborate Psychological and Pedagogic theory by adding new scientific data on the peculiarities of the adolescents with different cognition types intellectual activity conceptual predictors.

## Conclusions

The research helped to find out that conceptual abilities of adolescents with different cognition types are represented by features of connections between the elements of semantic, categoric and conceptual abilities being conceptual predictors of an intellectual activity success. Structural peculiarities of the adolescents with different types of cognition conceptual abilities reflect specific character of an intellectual activity success conditions. The specific character of adolescents with different cognition types conceptual structures maturity is directly correlated with the level of its humility.

The adolescents with an open-minded cognition (being a descriptor of an intellectual activity success) are characterized by prevailing of analytical clustering, while some signs of categoric clustering are also typical of this group. These students are able to express certain meaning by using different ways of its representation based on semantic abilities; to put forward new ideas and thoughts. This fact proves the tendency to conceptual abilities developing.

The adolescents with neutral cognition are marked by some intellectual capability to have an open-minded cognition in future.

Adolescents with a closed-minded cognition differ from other adolescents groups by clustering based on simple associative coupling; this fact indicates a low level of categoric abilities maturity and non-cognitive way of activity.

Interestingly, one of the peculiarities of the adolescents with different cognition types conceptual abilities is represented by different features of conceptual structures differentiation and integration. This fact, in our opinion, shows that the predictors of all students (having closed-minded, neutral and even open-minded cognition) intellectual success are insufficiently formed.

The results of the research prove viability of developing a special remedial program, including methods, procedures and psychotechnologies aimed at developing conceptual predictors of adolescents' intellectual activity as well as at forming their conceptual abilities and an open-minded cognition.

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### Conflict of interests

The authors declare no conflict of interest.

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