

THE USE OF TAXONOMIC CLUSTERING MECHANISMS IN THE PROCESS OF PSYCHOLOGICAL DIAGNOSTICS OF SOCIAL SUCCESS OF YOUNGER SCHOOLCHILDREN

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АНОТАЦІЯ

The objective of this article is to explore the correlation between specific psychological profiles, which characterize the expressive and communicative abilities of primary school-aged children in narrative formats, and their social success during interactions. The clustering of schoolchildren's social success is achieved through the use of growing pyramidal networks, which structurally represent the operational environment of their activities during interactions. The input data for the clustering process consist of values obtained from psychological profiles, evaluated using appropriate scales in the testing of schoolchildren according to specific methods. The clustering procedure identifies forty psychological profiles that reflect the dynamics of their interaction in narrative formats and their corresponding levels of social success. Taxonomic clustering of the test results of junior schoolchildren reveals stable groups of interactions among them.

Keywords: social success, operational activity, psychodiagnostics, hyperproperties, growing pyramidal networks, taxonomy, psychological profiles.

Purpose. The purpose of the article is to reveal the interconnectedness of the states of certain psychological profiles that characterize the interactions of elementary school children based on their ability to express themselves and communicate in a narrative format. Based on this, the research hypothesis is formulated: "The psychological profile of the children's activity can be represented by a coherent set of certain clusters that characterize the directions of the formation of social success".

Methods. Clustering of school children's social success is implemented on the basis of the technology of building growing pyramidal networks, which structurally reflect the operational environment of elementary school children's activities during interaction. The operational environment is characterized by psychological profiles that

reflect the development of school children at the beginning of their formation in society as individuals. The input data for the construction of clusters are the values of the states of psychological profiles, which are evaluated according to the appropriate scales in the process of testing students according to certain methods. 30 elementary school students (8-9 years old) were involved in the study. The basis of the clusters is forty psychological profiles, which determine the possibilities of their interaction in a narrative format and the corresponding states of development of social success.

Results. The mechanism of semantic clustering of psychological profiles of school children's social success based on the construction of growing pyramidal networks is determined. In the process of interpreting the results of the cluster analysis of the data of psychological profiles, the level of formation of students' worldview and the ability to

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express themselves about it in the format of a narrative were revealed. In addition, a number of taxonomies are defined, which reflect the manifestations of the abilities of each student in the format of hyperproperties. Examples of such manifestations of hyperproperties for various clusters are given. A classification table of psychological profiles was formed and a corresponding set of clusters was created. Recommendations are given on the use of the platform of growing pyramidal networks to a practical psychologist in an educational institution for psychological and pedagogical support during younger students social success formation in the learning process.

Introduction. The operational activity of schoolchildrens, in particular elementary school childrens, has a rather fundamental multidisciplinary and multicriteria psychological interpretation (Ganaie & Hafiz, 2015; Greenson, 2018; Ilina, 2008). Even more, younger schoolchildren in whose minds a complete worldview, reflecting its various aspects, and above all a generalized image of the social environment, just now define the formation of self-creation in concepts, in particular in the learning process, is usually fragmentary in the format of a rather simplified narrative.

Therefore, these narratives in terms of content, and especially in terms of attributes of concepts, reflect the level of formation of their social success according to various psychological profiles. In our understanding, the social success of younger schoolchildren is an integrative personality formation, which is characterized by: a valuable attitude towards oneself as a doer; possession of flexible knowledge and skills according to the elementary school program; emotional, volitional and communicative qualities of an active personality.

In general, we consider the psychological profiles of younger schoolchildren social should comprise: the desire to become aware of the environment properties; the ability to prove the truth or falsity of one's own position, to express opinions in a reasoned, clear, concise manner; independent, persistent new information acquirement; ability to think original and creative; the ability to assess one's own strengths and resources; learning of moral knowledge; the ability to rational mental operations, the object of which are the processes of interpersonal interaction; developed emotional intelligence, the ability to

be aware of oneself as a schoolchildren who explores the world around him with the help of significant adults, etc.

In our opinion, these psychological profiles are closely interconnected. It is clear that social success is possible only if the person evaluates the peculiarities of educational and life situations and his own representation in these situations. In turn, the depth of the child's awareness of educational and life situations depends on the value attitude to the subject of consideration, which depends on the child's knowledge acquisition on the basis of practical activity under the conditions of developed conceptual and divergent thinking, etc. At the same time, the leading motive is the child's desire to learn, to achieve success with the help of strong-willed qualities, the actualization of abilities in the products of his activity, within the limits of adequate expression of his emotions, the ability to identify his own communication problems and establish effective relationships with others.

However, younger schoolchildren are not always able to think perfectly and logically express narratives, which complicates the process of determining the psychological profiles of personal achievements of schoolchildrens, in particular in the learning process. Therefore, the levels of formation of their social success, in this way, are revealed with the help of psychodiagnostics, which contributes to the study and understanding of their personal, psychological properties by a practical psychologist of an educational institution, who is able to provide them with an objective interpretation.

So, in the process of research both active, conscious and passive, unconscious manifestations of the child's behavior and the corresponding motivation for it, we can determine the psychological profiles that influence the nature of the child's behavior and evaluate the effectiveness of this influence. Traditionally, psychological diagnosis of various types of activities, psychological processes, psychological states and psychological peculiarities of schoolchildrens uses certain sets, which consist of methods, in particular, projective and unstructured, if it concerns elementary school childrens, as well as tests, questionnaires. Psychological profiles are determined by levels, the values of which are usually displayed by numerical scales with different intervals. However, it should be noted that all

these intervals can be normalized by the interval [0,1].

In such formulation, the above-mentioned psychological profiles have certain linguistic variables that determine the respective levels of schoolchildrens, and take specific numerical or linguistic significance. We will note that the linguistic significance in the end of the assessment also take numerical significance from the previously defined interval.

Even more, the indicated psychological profiles of the assessment of the social success formation of junior schoolchildrens can be interpreted as corresponding schoolchildrens' qualities with different levels of manifestation in their leading activity, that is, learning. In this case, we can differentiate schoolchildrens according to the level of manifestation of their qualities. In other words, when conducting a certain psychodiagnostic procedure based on the psychological profiles of the schoolchildrens' activity, we reveal the manifestations of their qualities. And in future, when we consider these manifestations, we can, based on the results of the corresponding psychological profiles of assessing their social success, cluster schoolchildrens according to the corresponding qualities (Everitt et al., 2011).

Today, assessment of psychological profiles of social success of elementary school schoolchildrens and their relationships is an extremely relevant problem. It is especially necessary to identify the interdependence of psychological profiles in the social interaction of schoolchildrens with each other in the learning process. Precisely, this study is devoted to the problem of identifying group psychological characteristics of schoolchildrens' interaction. Taking this into account, the following hypothesis can be formulated: "The psychological profile of the activities of younger schoolchildren can be represented by a coherent set of certain clusters that characterize the directions of the formation of social success".

Analysis of the latest research. Motivational and instrumental resources, etc. of the individual according (H. Ball, 2016) are essential not only in order to create one's own products of activity, but also to effectively implement them in society. In this aspect, the constructive interaction of a person with the socio-cultural environment is also important, because it directly affects the success of

the individual. The research interest of representatives of various approaches is focused around the problem of personal success, in particular social success.

From the standpoint of Philosophy (M. Boychenko, I. Zeivald, N. Rozenberh, etc.) have studied social success as the indicator of the individual's integrity. From the point of view of Sociology (L. Bevzenko, L. Burkova, Ye. Savin, A. Sagalakova, N. Sokolovska, A. Yarema, etc.), the trend of characterizing social success as an assessment of individual achievements can be seen. From the standpoint of Social Psychology (M. Kondratiev, V. Moskalenko, etc.) have studied the idea of a socially successful person. From the standpoint of Pedagogy (N. Baranets, E. Varlamova, O. Grushyn, O. Dieieva, A. Zbutsky, L. Kazymyrska, V. Pia-tunina, etc.) have considered the process of social success forming as an effective socialization of the individual. From the standpoint of Psychology (A. Bandura, R. Vaisman, D. Houlman, A. Elizarov, I. Malysheva, O. Mateiuk, O. Mishchenko, V. Tolochech, M. Ganaie, etc.) have considered factors, properties, predictors etc., including adequate self-esteem, level of goals, self-confidence, self-respect, satisfaction with one's activities, social intelligence, effective skills, etc. The aspect of the formation of a socially successful personality of a primary school student has been studied by O. Mytnyk.

To assess the state of social success of an individual, in particular, the social success of younger schoolchildren, the methods of Pearson's linear correlation, ϕ^* Fisher's criterion, Student's criterion, Wilcoxon's criterion, Kendall's concordance coefficient were mostly used. However, they are not able to identify zones of consolidation of schoolchildren at the semantic level. And at the initial stages of the formation of the schoolchildren's social success, this is quite important. Taxonomic clustering performs the appropriate mechanism to identify clusters of semantic consolidation of schoolchildren in various profiles of their activity and interaction.

Psychological profiles of elementary school schoolchildrens. To begin with, we will define psychological profiles that reflect social success and characterize the psychological states of younger schoolchildren (Bevzenko, n.d.; Diedov, 2014; Fatykhova, 2011; Fomenko, 2018; Ganaie & Hafiz, 2015; Holovei &

Rybalko, 2005; Ilina, 2008; Korobko & Korobko, 2021; Ovcharova, 2003; Tunyk, 2003). In this case, psychological profiles reflect the personal psychological development of younger schoolchildren at the beginning of their formation in society as individuals. Table 1 shows a list of the named psychological profiles, in particular some of their factors, and the levels of their assessment according to the appropriate scales.

The psychological profiles, that are shown in generalized form in Table 1, reflect the following hyperproperties typical for younger schoolchildren – 1) the desire to understand the properties of the environment; 2) the ability to learn the latest knowledge; the ability to consider problematic issues, to express various hypotheses and communicate when solving them using conceptual

thinking; 3) the ability to express speed, flexibility, originality, elaboration, verbal abilities; 4) the ability to evaluate one's own actions and resources; 5) to form true moral values; 6) to have personal organization, perseverance in obtaining results; 7) the ability to evaluate and interpret one's own emotions, actions and emotions, actions of others; 8) the awareness of his new social situation, himself as a schoolchildren who explores the world around him with the help of teachers. In fact, the listed psychological profiles determine certain classes of psychological states of schoolchildrens.

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Table 1

№ п/п	Psychological profile	Factors	Assessment levels	Scales
1.	school motivation		high level good school motivation positive attitude to school low school motivation negative attitude to school	25-30 24-20 15-19 10-14 0-10
2.	mental development		high level average insufficient (below average) level low level very low level	100-80 79-60 59-40 39-20 19-0
3.	divergent thinking	speed of thinking flexibility of thinking originality of thinking elaboration of thinking creative use of language	high level (hl) average (a) low level (ll)	hl a ll 12-11 10-8 7-0 11-8 7-6 5-0 33-26 25-22 21-0 31-18 17-14 13-0 34-26 25-23 22-0
4.	self-esteem		overestimated self-esteem adequate self-esteem adequate self-esteem underestimated self-esteem low self-esteem low self-esteem sharply underestimated self-esteem	inflated self-esteem adequate self-esteem adequate self-esteem low self-esteem low self-esteem low self-esteem sharply underestimated self-esteem
5.	moral guidelines		very low level low level average high level.	3 2 1 0
6.	persistence and self-discipline		the minimum measure persistence and self-discipline normative values of the scale of persistence and self-discipline maximum degree of persistence and self-discipline	0-4 5-16 17-20
7.	social and emotional intelligence		high level average below average level low level very low level	4 3 2 1 0
8.	learning motivation		learning motivation social motivation game motivation the attitude towards oneself as a schoolboy is not formed attitude to school is negative	25 – 30 20 – 24 15 – 19 10 – 14 0 - 10

the ability to learn the latest knowledge; the ability to consider problematic issues, to express various hypotheses and communicate when solving them using conceptual thinking; 3) the ability to express speed, flexibility, originality, elaboration, verbal abilities; 4) the ability to evaluate one's own actions and resources; 5) to form true moral values; 6) to have personal organization, perseverance in obtaining results; 7) the ability to evaluate and interpret one's own emotions, actions and emotions, actions of others; 8) the awareness of his new social situation, himself as a schoolchildren who explores the world around him with the help of teachers. In fact, the listed psychological profiles determine certain classes of psychological states of schoolchildrens.

Under this condition, we consider all schoolchildrens with the help of their educational and cognitive activities, which are performed in a separate class. In other words, schoolchildrens interact with each other in a certain way and this process has a network character. They express their opinions, evaluate each other and themselves, etc. Considering this, their interaction has a narrative character. Therefore, schoolchildrens can be considered as certain persons who, in the process of learning, when studying the same type of disciplines, show certain qualities of their personality, which show how to which extent their worldview, which is just being formed in the process of learning, corresponds to the level of their social success.

Technological platform for clustering psychological profiles. The educational and cognitive activity of younger school children, as a certain behavior, can be imagined in the form of a logical-linguistic model (LLM) (V. Gladun et al., 2004; Velychko, 2019), which is able to reflect the relationships that arise between children in the process of interaction in the educational environment of the class and, accordingly, the school. Indeed, schoolchildrens realize their behavior in the classroom in the form of communication, expressing certain narratives to each other and addressing teachers. Certain moral and logical relationships arise between them based on interests in the form of friendship, help, joint games and decisions, etc.

When evaluating the results of this behavior, the researcher must understand that he will have to process

both qualitative and quantitative values of the psychodiagnostic results. Moreover, a relation of any order is not determined over these results. He is interested only in nominal values that characterize a certain psychological state of the schoolchildren. LLM precisely provides processing of similar variables that characterize and determine the processes of test measurements in the formats of answers to questions or performance of certain actions.

LLM network mapping of the interaction of psychological states of junior schoolchildrens takes into account the manifestations of their personal qualities, which are presented in Table 1, as psychological profiles. Psychodiagnosis according to the indicated psychological profiles was carried out according to the following psychodiagnostic methods, which were specially selected in order to record in detail the manifestations of the psychological profiles of the social success of younger schoolchild renin connection with a number of psychological variables significant in the context of our study (Bevzenko, n.d.; Diedov, 2014; Fatykhova, 2011; Fomenko, 2018; Ganaie & Hafiz, 2015; Holovei & Rybalko, 2005; Ilina, 2008; Korobko & Korobko, 2021; Ovcharova, 2003; Tunyk, 2003). When selecting psychological methods, such requirements for psychodiagnostic tools as reliability, representativeness, validity, objectivity, clarity and unequivocalness of the instructions for the diagnostic procedure were taken into account. Testing according to certain psychological methods took place in individual and group form. 2nd grade schoolchildrens in the number of 30 schoolchildrens, aged from 7 to 9 years, of Specialized School No. 3 – general educational institution of I-III degrees, Podilsky district, Kyiv city, Ukraine, participated as research subjects.

Therefore, psychological profiles are interpreted as hyperproperties that reflect the social success of schoolchildr ens. In the future, there is an opportunity to form certain clusters that unite schoolchildrens into groups according to their personal manifestations when conducting the psychodiagnostics presented above.

One of the possible well-tested implementations of logical-linguistic models is the growing pyramidal network (GPN) (Dovgyi & Stryzhak, 2021; Velychko, 2019). An important feature of GPN is their property of structuring

information based on the processing of property values that characterize the objects included in the GPN. In our case, the formation of the network structure of the interaction of primary school schoolchildrens is implemented through the hyperproperties of their psychological profiles, which are determined as a result of processing the values of these properties obtained in the process of their psychodiagnosis according to the psychological profiles presented in Table 1.

LLM in the format of the GPN is implemented on the basis of the presentation of input information that specifies the process being researched in the format of a text file. The specified file marking should include the following: a title line, lines with object property descriptions. Header line structure: object, class, (the name of the attribute 1), ..., (the name of the attribute n). The names "object" and "class" are required in the title line. The separating character between line elements is a comma. The structure of such lines:

(The name of the object 1), (the name of the class),
(value of the attribute 1), ..., (meaning value of the attribute n)

(The name of the object m), (the name of the class),
(value of the attribute 1), ..., (value of the attribute n).

Different objects can have a different number of attributes, which are listed in the object descriptions in an arbitrary order. The format of the input file without a header line is used to build logical-linguistic models of semantic analysis of text documents, where objects are described by an arbitrary number of various features. Relationships between objects are being established on the basis of the coincidence of attribute names in the descriptions of different objects.

As it can be determined from the above, the GPN format implements a graph-theoretic approach to clustering. Based on GPN, graph algorithms are implemented, and hierarchies between objects that make up a pyramidal network are formed and displayed. The fact that they implement both agglomeration (combining) and divisional (dividing) algorithms (V. Gladun et al., 2004; V. P. Gladun, 1994) should also be noted among the characteristic features of GPN during clustering. Moreover, as it can be seen from Fig. 1 and Fig. 2, we can distinguish certain

taxonomic structures (Dovgyi & Stryzhak, 2021; Lamberts, 2013) from the GPN, which reflect the hierarchies of the transition between schoolchildrens' psychological states according to their psychological profiles.

In turn, taxonomies as a certain format of LLM display quite objectively represent the structure of an arbitrary operational environment. In our case, we consider the operational environment of group interaction of schoolchildrens in the classroom according to the psychological profiles of the manifestation of their certain qualities as personalities (Table 1).

Each schoolchildren is characterized by a certain set of taxonomies that reflect the manifestations of his qualities as it is defined in psychological profiles in the Table 1. But, as it will be presented later, the entire set of taxonomies of all the schoolchildrens in the class form the GPN, which realizes their distribution into multiple clusters. The multiplicity fixes the fact that each schoolchildren belongs to the classes defined in the Table 1 by psychological profiles, according to the values of assessment scales according to psychological methods.

Thus, we actually define a certain technological platform, which, based on the taxonomic representation of assessment levels of psychological profiles of elementary school schoolchildrens social success forms the operational space of their interaction in classroom activities.

Assessment of psychological profiles of elementary school schoolchildrens. According to the defined methods, based on the psychological profiles presented in Table 1, the results of the evaluation of the psychological states of elementary school schoolchildrens social success were obtained, and are presented in general for the entire class in Table 2. Besides, with the help of this table it is possible to see all the hyperproperties of schoolchildrens which have certain numerical values that characterize them according to the corresponding psychological profile of Table 1. That is, according to the values of each cell of Table 2, we can determine the corresponding indicators of the psychological profiles of a particular schoolchildren. However, the very process of determining a specific profile for each schoolchildren requires a choice taking into account the factors of the psychological profile and the corresponding assessment scales.

In our case, only one profile has five manifestation

factors. This is divergent thinking, which includes such factors as speed of thinking, flexibility of thinking, originality of thinking, elaboration of thinking and creative use of language. Other profiles are single-factor and can be defined for each schoolchildren directly.

Since we consider all values as nominal, we do not need to arrange them and determine the sequence of processing for further research on the levels of schoolchildrens psychological profiles. Indeed, the formation of each schoolchildren social success, which is characterized by the corresponding psychological profiles from the Table.1 is random and chaotic in nature. Here everything depends on his attention to a specific problem/task, his competence in solving it, etc.

From the point of view of the clustering technology based on the use of the GPN of the schoolchildren sinteraction in class, the main thing, according to the definition of the GPN and rule A regarding its construction, are the names of the psychological profiles, which are defined in the Table 1. We will note that each state is formed on the basis of combinations of the names of the corresponding psychological profiles and factors, values of their assessment according to certain scales, which are also presented in the Table1.

We will register this with a certain rule, since the entire study is implemented on the basis of certain psychological profiles, which we also interpret as hyperproperties, in our case, they are the concepts. Concepts are formed in the process of converting LLM into the format of GPN and taxonomies. They represent all LLM objects as hierarchically linked nodes. However, their number expands in the direction of specifying their levels, which determines the set of combinations of the very states in which schoolchildrens can be in the class. That is, each GPN concept of the class operating environment will have a name that is determined according to next rule A:

< psychological profile >+< factor >+< assessment >.

Thus psychological profile *school motivation*, as hyperproperty defines five concepts namely:

school motivation_high level
school motivation_good school motivation
school motivation_positive attitude to school
school motivation_low school motivation

school motivation_negative attitude to school

It is the intersections of sets of concepts of objects (schoolchildrens) that form the entire set of clusters into which schoolchildrens can be divided according to their psychological profiles of social success, which are determined by performed psychodiagnostics.

The correspondence between the specified assessment scales according to the selected methods and the values of specific psychological profiles is implemented on the basis of the "Scale" column of Table 1. The GPN implements the selection of a specific value by the name of the corresponding psychological profile in Table 2. After that, the hierarchical relationship between the concept and a specific group of schoolchildrens (research subjects) is determined.

The main task of further research of psychological profiles of schoolchildrens social success is to identify clusters that are formed on their basis. On the basis of the identified clusters, it is possible to implement psychological and pedagogical support for the formation of the social success of younger school children: to determine the complexity of educational tasks that they are able to solve first in interaction with an adult, that is, to determine the zone of their proximal development, and then independently; to discover their abilities, inclinations, interests, resources, etc.

Network mapping of schoolchildrens' psychological interaction. As one can see, the format of presenting information based on the results of psychodiagnostics meets the mentioned above technological requirements for the formation of LLM interaction of psychological profiles of schoolchildren ssocial success. First, we will define the concepts of our LLM.

After applying taxonomization rules to the data presented in Table 2, we will get the LLM in the format of the GPN, a fragment of which is presented in Fig. 3. The specified fragment of the general GPN reflects the interaction of psychological profiles of younger school children, which were displayed using psychodiagnostics according to methods (Bevzenko, n.d.; Diedov, 2014; Fatykhova, 2011; Fomenko, 2018; Holovei & Rybalko, 2005; Korobko & Korobko, 2021; Tunyk, 2003; Velychko, 2019). According to the defined rule A, concepts are defined by compositions of the names of psychological

profiles, their factors and assessment levels. Their meanings, which are given in Table 2, characterize the psychological profiles of schoolchildren in the class. And on the basis of the these meanings processing, the GPN of their network interaction is built, which is presented in Fig. 3. All states of GPN are formed by a set of hyperproperties determined for research, which are the interpretation of psychological profiles.

In future, we can display all the connections that are formed between schoolchildrens with the help of psychological profiles determined during psychodiagnosis.

It is best to use network clusters, which are subgraphs of the GPN (Dovgyi & Stryzhak, 2021; V. Gladun et al., 2004; V. P. Gladun, 1994; Lamberts, 2013). We will note that network clustering based on GPN has a so-called soft character. That is, objects that are clustered by their properties can belong to different clusters. The only condition is that all the objects that form the entire set of

clusters also form a complete GPN. Even more, each cluster must include at least two objects that are characterized by at least two common concepts.

From now on, we can identify and consider specific clusters that may be of interest to us, as well as to an arbitrary researcher.

If the researcher is interested in a certain hyperproperty, then he can isolate it from this GPN and get a list of those schoolchildrens who are directly in the psychological profile determined by this hyperproperty. Let's choose a hyperproperty *DT FLEXIBILITY_HIGH LEVEL*, which corresponds to the psychological profile *DIVERGENT THINKING* by factor *2.FLEXIBILITY OF THINKING* and by level *1.HIGH LEVEL (HL)* (Fig. 4). As we can see, a cluster is formed here, which determines the appropriate psychological profile for a group of schoolchildrens, namely – **child_2**, **child_8**, **child_12** та **child_25**.

Table 2.

Generalized results of psychodiagnostics of junior schoolchildrens of the 2nd grade

	school motiva tion	learnin g motiva tion	mental development				divergent thinking										
			I	II	III	IV	speed	flexibil it	origina lit	elabor at.	creativ e	self- estee m	moral guideli nes	persist ence and self- discipli ne	social and emotional intelligence		
Child 1	21	22	20	25.6	13.8	22.5	12	4	16	4	2	1	2	10	1		
Child 2	18	16	15.8	20.2	11.6	19.6	10	9	16	8	0	2	1	9	3		
Child 3	19	18	19.9	23.2	9	25	6	5	15	6	0	3	1	13	2		
Child 4	21	20	15.8	18.1	20.5	22.5	12	4	10	3	1	2	2	7	1		
Child 5	25	24	15.1	25.6	2	22.6	12	3	4	1	1	4	2	7	2		
Child 6	13	12	15.8	15	9	17.5	12	3	6	2	2	5	1	10	1		
Child 7	9	8	15.9	25.6	0	15.3	12	1	3	0	21	2	2	11	1		
Child 8	30	26	17.7	22.9	20.5	19.7	12	9	21	9	13	1	3	11	1		
Child 9	16	15	7.3	18.1	11.6	12.6	12	5	22	9	2	5	2	17	4		
Child 10	17	16	17.7	23.3	4.5	19.7	12	4	22	7	3	2	2	14	2		
Child 11	25	25	19.9	25.6	0	17.5	12	0	19	7	0	4	1	10	1		
Child 12	20	21	17.7	23.2	0	17.1	12	11	17	16	17	1	2	12	1		
Child 13	21	22	19.9	23.2	18.3	19.7	12	5	25	17	12	2	2	10	4		
Child 14	15	16	15.8	20.4	11.7	12.2	10	5	26	4	0	2	0	8	1		
Child 15	27	26	22.7	25.6	9	19.4	12	4	14	3	14	3	2	12	1		
Child 16	26	27	18.6	17.9	17.9	18.2	11	8	20	1	7	3	2	18	2		
Child 17	22	21	7.3	7.7	18.8	0	8	4	9	1	8	2	1	7	1		
Child 18	16	17	18.6	20.4	11.6	15	12	3	14	1	12	2	1	10	2		
Child 19	16	15	14.1	15	0	12.6	5	3	9	4	0	2	1	8	1		
Child 20	17	16	15.8	20.4	20.5	19.6	8	5	11	2	8	3	1	15	3		
Child 21	18	16	19.1	25.6	16	17.5	4	3	7	4	5	1	1	15	3		
Child 22	14	11	15.8	17.9	0	17.1	7	5	4	3	0	5	1	11	1		
Child 23	26	27	7.3	18	20.5	9.2	5	4	15	6	0	3	1	7	1		
Child 24	18	17	22.7	25.6	18.3	19.7	12	1	15	3	8	2	1	8	1		
Child 25	29	28	22.7	20.7	11.3	22.5	12	9	19	7	9	1	2	17	2		
Child 26	16	15	15.8	15.4	0	0	12	2	15	1	1	3	1	10	1		
Child 27	13	12	20.8	18	20.5	20.3	12	5	18	4	12	2	1	13	2		
Child 28	9	8	14.1	15	0	9.2	4	1	2	1	0	3	1	9	1		
Child 29	11	10	22.7	20.5	13.8	22.5	12	2	9	5	2	4	1	5	3		
Child 30	30	26	22.7	12.8	20.5	12.6	6	3	9	1	6	2	2	17	2		

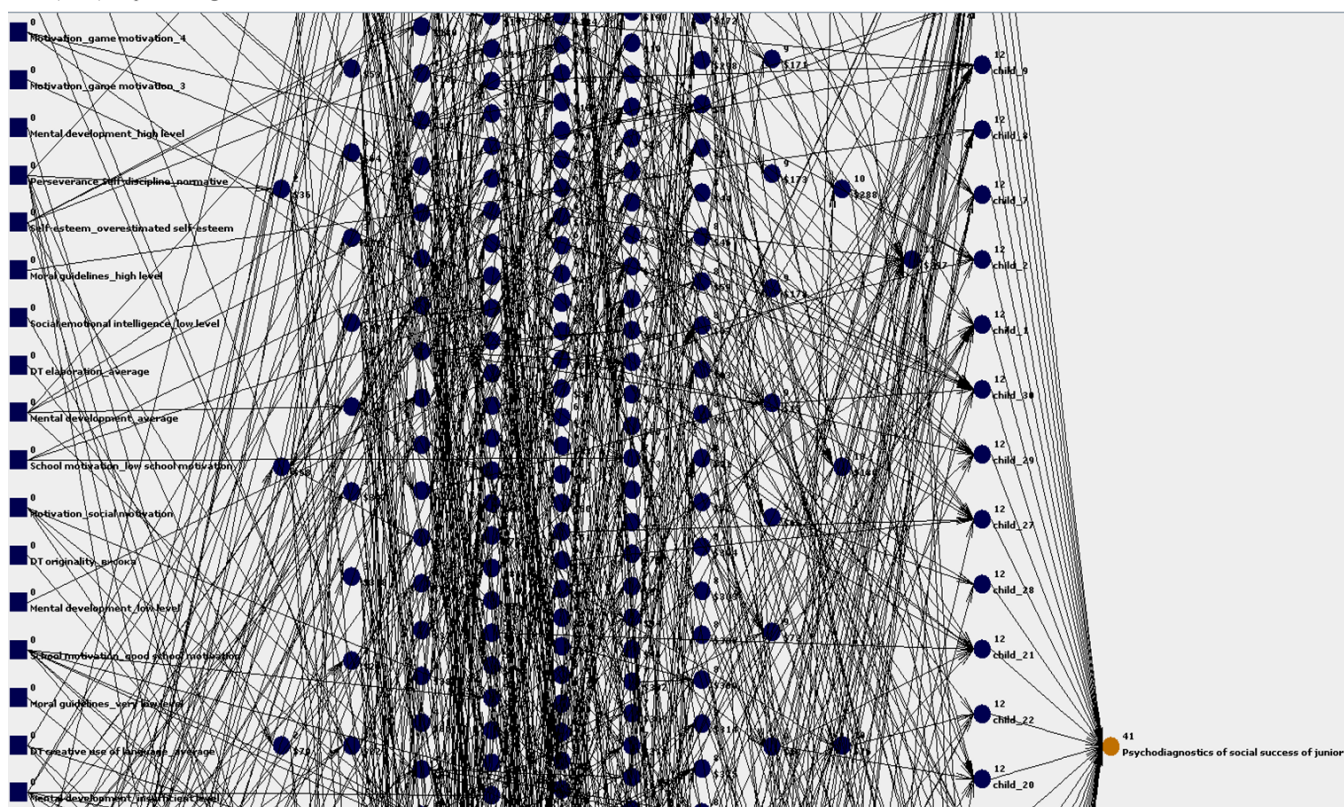


Fig. 3. LLM in the format of GPN display of network interaction of psychological profiles of junior school children.

As it was mentioned above, the clustering of objects whose psychological profiles are being studied has a multiple character. That is, there is a certain number of clusters that include a defined set of common objects. So to the cluster, which is characterized by a hyperproperty *MOTIVATION_GAME MOTIVATION_3* (Fig.5) and determines the appropriate psychological profile for a group of schoolchildrens, namely – **child_2**, child_3, child_9, child_10, child_14, child_18, child_19, child_20, child_21, child_24, child_26; and cluster, which is characterized by a hyperproperty *DT FLEXIBILITY_HIGH LEVEL* (Fig.4), a shared object is included – **child_2**. And it can act here as a transition to interaction between all schoolchildrens of these two clusters.

It should be noted here that in fact these schoolchildrens form certain groups according to psychological profiles, which, due to interaction through common schoolchildrens, allow improving the psychological state of the profile for each schoolchildren. For this, the practical psychologist of the institution, in cooperation with the class teacher, should create for the participants of the specified clusters certain various

developmental tasks, projects that will be interesting to all the schoolchildrens of the clusters.

Let's pay attention to specially marked conceptors that have a marker "\$" and the corresponding number in the format of a natural number from 1 to the specified N. These conceptors have a dual nature.

First, they form clusters of schoolchildrens' psychological profiles. This happens due to taking into account the probabilities that determine the possibilities of forming connections between the schoolchildrens of the class when choosing concepts according to specific psychological profiles.

Secondly, they directly determine the intermediate stages of transitions between the psychological profiles of schoolchildrens, which are also determined by the values of the concepts (Table 2).

We will consider one of such clusters. Let's take the conceptor \$191 (Fig.6), which forms a cluster characterized by a concept *DT FLEXIBILITY_HIGH LEVEL* (Fig.4). Child_2 enters to the composition of the cluster with the conceptor \$191, child_2 is also included in the cluster presented in Fig.5. (Hyperproperty *MOTIVA-*

As it follows from the cluster formation protocol, it includes two schoolchildrens `child_12` and `child_25`, which are characterized by five common concepts.

We will consider another cluster, the transition to which is implemented through the conceptor \$307 (Fig.7). This is a cluster of psychological profiles of schoolchildrens in a class characterized by three concepts



from different classes of psychological profiles: DT originality_average; Moral guidelines_average; DT speed_high level, and which unites 7 schoolchildren. The concepts of this cluster belong to two different classes of psychological profiles: *divergent thinking* (DT) and *moral guidelines*. The probability of activation of the cluster is

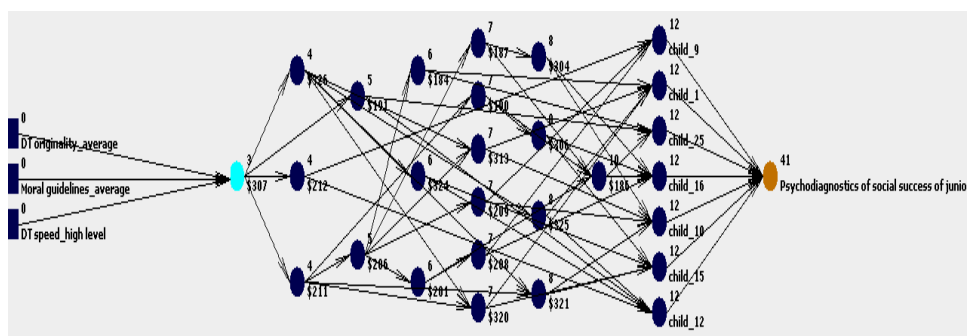


Fig.7. A cluster of psychological states of schoolchildrens in the class, that is formed in the GPN format, which are characterized by three concepts from different classes of psychological profiles: DT originality_average; Moral guidelines_average; DT speed_high level.

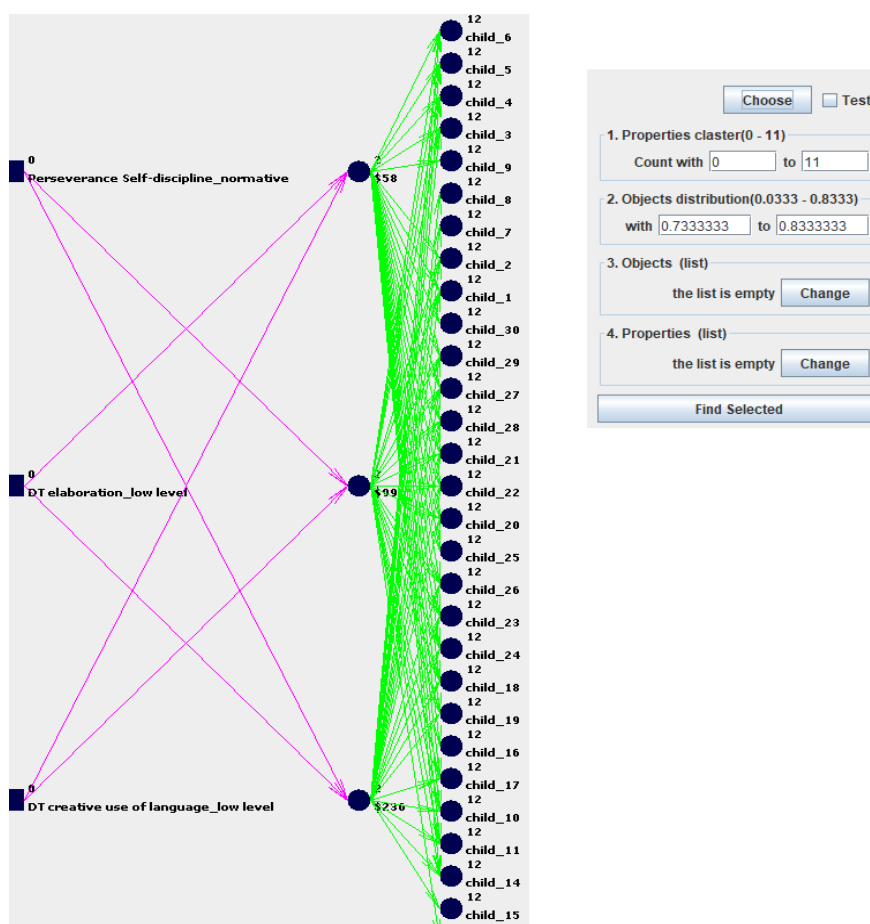


Fig.8. Taxonomic bundle by hyperproperties PERSEVERANCE SELF DISCIPLINE_NORMATIVE, DT CREATIVE_LOW LEVEL, DT CREATIVE USE OF LANGUAGE_LOW LEVEL

0,2333333.

The protocol of cluster formation by the conceptr
\$307:

\$307: 3; DT originality_average; DT speed_high
level; Moral guidelines_average

0.2333333; child_1; child_10; child_12; child_15;
child_16; child_25; child_9

As we can see from the protocol, transitions

between clusters are possible with the participation of
schoolchildrens: child_2; child_12 and child_25, which
are included in this and some other clusters (Fig.4 – Fig.7).

In fact, the clusters in the GPN format indicate
which hyperproperties of schoolchildrens characterize the
psychological profiles of their interaction and determine the
vectors of transitions between different psychological states
in the process of their interaction.

Taxonomic clusters of network interaction. One of the attributes of the cluster formation protocol is the distribution of probabilities of activation of hyperproperties of schoolchildrens in the class. If we define these probabilities as distances between schoolchildrens when certain hyperproperties are manifested, we can obtain certain taxonomic bundles.

Thus, in Fig. 8 bundle of three taxonomies is presented, which unite all schoolchildrens of the class with the exception of child_12. As it can be seen, the distances between schoolchildrens in this taxonomic bundle are in the interval [0.7333333; 0.8333333]. At the same time, as we can see, in this bundle, the transition states are also defined by three conceptors – \$58, \$99, \$236.

Even more, if you look carefully at Fig. 8, certain symmetries can be identified in this bundle. Thus, if you draw a conventional line between the concept (hyperproperty) DT CREATIVE_LOW LEVEL and the transition conceptor \$99, one can see that it splits the bundle into two symmetrical halves.

It is difficult to define what does this mean. However, the following hypothesis can be formulated – in the educational and cognitive activities of younger schoolchildren in the classroom, the states of their interaction according to various manifestations of psychological profiles can form certain fractal groups [fractals, homotopy taxonomies]. Such formations will ensure the optimization of the formation of schoolchildrens' interaction groups in the classroom based on the consideration of hyperproperties revealed during their psychodiagnostics. However, this is a separate problem that requires further separate research.

The dynamics of changes in the distances between the states of transitions – the probabilities of the manifestation of the activity of certain hyperproperties, is characterized by the concentration of such states in the average values of the probabilities and their local concentration at large values close to the value 1.

So in Fig. 9 a comparison of two taxonomic bundles is presented. The first bundle is formed on the segment [0.469000; 0.790000] of probabilities-distances to transition states, and the second is formed on the segment [0.590000; 0.890000].

In Fig. 9, it can be seen when shifting the distance

values on the scale to the segment [0; 1] to the left, the number of active hyperproperties, transition states decreases while keeping the number of schoolchildrens fairly constant. That is, taxonomic clustering realizes the identification of stable groups of schoolchildrens whose hyperproperties have an active manifestation. This gives the practical psychologist of the institution and the teacher who works with these schoolchildrens the opportunity not only to identify certain dependencies for each schoolchild, but also to create an action plan that will contribute to increasing the levels of these hyperproperties, that is, the formation of social success.

Conclusions. On the basis of GPN graph algorithms are implemented, hierarchies between objects that make up a pyramidal network are formed and displayed. The initial data for the GPN are a set of hyperproperties determined for the study, which are an interpretation of the psychological profiles of elementary school schoolchildrens.

Network clustering on the basis of GPN is hierarchical in nature, and objects can belong to different clusters at the same time. On the basis of identified clusters of psychological states of schoolchildrens according to psychological profiles, which also determines their possible interaction, it is possible to implement psychological and pedagogical support for the formation of social success of younger school children, that is, to determine the complexity of educational tasks that they are able to solve, to identify their inclinations, resources and combine them into interest groups, etc. Here, interest groups mean the definition of certain tasks, projects that can be solved collectively within the framework of their common psychological profile.

Taxonomic clustering realizes the identification of stable groups of schoolchildrens whose hyperproperties have an active manifestation. This gives the practical psychologist of the institution and the teacher who works with schoolchildrens the opportunity not only to identify certain dependencies for each schoolchild, but also to determine for them the directions of project activities and create an action plan that will contribute to increasing the levels of the identified hyperproperties.

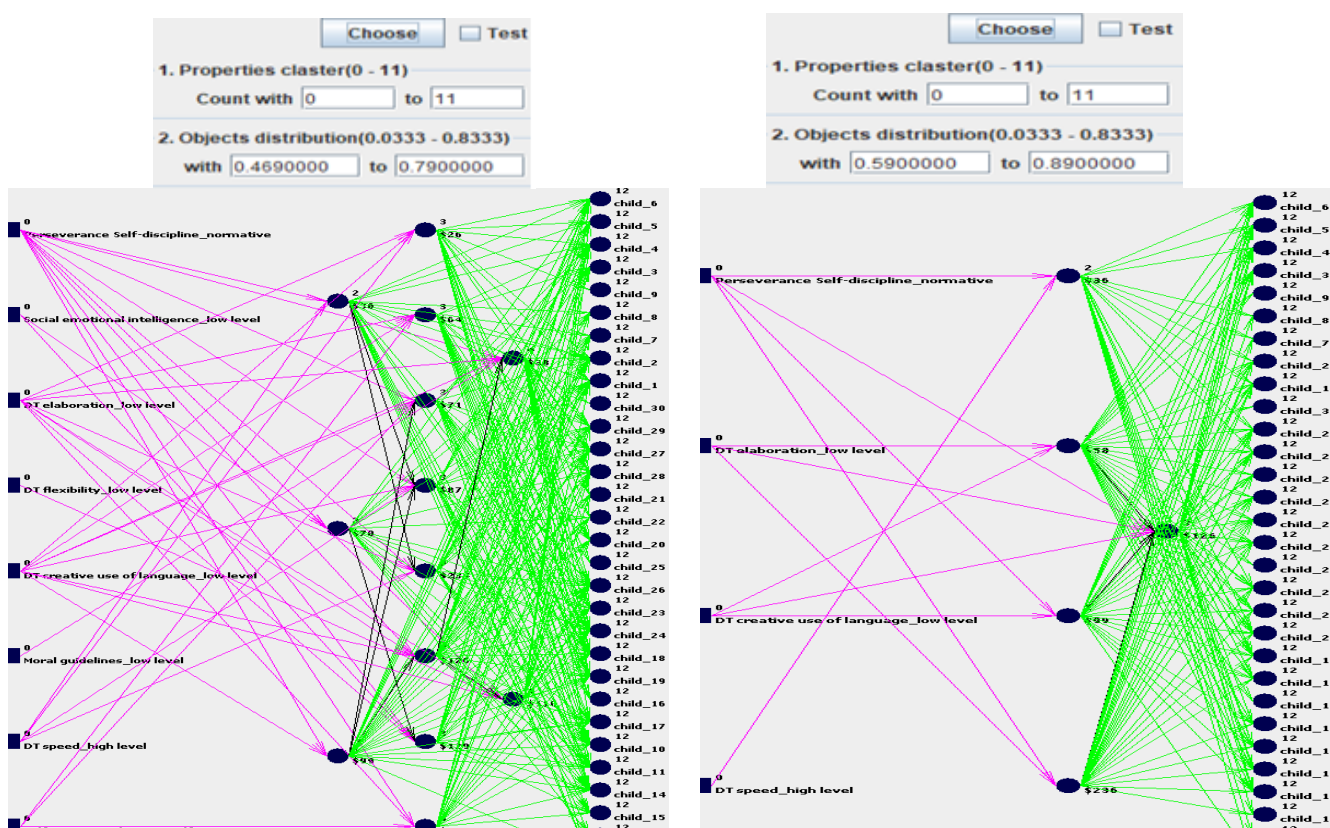


Fig. 9. Two taxonomic bundles formed by different probabilities

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THE USE OF TAXONOMIC CLUSTERING MECHANISMS IN THE PROCESS OF PSYCHOLOGICAL DIAGNOSTICS OF SOCIAL SUCCESS OF YOUNGER SCHOOLCHILDREN

ABSTRACT

The article is devoted to the study of the problem of identifying the interconnectedness of the states of certain psychological profiles, which characterize the interactions of younger primary schoolchildren based on their ability to speak up and communicate in a narrative format. Based on this, the research hypothesis is formulated: “The psychological profile of the students’ activity can be represented by a coherent set of certain clusters that characterize the directions of the formation of social success”.

In the process of the research, the clustering of students’ social success was carried out. Its implementation was carried out on the basis of the technology of constructing growing pyramidal networks, which structurally reflect the operational environment of the younger primary schoolchildren activities during their interaction. It was based on the assumption that their operational environment is charac-

terized by psychological profiles that reflect the development of schoolchildren at the beginning of their formation in society as individuals. The input data for the construction of clusters were the values of the states of the psychological profiles, which are evaluated according to the appropriate scales in the process of testing students according to certain methods. 30 primary schoolchildren (8-9 years old) were involved in the research. The basis of the clusters is forty psychological profiles, which determine the possibilities of their interaction in a narrative format and the corresponding states of development of social success.

As a result, the mechanism of semantic clustering of psychological profiles of students’ social success was determined based on the construction of growing pyramidal networks. In the process of interpreting the results of the cluster analysis of the psychological profiles data, the level of formation, students’ mastery of the picture of the world and the ability to express their thoughts about it in the format of a narrative were revealed. In addition, a number of taxonomies are defined, which reflect the manifestations of the abilities of each student in the format of hyperproperties. Examples of such manifestations of hyperproperties for various clusters are given. A classification table of psychological profiles was formed and a corresponding set of clusters was formed. Recommendations are given on the use of the platform of growing pyramidal networks to a practical psychologist in an educational institution for psychological and pedagogical support of the formation of social success of younger students in the process of education.

Thus, it was determined that the taxonomic clustering of the results of testing of younger students performs the identification of stable groups of students whose hyperproperties have an active manifestation. This gives the practical psychologist of the institution and the teacher who works with students, the opportunity not only to identify certain dependencies for each student, but also to determine the directions of project activities for them and to create action plans that will contribute to the development of his abilities.

Keywords: social success, operational activity, psychodiagnostics, hyperproperties, growing pyramidal networks, taxonomy, psychological profiles.

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ВИКОРИСТАННЯ МЕХАНІЗМІВ ТАКСОНОМІЧНОЇ КЛАСТЕРИЗАЦІЇ В ПРОЦЕСІ ПСИХОЛОГІЧНОЇ ДІАГНОСТИКИ СОЦІАЛЬНОЇ УСПІШНОСТІ МОЛОДШИХ ШКОЛЯРІВ

АНОТАЦІЯ

Стаття присвячена дослідженню проблеми виявлення зв'язності між собою станів певних психологічних профілів, які характеризують взаємодії молодших школярів з початкової школи на основі їх вміння висловлюватися та спілкуватися у наративному форматі. Виходячи з цього формулюється гіпотеза дослідження: «Психологічна профільність діяльності учнів може бути представлена зв'язною множиною певних кластерів, які характеризують напрямки формування соціальної успішності».

У процесі дослідження була проведена кластеризація соціальної успішності учнів. Її реалізація була здійснена на засадах використання технології побудови зростаючих пірамідальних мереж, які структурно відображають операціональне середовище діяльності молодших школярів початкової школи при взаємодії. В її основу було покладено установку, що їх операціональне середовище характеризується психологічними профілями, які відображають розвиток школярів на початку свого становлення у соціумі як особистості. Вхідними даними для побудови кластерів були вибрані значення станів психологічних профілів, які оцінюються за відповідними шкалами у процесі тестування учнів за певними методиками. Для дослідження було залучено 30 учнів молодшого віку (8-9 років). Основу кластерів становлять сорок психологічних профілів, які визначають можливості їх взаємодії у наративному форматі та відповідні стани розвитку соціальної успішності.

У результаті було визначено механізм семантичної кластеризації психологічних профілів соціальної успішності учнів на основі побудови зростаючих пірамідальних мереж. У процесі інтерпретації результатів кластерного аналізу даних психологічних

профілів, виявлено рівні сформованості, опанування учнями картини світу та вміння висловлюватися про неї у форматі наративу. До того ж визначено множини таксономій, що відображають прояви здібностей кожного учня у форматі гіпервластивостей. Наводяться приклади таких проявів гіпервластивостей для різних кластерів. Сформовано класифікаційну таблицю психологічних профілів та сформована відповідна множина кластерів. Даються рекомендації щодо використання платформи зростаючих пірамідальних мереж практичному психологу у закладі освіти для психолого-педагогічного супроводу формування соціальної успішності молодших учнів у процесі навчання.

Таким чином було означено, що таксономічна кластеризація результатів тестування молодших учнів реалізує виявлення стійких груп учнів, гіпервластивості яких мають активний прояв. Це надає практичному психологу закладу та вчителю який працює з учнями, можливість не тільки виявити певні залежності для кожного учня, а й визначити для них напрями проектної діяльності та створювати плани дій, що сприятиме розвитку його здібностей.

Ключові слова: соціальний успіх, оперативна діяльність, психодіагностика, гіпервластивості, зростаючі пірамідальні мережі, таксономія, психологічні профілі.

How to cite (як цитувати):

Stryzhak, A., & Stryzhak, O. THE USE OF TAXONOMIC CLUSTERING MECHANISMS IN THE PROCESS OF PSYCHOLOGICAL DIAGNOSTICS OF SOCIAL SUCCESS OF YOUNGER SCHOOLCHILDREN. *PSYCHOLOGICAL JOURNAL*, 9(4), 30-44. <https://doi.org/10.31108/1.2023.9.4.3>

Дата отримання статті: 03.02.2023

Дата рекомендації до друку: 25.04.2023

Дата оприлюднення: 30.04.2023