

Cognitive features and strategies for the meaning transfer of students in the process of online learning

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Abstract. Solving the problem of finding new technologies and ways of teaching in the education system today has become a global topic. Undoubtedly, young people quickly adapted to the new conditions of learning through Internet technologies. However, it should be taken into account that some psychological qualities of students influence their preference for forms of learning: direct "live" communication and interaction in the "educator-student" system, or online learning. The study involved students of 1-2 years of study of bachelor's degree in technical and humanitarian areas. A total of 103 students participated, including 49 girls and 54 boys aged 18 to 24 (average age is 18.7). Methods used: survey - Cognitive Flexibility Inventory, CFI (CFI-R) (Dennis J.P., Vander Wal J.S. adapted by Kurginyan S.S., Osavolyuk E.Yu.), Questionnaire by S. Epstein "Rationality-Experience" (adapted on the Russian sample by T. V. Kornilova, A. Yu. Razvalyaeva), Analyticity-holisticity scale (Apanovich VV, Znakova VV, Alexandrov Yu.I.), Questionnaire "Meaning transfer strategies" (Suroedova E.A.), Questionnaire that made it possible to collect data on respondents; statistical methods. The study established differences in cognitive styles, ways of comprehending cognitive and social situations, cognitive flexibility and strategies for meaning transfer between groups of students with different preferences for the learning format. Research perspectives are aimed at studying shifts in the development of cognitive features and strategies for meaning transfer in the process of online learning.

1 Introduction

Modern society has moved to a new stage - information and this has led to significant changes in the education system. The main task of the modern education system is defined as the development of students - cultural, personal, and cognitive. And the most important, key competence that is formed in the learning process is the ability to learn. [1]

A world in which we are increasingly confronted with the growth of unstructured, unpredictable, complex and novel events places high demands on social systems (personality,

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society, organizations) to find ways and resources to adapt to new conditions. The education system around the world during the pandemic faced the issue of adapting to changing conditions and productive functioning. The technical development of society and proven methods of working on the Internet have allowed schools and educational institutions to switch to a new distance learning format. However, online learning has posed new challenges for university professors and educators: the search for new styles and strategies for transferring knowledge, the formation of social and professional competencies in indirect interaction, the development of the cognitive sphere, learning skills and intellectual abilities of students through computer and Internet technologies. . Indirect interaction via the Internet with pupils and students does not always make it possible for educators to identify the level of understanding of educational material, its assimilation and the formation of educational skills. It is even more difficult to identify the pace and direction of students' cognitive development. In conversations with students about their preferences for "live" (i.e. full-time) learning or online learning, educators receive different answers, which can be represented on a dichotomous scale as follows: 1) the unacceptability of the online format in learning, which leads to an increase in academic load, misunderstanding of some aspects of the educational material; 2) positive feedback from students about the format of online learning, in which they see an opportunity to safely reveal themselves, quickly find the necessary information, and establish productive mediated interaction.

This led to the idea that there are personal and cognitive characteristics of students that influence their preference for a learning format.

1.1 The problem of online learning in modern research

The use of information and communication technologies in education has determined great progress, contributing to the development of students' digital competencies in accordance with the technological, individual and educational needs that are in demand for the formation of the competence of future professionals [2-4] and makes better use of time for learning outside the classroom [5]. As more institutions adopt some form of technology-based learning, online discussions and forums are increasingly used in university-level courses [6]. As a result of this widespread adoption, many scholars have attempted to evaluate the effectiveness of an online learning tool; others have explored the design, implementation, use, and evaluation of various forms of distance learning [7].

C. N. Gunawardena, F. J. Zittle [8] defined the structure of the main concepts and important elements for identifying, grouping, and analyzing the quality of discussion forums on the Internet. Scholars structure these elements around five themes: social presence, interaction, cognitive strategies, and student-centered collaborative learning. However, the organization of online forums makes the analysis of the assimilation of educational material more difficult for the educator and at the same time a more systematic, purposeful and verifiable way of transmitting and monitoring educational and professional knowledge. I.G. Richards [9] points out that the role of evaluation is to ensure participation, interaction and, where necessary, collaboration and teamwork, especially in group work. The author emphasizes that the focus of such an assessment should be to assess cognitive activity and the achievement of course goals. The Community of Inquiry (CoI) model DRGarrison, T. Anderson, W. Archer [10, 11] is perhaps one of the latest and proven models of pedagogical computer technology. However, there are also problems in the process of online learning. A.V. Korchentseva, exploring the problem of online learning from the point of view of teachers, revealed some fears of teachers associated with the possibility of non-verbal communication. The author writes that the functions which non-verbal communication performs in the learning process remain unrealized. These are, for example, such functions as: establishing eye contact with the audience, emotional exchange; getting feedback from

students on their understanding of the topic; their attitude to what is happening in general, and, in particular, respect for the teacher. All this is difficult if not all students turn to video and sound during the online learning format [12].

2 Cognitive features of students and strategies for meaning transfer

In psychology, subjective rationality began to be understood as a property of strategies implemented by an empirical person, moreover, with a different understanding of their regulation (cognitive and personal) [13-16].

Epstein S. used the notion of two systems that has developed in cognitive psychology: a) fast, holistic, figurative, emotional, and b) slow, analytical, verbal-logical. Differences in experiential and discursive types of knowledge were embodied in ideas about individual styles as inclinations or commitment of a person to intuitively (empirically, empirically) or rationally (verbally discursively) regulate their decisions and actions.

Differentiation of subjective rationality in the ability to rational or intuitive ways of solving problem situations and solutions made it possible to single out analytical-rational, or rational-analytical (analytical-rational thinking styles), and intuitive-experiential (intuitive-experiential), or intuitive cognitive styles. Epstein S. writes that the "Intuitive" style can lead to stereotyped thinking and decisions limited by contexts; it is closely related to the interpersonal and emotional spheres. "Rational" is more associated with adaptive personal characteristics and constructive coping strategies [17, 18]. In the concept of Self-organization of joint mental activity of Belousova A.K. the style of thinking is determined through the function that each person assumes in joint mental activity. The scientist revealed that in the processes of joint solution of mental problems, each group of students has a unique combination of functions, which the author defines as a group thinking style. The study allowed the author to identify thinking styles in joint mental activity: initiative, critical, managerial and practical thinking styles [19]. Russian researchers define analyticity-holisticity as a type of thinking in a broad sense, as a worldview category [20], understanding analyticity and holisticity as types of mentality [21] inherent in Western (WEIRD) and non-Western (non-WEIRD) cultures, respectively [22].

In modern psychology, the analyticity-holisticity model of R. Nisbett et al. is generally accepted. R. Nisbett and co-authors developed a four-component model of analyticity-holisticity, highlighting four main components in the structure of analyticity-holisticity, one way or another related to taking into account or ignoring the context: focus of attention; causal attribution; perception of change; tolerance for contradictions [23]. In many foreign studies, cognitive flexibility is defined as a component of executive functioning, which characterizes the ability of an individual to arbitrarily change cognitive attitudes when perceiving a situation or responding to it in different ways [24]; the ability to express various thoughts (ideas, perceptions, views), think about response options and transform a line of behavior to cope with changing circumstances [25].

The terms psychological inflexibility and psychological flexibility have largely replaced behavioral constructs and correspond to the "thinking flexibility" / "thinking rigidity" construct. Psychological inflexibility (rigidity) is expressed in the rigid dominance of psychological reactions over chosen values and unforeseen circumstances in the direction of actions [26]. On the other hand, cognitive flexibility is defined as the ability of an individual to contact the environment in accordance with their own rules and attitudes. Cognitive flexibility is currently understood in psychology as conscious actions and acts of a person in behavior and activity to change or persevere in achieving meaningful goals [27]. Meaning transfer in the educational context occupies an important place, since knowledge (educational, professional, general scientific) is endowed with meaning for the subjects of

the educational process. The ability to convey the meaning of transmitted knowledge is the competence of a modern educator. E.A. Suroyedova, on the basis of the severity and correlation of verbal and non-verbal activity, identified strategies for meaning transfer. Under the strategy of meaning transfer, the author understands the ways of translating meanings by verbal and non-verbal means of communication [28, 29].

3 Cognitive features and strategies for the meaning transfer of students in the process of online learning

As mentioned above, the Community of Inquiry (CoI) model D. R. Garrison, T. Anderson, W. Archer [30] is the most common and actively used by teachers in the educational process. The authors note that mediated communication through Internet resources and Internet platforms contributes to the three-way process of creating a professionally meaningful online learning experience: social interaction, cognitive development and presence, providing contact and interaction in the "teacher-student" system. The teacher-student system acts as a community of researchers, namely as a group of individuals who jointly participate in purposeful critical discourse and reflection to construct personal meaning, mutual understanding and interaction [31]. Thus, the above definition defines interaction and collaboration as a hallmark of the Community of Inquiry (CoI model). R. M. Marra, J. L. Moore, A.K. Klimczak (2004) consider the discussion forum an important component of online courses and argue that teachers and students rely on these asynchronous forums to interact with each other in ways that potentially promote critical thinking, professional problem solving, and knowledge generation. There is a large number of studies that show that student participation in an online discussion forum is positively correlated with their academic performance [32-33].

D.Nandi, S.Chang, S.Balbo (Nandi, D., Chang, S., & Balbo, S. 2009) describe the online discussion forum as a ubiquitous communication tool in the online learning environment and claim that it has a significant impact on the formation of types of communication. They state that online discussion forums have been successfully used as communication tools to support interaction, exchange of ideas and knowledge among students and teachers.

4 Operationalization of the study of cognitive features and strategies of meaning transfer

The aim of the study is to study the cognitive characteristics and strategies for the meaning transfer of students who prefer online learning.

Research hypothesis. Probably, there are differences in the cognitive characteristics and strategies of meaning transfer among students who prefer different learning formats.

For the purpose of this study, the following methods were used.

1. Cognitive Flexibility Inventory, CFI (CFI-R) (Dennis J.P., Vander Wal J.S. adapted by Kurginyan S.S., Osavolyuk E.Yu.) (Kurginyan S.S., Osavolyuk E.Yu. 2018). The Cognitive Flexibility Questionnaire is a brief self-report that allows you to assess the degree of an individual's awareness of his ability to give possible explanations for life events experienced, difficult situations that he encounters, and offer various options for getting out of them.

The toolkit is a short self-report consisting of twenty items. Questionnaire items are combined into two scales that are designed to measure three aspects of cognitive flexibility. The "Alternatives" scale includes 13 items of the questionnaire; the "Control" scale consists of 7 points; six of the twenty items on the questionnaire are inverse. Evaluation of statements is made on a 7-point scale. The score on the scale is determined by the sum of the scores for

the items that make up its content. High values indicate a pronounced flexibility, mainly measured by the scale of its aspect.

The methodology passed a psychometric procedure for reliability, validity, normal distribution of primary data, consistency of expert assessments in the adequacy of the translation of questionnaire items from English into Russian.

2. Questionnaire by S. Epstein "Rationality-Experience", adapted on the Russian sample by T. V. Kornilova, A. Yu. Razvalyaeva (Kornilova T.V., Razvaliaeva A. U. 2017).

The toolkit is a short self-report consisting of forty items. Questionnaire items are combined into four scales: the use of intuition, intuitive abilities, the use of rationality, the ability to rational decisions, which are designed to measure analytical-rational or rational-analytical (analytical-rational thinking styles), and intuitive-experiential (intuitive experiential), or intuitive cognitive styles. Each scale includes 10 items of the questionnaire. Evaluation of statements is made on a 5-point scale. The score on the scale is determined by the sum of the scores for the items that make up its content. The Rational-Experimental questionnaire demonstrated good psychometric properties when tested on a Russian-speaking sample.

3. Analyticity-holisticity scale (Apanovich V.V., Znakova V.V., Aleksandrov Yu.I. 2017).

The AHS methodology includes 24 items. Of these, 18 are direct and 6 are reverse. All questions are grouped into 4 subscales (focus of attention, causal attribution, tolerance for contradictions, perception of changes), which reflect one of the indicators of analyticity-holisticity identified by R. Nisbett (the description of these indicators was given above). Each of the subscales includes 6 questions.

For each of the questions, the respondent is assigned points corresponding to the number of the answer option chosen by him for the direct items. For inverse items, the scale is inverted: a choice of 7 is worth 1 point; a choice of 6 is worth 2 points, and so on. Thus, for each of the subscales, the respondent can score a minimum of 6 points, and a maximum of 42. Low scores correspond to the analytical pole, while high scores correspond to the holistic one. The AHS technique has satisfactory psychometric characteristics.

4. Questionnaire "Strategies of meaning transfer" (Suroedova E.A. 2011).

The questionnaire allows you to set the strategy of meaning transfer, depending on the ratio of the verbal and non-verbal activity of the respondent. In addition, the technique allows you to establish, on the basis of self-reports of the subjects, verbal and non-verbal activity in the process of communication.

The questionnaire "Strategy of meaning transfer" includes 40 items. of which 33 are direct and 7 are reverse. The question is evaluated by the respondent on a five-point scale. This allows you to score on the scales the minimum number of 20 and the maximum 100. Next, the strategy of meaning transfer is established: passive strategy of meaning transfer; balanced strategy of meaning transfer; active strategy; emotionally dominant strategy; cognitive-dominant strategy. The questionnaire "Strategy of Meaning Transfer" demonstrated satisfactory psychometric properties when tested on a Russian-speaking sample.

5. Questionnaire, which made it possible to collect data on respondents (age, gender, direction of study), as well as to establish the form of education preferred by respondents. Students were asked to answer the question: "What form of education do you prefer - online learning, full-time learning, blended learning using direct and indirect interaction with teachers and the study group?". The questionnaire made it possible to divide the sample into three groups: 1 - those who prefer online learning; 2 – those who prefer full-time education; 3 - prefer blended learning (50/50 online and full-time education).

Characteristics of the study sample. The study involved students of Don State Technical University, the city of Rostov-on-Don, Russia, enrolled in 1-2 undergraduate courses in technical and humanitarian areas. A total of 103 students participated, including 49 girls and

54 boys aged 18 to 24 (average age is 18.7). Data collection procedure. Data collection was carried out using forms in the classrooms of the university in study groups. Students were asked to answer the questions of the questionnaire and questionnaires. The initial data collection procedure took 1.5 hours for each group. Next, the forms were processed.

Statistical analysis. To classify the underlying characteristics of the sample, the variables were described as a number (percentage) and a mean value (standard deviation). The following mathematical statistics were used: descriptive statistics, Kruskal-Wallis H-test, Mann-Whitney U-test, Fisher's ϕ -angular distribution.

5 Research results

With the help of the questionnaire question "What form of education do you prefer - online education, face-to-face education, blended learning using direct and indirect interaction with teachers and the study group?" the study group was divided into three subgroups depending on the students' preferences for the forms of education. Three groups were established. The first group, students who prefer online learning (ol), consisted of 47 students, including 25 boys and 22 girls, with an average age of 18.9. The second group included 36 students who preferred full-time education (f-te). This group consisted of 15 boys and 21 girls, the average age was 18.4. The third group, students who prefer blended learning (bl), consisted of 20 people, including 6 girls and 14 boys, with an average age of 19 years.

Testing the assumption about differences in cognitive features and abilities for meaning transfer using the Kruskal-Wallis method of mathematical statistics among students with different preferences for forms of education revealed statistically significant differences (Table 1-3). Next, a pairwise comparison of the Mann-Whitney U-test groups was carried out (Table 1-3).

Table 1. Cognitive styles of students with different preferences for forms of education. Rational-experiential inventory technique

Group / Test scale		use of intuition	intuitive ability		use of rationality	ability to make rational decisions
1 group (ol)	n=47	M=33.8, σ =3.7	M=29.3, σ =3.5		M=30.3, σ =3.7	M=31.5, σ =3.7
2 group (f-te)	n=36	M=32.6, σ =2.9	M=31.5, σ =3.1		M=28.6, σ =3.7	M=31.0, σ =2.9
3 group (bl)	n=20	M=32.0, σ =2.6	M=29.6, σ =2.1		M=29.6, σ =3.1	M=29.7, σ =2.3
Kruskal-Wallis test		4.803	10.906		5.344	6.093
p		.091	.004		.069	.048
Comparison groups		Group 1-3	Group 1-2	Group 2-3	Group 1-2	Group 1-3
Mann Whitney U test		326.000	517.000	219.000	602.500	302.000
p		.048	.002	.015	.025	.021

It has been established that the severity of cognitive styles of students with different preferences for forms of education differ significantly.

Significant differences were revealed in the ways of understanding cognitive and social situations by students with different preferences for forms of education. Students who prefer full-time education have higher scores on the methodology scales, with the exception of the Contradiction Tolerance scale.

Table 2. Ways of comprehending cognitive and social situations by students with different preferences for forms of education. Methodology Analytic-holistic scale.

Group / Test scale		focus of attention	causal attribution	tolerance for contradictions	perception of change	total indicator	
1 group (ol)	n=47	M=26.1, σ =3.8	M=30.6, σ =6.4	M=26.7, σ =4.3	M=25.6, σ =4.8	M=108.6, σ =12.9	
2 group (f-te)	n=36	M=27.6, σ =4.7	M=32.6, σ =4.4	M=27.0, σ =4.9	M=27.7, σ =4.0	M=115.0, σ =11.7	
3 group (bl)	n=20	M=24.8, σ =3.7	M=27.6, σ =5.6	M=27.5, σ =3.5	M=25.1, σ =3.0	M=105.1, σ =11.0	
Kruskal-Wallis test		5.214	10.165	.247	5.902	10.164	
p		.074	.004	.884	.052	.006	
Comparison groups		Group 2-3	Group 2-3	-	Group 2-3	Group 1-2	Group 2-3
Mann Whitney U test		223.000	169.000	-	218.500	591.500	181.500
p		.019	.001	-	.015	.019	.002

Table 3. Cognitive flexibility and the ability to convey meaning to students with different preferences for forms of education. Methods "Cognitive flexibility inventory" and "Strategy of meaning transfer".

Group / Test scale		Cognitive flexibility		Meaning Strategies			
		Alternatives	Control	Non-verbal activity		Verbal activity	
1 group (ol)	n=47	M=64.6, σ =9.2	M=25.9, σ =6.3	M=68.4, σ =8.9		M=71.2, σ =7.5	
2 group (f-te)	n=36	M=65.4, σ =7.7	M=25.7, σ =6.6	M=72.9, σ =8.3		M=72.6, σ =7.7	
3 group (bl)	n=20	M=59.7, σ =10.2	M=25.7, σ =6.3	M=66.4, σ =9.3		M=63.5, σ =4.2	
Kruskal-Wallis test		.970	.022	8.499		21.988	
p		.083	.989	.014		.000	
Comparison groups		Group 2-3		Group 1-2	Group 2-3	Group 1-3	Group 2-3
Mann Whitney U test		228.000		597.500	208.500	175.000	99.500
p		.024		.022	.009	.000	.000

The results of mathematical statistics made it possible to identify some differences in the cognitive flexibility and ability to convey meaning to students with different preferences for the forms of education. Students who preferred full-time learning have higher scores on the Alternative Flexibility scale. Students who prefer blended learning differ significantly in verbal and non-verbal activity. Group 3 students are characterized by lower activity in the process of meaning transfer.

Fisher's ϕ -angular distribution made it possible to establish a difference in the distribution of the proportion of persons with different strategies of meaning transfer in groups of students. It was found that there are significantly more students with an emotionally dominant strategy in group 2 than in group 3 ($\phi = 1.657$, at $p \leq .05$). It was revealed that there are

significantly fewer students with a balanced strategy of meaning transfer in group 3 than in group 1 ($\varphi = 2.083$, at $p \leq 0.05$). There are significantly more students with a Balanced strategy of meaning transfer in group 3 than students in group 1 ($\varphi = 2.143$, at $p \leq 0.05$) and in group 2 ($\varphi = 2.370$, at $p \leq 0.01$).

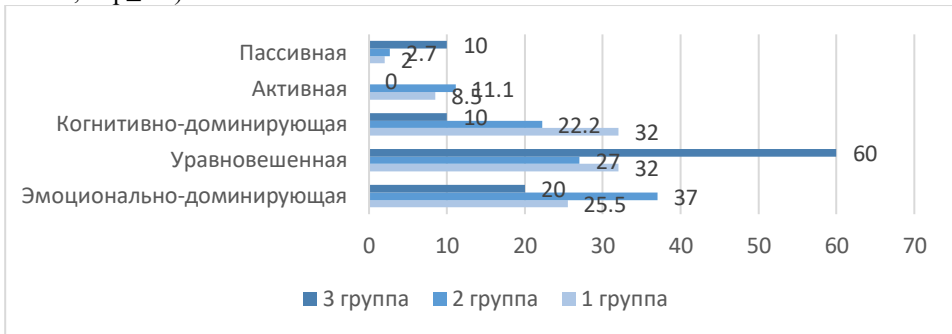


Fig. 1. Distribution of meaning-transfer strategies in groups of students with different preferences for the learning format.

Thus, there are significant differences in the styles and methods of cognitive activity of students with different preferences for forms of education.

6 Discussion

The results of the study of cognitive features and strategies of meaning transfer of students who prefer different forms of education allow us to describe the quantitative characteristics of cognitive styles, ways of understanding cognitive and social situations, flexibility and verbal / non-verbal activity of bachelor students.

The severity of cognitive styles among students who prefer different forms of education differ significantly. So, students who prefer online learning have significantly higher indicators on the scale of using intuition, in contrast to students who prefer blended learning. Intuitive ability is more pronounced in students who prefer full-time education than in students of groups 1 and 3. The rational style of cognitive activity is more pronounced among students who prefer online learning. They differ from the students of group 2 in higher rates on the scale of using rationality and from the students of group 3 in the ability to make rational decisions. The results obtained allow us to say that students who prefer the online form of education use intuition in solving cognitive problems based on search landmarks that are not logically related or insufficient to draw logical conclusions. Students who prefer full-time education use the ability to intuition much more often in the educational process (Kornilova T.V., Kornilov S.A. 2013). Students who prefer online learning more often use rationality as a consistent collection of information in the educational process. The students of this group have a more pronounced analytical style of thinking; they resort to careful logical analysis when solving educational and professional problems, and are ready for the rationale for the decisions made.

Comparison of the ways of understanding cognitive and social situations by students with different preferences for the forms of education also showed a number of differences between students with different preferences for the forms of education. Students who prefer full-time study are characterized by a tendency to analyze phenomena and social situations, taking into account the context in which they are immersed; they are characterized by interactionism. In general, we can say that students who prefer full-time education are more pronounced holistic pole and intuitive style of thinking.

The study of cognitive flexibility revealed that there are distinctive features between groups of students who prefer full-time education and students who prefer blended learning. Thus, students of the second group are more inclined to seek additional information when solving problem situations, which is not always obvious to establish the causes of its occurrence; when making a decision, they consider several options for its resolution, try to consider it from different points of view.

The results of the study of verbal and non-verbal activity made it possible to establish that students who prefer a blended form of education show less communicative activity in interaction with classmates and teachers in the educational process.

Comparison of the proportion of individuals with different strategies of meaning transfer also made it possible to identify some specific features. Thus, in the group of students who prefer a blended form of education, students with a balanced strategy of meaning transfer are more represented, i.e. their verbal and non-verbal activity in the process of meaning transfer is at an average level. In the group of students who prefer full-time education, there are significantly more students with an emotionally dominant strategy of meaning transfer. Students who prefer the full-time format of learning in the process of learning activities show greater non-verbal activity.

An analysis of foreign sources on the problem of cognitive characteristics and strategies for the meaning transfer of students who prefer online learning did not allow us to identify studies on this issue. However, there are a large number of studies on the involvement of students in online technologies in the educational process, which indirectly correlate with the results of our study.

Lupu Costică, conducted an analysis of the activities of primary school students and found that students who studied with the help of computers, as a rule, acquired more educational material in a shorter time and showed better results in the National Assessment Exam compared to students from other schools in the city. Students have found that the use of Internet technologies for math education contributes to the formation of their mental operations and promotes creative thinking, leads to the development of cognitive processes and develops adaptive behavior when solving mathematical problems (Lupu C. 2014). The results of this study correlate with the results of our study, that students who prefer online learning show more rational ways of knowing, adaptability and flexibility. Publications show that online interaction of students with peers and their reflections benefited them in mastering educational knowledge. As studies by S.M. Thang (2010), students who studied online showed the ability to restructure their knowledge and make meaningful connections with other forms of knowledge and experience, to control and analyze their own learning. The conclusion that students involved in online learning are more capable of rationality and analytical mindset is consistent with the findings of similar studies by S. Manlove, A. W. Lazonder, T. de Jong (2006). The authors found that students immersed in a simulation-based interactive learning environment are characterized by more complex problem solving skills (R.Azevedo, J.T.Guthrie, D.Seibert 2004).

These results open up new directions of research on the importance of these factors in the educational and professional process and have not yet been studied in depth in the field of specialist training and are rarely taken into account by scientific data. Reflection and awareness of these factors are essential for the optimization of learning strategies, taking into account the learning needs of students.

7 Conclusion

The results of the study of cognitive features and strategies of meaning transfer of students who prefer online learning led to the following conclusions.

Students who prefer online learning are much more likely to use intuition in the learning process. Also, this group of students is more characterized by a rational style of cognitive activity. Students who prefer online learning are characterized by high verbal and non-verbal activity.

Intuitive ability and holisticsity are much higher among students who prefer to study in a full-time format. In addition, this group of students is characterized by greater cognitive flexibility on the Alternatives scale. Verbal and non-verbal activity in the classroom for these students is significantly higher than for students who prefer a blended learning format. A characteristic feature of the students of this group is high non-verbal activity and preference for the emotionally dominant strategy of meaning transfer.

Research perspectives are aimed at studying shifts in the development of cognitive features and strategies for meaning transfer in the process of online learning.

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