

Development of Students' Verbal and Logical Thinking in the Course of Research Work

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Abstract

Verbal and logical thinking is a type of thinking carried out through logical operations with concepts. The subject can learn the essential features and relationships of the reality in the course of verbal and logical thinking, operating with logical concepts. The aim of the study was to experimentally test the impact of research work on the students' level of verbal and logical thinking. The study involved: Thinking Types, Generalization of Concepts, Classification of Objects, Comparison of Concepts by K. Goldstein. The results of the pedagogical experiment allowed stating that there was an increase in the level of verbal and logical thinking in the subjects of the experimental group as a result of special experimental work. The students of the experimental group were involved in research work in three stages: motivational and preparatory, substantive and procedural, analytical and resultant. The main forms of research work of students were: holding round tables, meetings of the student scientific community, the Council of Young Scientists; involvement of students in webinars on research programmes and grants, competitions for student research papers, introduction of students into the basics of research activities through individual consultations with supervisors, representatives of the Council of Young Scientists; preparation of abstracts, brief outline reports of conferences, articles; conducting disputes; participation in the work of the student scientific community, problem groups, workshops, laboratories. We consider the study of the relationship between the dominant type of thinking of students and the major chosen in higher educational institution as a prospect for further research.

Keywords: future specialists, professional training, research work, thinking, verbal and logical thinking

1. Introduction

Development of scientific potential of society is one of the priority directions of state policy. Highly qualified personnel, who is ready for research activities, are of considerable interest to society. Such graduates are competitive, capable of problem solving in an original way, of innovative activity. Therefore, special attention in the process of professional development should be paid to the student's research work.

Research work is a cognitive activity, which aims at obtaining new knowledge, which must be substantiated and proven. In order to perform such complex operations, the researcher should have a high level of mental activity.

Different thinking types may be dominant in a person, but abstract and symbolic, verbal and logical, as well as creative thinking are important for research work. Verbal and logical thinking is of particular interest in higher education. It distinguishes people with a pronounced verbal intelligence, allows establishing causal relationships, as well as relationships between objects and the environment.

Analysing the complex and multifaceted problem of the development of verbal and logical thinking in students in Pedagogical Psychology, it was found that modern processes of democratization of society and the development of its legal sphere require a qualitatively new level of training of specialists. This is largely due to the level of their logical and methodological training. It follows that the main task of higher education is to help the student in the process of his/her formation not only as a future specialist, but also as a person who has a developed verbal and logical thinking. Given the above, we can conclude that the development of verbal and logical thinking in students is an *urgent research problem*.

The aim of this study is to experimentally test the impact of research work on the level of students' verbal and logical thinking.

The main objectives that follow from the topicality of this study and need to be fulfilled are the following:

- 1) determine which thinking types of students of different majors are the most pronounced;
- 2) study the peculiarities of the organization of students' research work in order to develop verbal and logical thinking;
- 3) provide recommendations for the development of verbal and logical thinking in students in the course of research work.

2. Literature Review

The ability to reason is one of the important traits that distinguish humans from other species. In the most general sense, reasoning refers to any form of expressed verbal thinking, regardless of its specific nature (Markovits, 2018). In psychology, thinking is understood as a process of cognitive activity of an individual, characterized by a generalized and indirect reflection of reality (Maklakov, 2016). Moreover, thinking usually means what we do with things in the absence of things (Malafouris, 2020). The type of thinking is an individual way of transforming information (Brylina et al., 2016). Knowing your type of thinking, you can predict success in a particular professional activity (Kodekova, Mukatayeva, Korvyakov & Auyezova, 2018). Rezapkina (2010) distinguishes 4 thinking types: subject and action (S-A), abstract and symbolic (A-S), verbal and logical (V-L), visual and figurative (V-F).

The effectiveness and quality of mental work in completing educational assignments is directly dependent on the level of the system of techniques of verbal and logical thinking. Mastering this system significantly affects the process of purposeful establishment of the culture of mental work of students and positive learning motives (Liu, Cui, Liu & Zhang, 2020).

Verbal and logical type of thinking is the highest level of development of students' thinking. This type of thinking is based on the concept of objects and phenomena, it proceeds internally and it is necessary to rely on a situation that is clearly perceived (Boden, 2009, p. 351-372).

An important attribute of verbal-logical thinking is concreteness, which is manifested in the accuracy of expressions, conclusions and the application of scientific style of presentation.

As Aimagambetov, Nakipova, Khanov and Bashiro (2020) noted that the teachers of all subjects in higher education constantly feel the need for fairly well-established skills of students to perform logical actions. In the study of any subject, students must know the definitions of the concepts that make up the content of this science, be able to classify them, prove. However, our observations show that most students do not have even the minimum logical skills needed to succeed in higher education. Many of them have great difficulty in learning the material, memorize definitions, rules, evidence, they cannot give a definition of a well-known concept, draw conclusions from the above statements; cannot make a classification, simple reasoning, to establish the correctness of the conclusions and definitions.

Mukhina (2003) in her study of the age characteristics of adult intelligence came to the conclusion that adults aged 18 to 40 experience a frequent change of ups and downs in the development of thinking. At the age of 18-21, the level of verbal and logical thinking is much higher than the level of figurative and practical one. According to Mukhina and Basyuk (2017), the main function of verbal and logical thinking is reduced to the processing and transformation of the received information, which is carried out in three stages. The first stage involves an accumulation of information, the material is transformed into long-term memory and its primary mental processing begins. In the second stage, the material is transformed at the conceptual level through abstraction and generalization. The third stage of transformation occurs only at the level of creative thinking, which is characterized by advancing hypotheses. As a result, there is mobility and flexibility of the relationship of figurative, logical and effective components of thinking.

Comparing young people with adolescents, Nemov (2013) noted significant development of theoretical thought in the former. The youth style of verbal and logical thinking is characterized by abstract theorizing, creation of abstract models and fascination with philosophical structures. Students increase the level of observation, develop critical verbal and logical thinking in the process of professional ontogenesis. However, according to Pinyaeva and Andreeva (1998), successes in the professional sphere (for example, in part-time students aged 30-40) can lead to the development of such manifestations as exaggeration of the role of individual details of the object, excessive suspicion, permissiveness, hasty and erroneous conclusions.

It is at the student age that the composition of verbal and logical thinking is formed, which characterizes the future professional orientation of the individual. The humanitarian must have not only a rich vocabulary, but also be able to use it correctly, accurately correlate specific and abstract concepts, have a generally highly developed verbal and logical thinking (Feoktistova, Staselko & Kramarovskaya, 2019). Students of the faculties of natural sciences must have highly developed logical and abstract thinking, the ability to control mental processes, and they must have impeccable logical judgments (Kiswanto, 2017).

Students' verbal and logical thinking functions taking into account language means and symbols. Its physiological basis is provided by the second signalling system and cognitive activity strategies, which are realized on the basis of the left hemisphere's functions. Verbal and logical thinking is the latest stage of evolutionary and individual development of students' thinking. Verbal and logical type of students' thinking is realized in an abstract verbal form with the help of logical operations with concepts. Students' verbal and logical thinking is inextricably linked to language (Haciomeroglu, 2016).

As Ovchinnikova, Lazarev, Lazareva and Tigrova (2020) noted, the use of methods and laws of formal and dialectical logic, methods of scientific thinking allows students to form a style of verbal and logical thinking.

So, based on the analysis of literature and identified problems, we formulated the *hypothesis* that the development of verbal and logical thinking of students will be effective if the students are actively involved in research work during their studies.

3. Methods and Materials

The Thinking Types method (modified by Rezapkina (2010)) was used to determine the students' thinking types. The method contains five scales for measuring thinking types: subject and action (S-A), abstract and symbolic (A-S), verbal and logical (V-L), visual and figurative (V-F), creative (C). To identify the level of verbal and logical thinking, the Fedosieieva' Generalization of Concepts, Goldstein's Classification of Objects, as well as Comparison of Concepts were used (Almanac of Psychological Tests, 1995). These techniques are aimed at studying such *criteria of verbal and logical thinking as logic, the ability to generalize, classify and compare objects and concepts*.

The results of the study were interpreted according to a 3-level evaluation system:

- high level — the subject correctly and generally assesses the situation as a whole, proves the generalization by analysis of specific fragments, analyses the fragments in a certain order (consistently);
- medium level — the subject has difficulties when completing the assignment, he/she needs the experimenter's help in the form of stimulation and correction of answers;
- low level — the subject does not cope with the assignment, does not accept the experimenter's help, does not proceed to the next stages of the assignment.

A correlation analysis was performed using a nonparametric method of comparing two samples of Pearson's chi-squared test (χ^2) for independent samples to process the results of the study. Statistical data processing was performed using SPSS 10 for Windows, Excel.

The design of the experiment was traditional: the control group studied according to traditional methods, while the students experimental group were actively involved in conducting various forms of research work. A diagnostics was made to determine the levels of verbal and logical thinking before and after the experiment.

The subjects of the study were full-time students majoring in 081: Law and 053: Psychology, who study in the 3rd and 4th of the bachelor's degree. The subjects were randomly selected. The study was conducted on a voluntary basis upon consent for personal data processing. The Kharkiv Humanitarian- Pedagogical Academy, South Ukrainian National Pedagogical University named after K.D. Ushynsky, V.O. Sukhomlynskyi National University of Mykolayiv, National University of Ostroh Academy were chosen as the experimental base for the study. The students of the above educational institutions made up the general population of 238 subjects. After calculating the size of the required (representative) sample using an online calculator (with parameters: confidence probability — 90%, error — 5%), the size of a valid sample was 147 people. This number was the starting point for the formation of the experimental group (EG) ($n=72$) and the control group (CG) ($n=75$).

The study was arranged in three stages during 2019-2021. The pedagogical experiment, namely the involvement of students of the experimental group in research work in order to develop verbal and logical thinking, took place in stages. The first stage was *motivational and preparatory*. At this stage, students were encouraged to research activities through holding round tables, meetings of the student scientific community, the Council of Young Scientists; involvement in webinars on research programmes and grants, student research papers competitions. At the next — *substantive and procedural* — stage, the students were introduced into the basics of research activities through individual consultations with supervisors, representatives of the Council of Young Scientists; preparation of abstracts, brief outline reports of conferences, articles; conducting disputes; participation in the work of the student scientific community, problem groups, workshops, laboratories, other forms of research work. Analytical and resultant (final) stage was to encourage students to analyse and evaluate the results of their own research activities, its presentation and testing.

4. Results

To identify the predominant students' thinking types, we used the Thinking Types questionnaire modified by Rezapkina (2010) (Table 1).

Table 1. Expressiveness of Students' Thinking Types (According to the Thinking Types Questionnaire (modified by Rezapkina (2010)).

Thinking type revealed	Number of students			
	053: Psychology		081: Law	
	abs.	%	abs.	%
Subject and action	13	25.9	11	23.7
Abstract and symbolic	9	29.6	24	55.3
Verbal and logical	13	44.4	19	44.7
Visual and figurative	20	70.4	11	26.3
Creative	17	59.3	10	23.7

The analysis of the obtained data showed that most students in the group of students majoring in 081: Law had abstract and symbolic thinking type (63.2%), which indicates a developed ability to manipulate information through symbols, codes and special formulations. Also, a significant number of students in this major is characterized by verbal and logical type (44.7%), which indicates a pronounced verbal intelligence, developed ability to formulate and express their thoughts. Visual and figurative (26.3%), subject and action (23.7%), and creative thinking (23.7%) types are the least pronounced, which indicates a less developed focus on creativity.

In the group of students majoring in 053: Psychology, the largest number of people is characterized by a visual and figurative thinking type (70.4%), which indicates the development of an artistic way of thinking and a creative view of reality. The creative thinking type (59.3%) ranks second, which is characterized by a creative, non-standard approach to solving problems, developed imagination. The degree of expressiveness of the verbal and logical

thinking type (44.4%) in psychology students almost corresponds to the level recorded in law students (44.7%). This indicates that the ability to think logically develops and manifests itself in students regardless of the major. This type is characterized by a mental process in the direction of generalization, students can be critical of certain situations, form certain judgments about them, draw appropriate conclusions. Abstract and symbolic (29.6%), as well as subject and action (25.9%) thinking types are the least pronounced in students majoring in Psychology.

One of the tendencies of students, regardless of the major, is less expressiveness of subject and action thinking focused on specific activities and a clear end result. A pre-experimental measurement was performed according to certain criteria and methods in order to determine the initial data for the development of verbal and logical thinking of students, the results of which are presented in Table 2.

Table 2. The Results of the Distribution of Respondents by Levels of Development of the Criteria of Verbal and Logical Thinking (after experimental measurement)

Criteria\groups	Comparison				Classification				Generalization			
	EG		CG		EG		CG		EG		CG	
	Ab.	%	Ab.	%	Ab.	%	Ab.	%	Ab.	%	Ab.	%
High	7	9.7	10	13.3	18	25	16	21.3	12	16.6	15	20
Medium	61	84.7	60	80	49	68	52	69.3	54	75	52	69.3
Low	4	5.6	5	6.7	5	7	7	9.4	6	8.4	8	10.7

The data in Table 2 show that the majority of respondents in the control group (80%) and the experimental group (84.7%) are able to make comparisons (comparison operation), only 5 students in the control group and 4 students in the experimental group made mistakes. The high level of this criterion is characteristic of only 9.7% in CG and 13.3% in CG, which indicates insufficient level of this operation.

A high level of classification operation is inherent in a quarter of surveyed EG students and 21.3% in CG. There were 68% of EG students and 69.3% of CG students with a medium level of this operation, which is approximately the same. There were also 7% of EG students and 8.4% of CG students who made mistakes when completing the classification assignment.

There were 16.6% of the surveyed EG students and 20% of CG students who had a high level of generalization operation. The medium level of the generalization criterion was found in 75% of respondents in EG and 69.3 in CG. The results obtained through a set of methods allowed us to divide the respondents of the control and experimental groups into groups with different levels of verbal and logical thinking.

Table 3. The Results of the Distribution of Respondents by Levels of Development of Verbal and Logical Thinking (pre-experimental measurement)

Levels	Low level		Medium level		High level		Total	
	Number	%	Number	%	Number	%	Number	%
EG	5	7	55	76.4	12	16.6	72	100
CG	7	9.3	55	73.3	13	17.4	75	100
Total	12	8.2	110	74.8	25	17	147	100

Based on the data in Table 3, we can conclude that the majority of students in the experimental group have a medium level of verbal and logical thinking (74.4), while 73.3% of the representatives of the control group had the same level. The high level is characteristic of less than a quarter of the surveyed participants: 16.6% in EG and 17.4% in CG.

So, the results of the diagnosis showed the need for special pedagogical work on the development of verbal and logical thinking in students.

A control survey of students of the experimental and control groups was conducted to test the effectiveness of the experimental work. The method used for the post-experimental measurement coincided with the method applied for the pre-experimental measurement of the levels of verbal and logical thinking. The obtained data are presented in Table 4.

Table 4. The Results of the Distribution of Respondents by Levels of the Criteria of Verbal and Logical Thinking (post-experimental measurement)

Criteria \ Groups	Comparison				Classification				Generalization			
	EG		CG		EG		CG		EG		CG	
Levels	Ab.	%	Ab.	%	Ab.	%	Ab.	%	Ab.	%	Ab.	%
High	25	34.7	11	14.7	32	44.4	16	21.3	27	37.5	16	21.3
Medium	45	62.5	60	80	37	51.4	54	72	44	61.1	51	68
Low	2	2.8	4	5.3	3	4.2	5	6.7	1	1.4	8	10.7

Having analysed the data in the table, we found that 5.3% of students in the control group do not know how to compare subjects and only 2.8% of students in the experimental group were at a low level. In the control group, subjects still indicate only similarities or differences, both not completely, and the experimental group students have acquired the ability to distinguish similarities and differences as a result of systemic research. More than half of the students in both groups are good at the generalization operation: 68% in the control group and 61.1% in the experimental group. And only 1 student of the experimental group and 8 students of the control group had a low level for the assignment. The number of students with a high level of generalization increased significantly — from 16.6% to 37.5%.

Regarding the classification operation, the number of students with a high level of this skill has significantly increased in EG: from 25% to 44.4. The control group also underwent changes, but not as significant. The generalized results of the post-experimental measurement are presented in Table 5. Comparative results before and after the experimental work are presented in Figure 1.

Table 5. The Results of the Distribution of Respondents by Levels of Verbal and Logical Thinking (post-experimental measurement)

Levels	Low level		Medium level		High level		Total	
	Number	%	Number	%	Number	%	Number	%
EG	2	2.8	42	58.3	28	38.9	72	100
CG	6	8	55	73.3	14	18.7	75	100

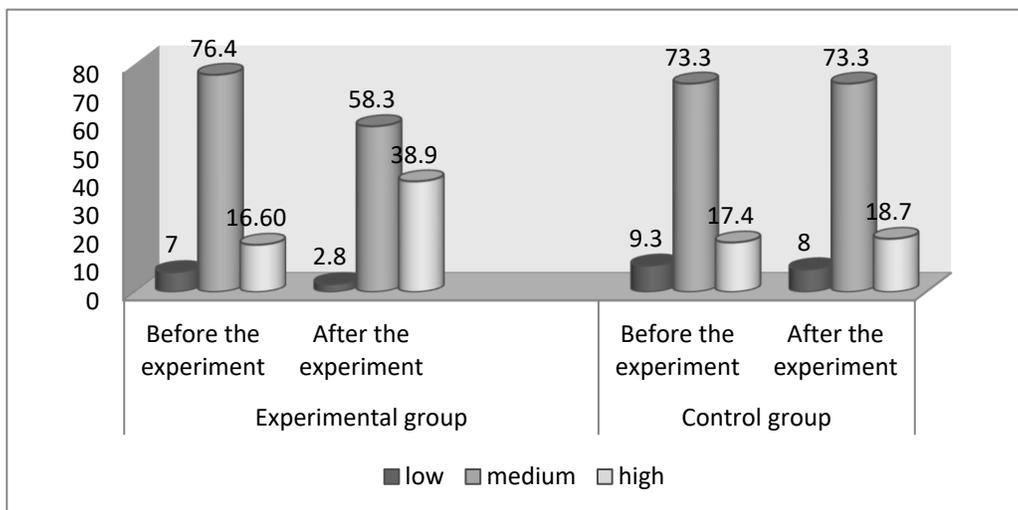


Figure 1. The Results of the Distribution of Respondents by Levels of Verbal and Logical Thinking (before and after the experiment)

Therefore, the number of participants in the experimental group with a high level of verbal and logical thinking increased from 12 to 28, and the number of students with a low level of verbal and logical thinking decreased from 5

to 2, that is students moved from lower level to higher level. It should be noted that the students' performance in the experimental group has also somewhat changed.

We used Pearson's chi-squared test (χ^2) to determine whether there are differences in the distribution of students of the experimental and control groups on the levels of verbal and logical thinking after the experiment. We formulate the hypothesis:

H_0 — the level of verbal and logical thinking after the experiment in the control and experimental groups is the same;

H_1 — the level of verbal and logical thinking after the experiment in the control and experimental groups is higher in the experimental group than in the control.

The obtained value $\chi^2_{emp}=6.433$ is more critical, which is equal to $\chi^2=5.991$ for the significance of $p=0.95$ and the number of degrees of freedom $C=2$. So, $6.433>5.991$ ($\chi^2_{emp}>\chi^2$) for $p=0.95$, that is the difference between the distributions is significant (hypothesis H_1).

Therefore, the results of the control experiment confirmed the validity of our hypothesis that research work has a positive effect on the development of verbal and logical thinking.

4. Discussion

As a result of experimental work, it was determined that the pre-experimental level of verbal and logical thinking in students of the control and experimental groups was the same. The results of the diagnosis showed that most students in both groups have the medium level of generalization, classification and comparison skills. The formative stage involved purposeful work for the development of techniques of verbal and logical thinking in the experimental group by involving EG students in research work. Analysis of the dynamics at the control stage of the experiment showed that there was an increase in the level of verbal and logical thinking in the subjects of the experimental group as a result of special experimental work. Such changes can be considered as the correct organization of the process of the development of verbal and logical thinking in students.

Students in the experimental group have become better at mental operations of comparison and generalization, some use concretization, while abstraction and classification are used unconsciously, which is determined by the age peculiarities of the psyche. The use of comparison, generalization and specification operations is the basis for understanding the educational material. There have also been changes in the performance of students in the experimental group, as well as in the research activities of students.

The statistically significant differences in the dynamics of most of the subjects in the experimental and control groups, confirmed by qualitative analysis and data of additional research methods, indicate that the system of work done during the formative experiment significantly affects the effectiveness of verbal and logical thinking in students.

The study shows the relevance of further research in higher education. Current research is mainly aimed at determining the level of verbal and logical thinking of preschoolers, primary and secondary school students or children with disabilities or developmental disorders (Filyutina et al., 2018; Yunus, 2021). It was determined in the course of the research that verbal and logical thinking develops and manifests itself regardless of the major, and the high level of its development is important for any future professional activity. After all, this type is characterized by generalization, critical thinking, the ability to make analogies or comparisons, the ability to logically formulate own judgments and draw appropriate conclusions.

Our results are consistent with Tussupbekova et al. (2018) that the implementation of the following pedagogical conditions contributes to the development of verbal and logical thinking in students: the inclusion of students in activities to solve professional problems and the organization of research activities, creative application of knowledge.

Research work is an integral part of professional training of students in higher education. It provides for the involvement of students in research activities, conducting experiments in order to obtain certain results, to form the students' inclination to research activities, make them learn the methods of scientific knowledge, develop the ability to work in creative teams, with literature. An important indicator of a high level of verbal and logical thinking is the student's writing a quality research paper (abstracts, articles, degree project) and the ability to present it and participate in scientific discussions and debates.

We agree with Nuriddinov, Normamatov and Nuriddinov (2020) that students should be involved in research work from the first years of study and continue this work throughout their studies at the educational institution. Moreover, the technology of organization of research work is an integral part of professional training of students in the digital environment (Andryushin, Shcherbatov & Makarevich, 2018).

Research work of students serves to form a highly qualified, creatively thinking specialist who is able to independently solve the problems that he/she faces (Povidaychuk, 2016).

Interviews with students of the experimental group and analysis of research papers (Hevko et al., 2021; Moiseev et al., 2019) allowed concluding that research activities of students ensures the most complete manifestation of individuality, creativity, readiness for self-fulfilment. The main tasks of research work of students are: instilling and independent fulfilment of personal and creative abilities of students (comprehensive development of the student's personality, formation of his objective self-esteem, thinking skills, creativity) (Syahrin, Suwignyo & Priyatni, 2019); learning the methodology of rational and effective acquisition and use of knowledge; introduction into the modern methods of work with scientific literature and information sources; acquisition of skills of creative scientific and research activity (Karpenko, 2018); identification of capable young people for further study in a post-graduate course, work in departments and research laboratories.

5. Conclusions

The state is currently interested in training highly qualified personnel who are ready to work under the conditions of uncertainty. The qualitative development and improvement of science requires a high scientific potential of society, as well as developed verbal and logical thinking. That is why special attention in the course of professional education should be paid to the development of the scientific potential of society, and accordingly to the development of students' thinking abilities.

This study allowed determining that verbal and logical thinking develops and manifests itself regardless of the students' major. This type is characterized by a mental process in the direction of generalization, students can be critical of certain situations, form certain judgments about them, draw appropriate conclusions.

The results of the experiment showed that there were significant changes in all criteria (generalization, comparison, classification) in the experimental group. The number of participants in the experimental group with a high level of verbal and logical thinking has increased significantly, while the number of students with a low level of verbal and logical thinking has decreased accordingly. Students of the experimental group actively carried out research work in all proposed forms (seminars, conference reports, participation in debates, in the work of student scientific community and problem groups, etc.), which increased the level of their verbal and logical thinking according to the experiment.

Research materials can be used by teachers and supervisors to increase the level of verbal and logical thinking of students, as well as scientists, teachers of general secondary education, students for further study of the patterns of development of verbal and logical thinking in different age groups. The practical significance of the study is the possibility of applying a set of research activities in practice in the higher education system.

We consider the study of the relationship between the dominant type of thinking of students and the chosen major in higher education as a prospect for further research.

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