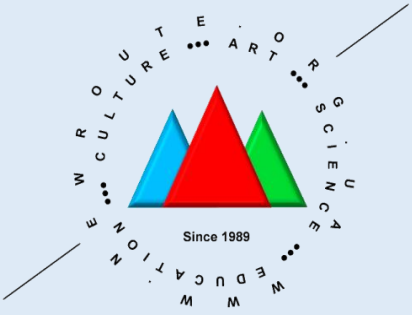
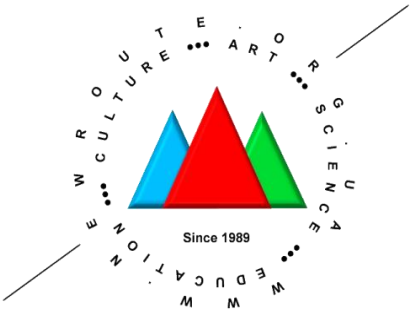


ГЛОБАЛЬНІ ЗМІНИ РОЗВИТКУ СУСПІЛЬСТВА НА ЗЛАМІ ТИСЯЧОЛІТЬ

Колективна монографія

СГ НТМ «Новий курс»

2023



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Колективна монографія присвячена актуальним питанням трансформації суспільних відносин в умовах цивілізаційних змін. Досліджуються сучасні проблеми в сфері педагогіки, соціології, філософії, психології, соціальних комунікацій, спорту, фізичної культури, туризму, рекреації, мистецтвознавства, культурології, філології, історії, економіки, управління, права. Монографія буде корисною науковцям, викладачам, здобувачам вищої освіти, а також широкому колу осіб, які цікавляться питаннями сучасного розвитку соціально-гуманітарної сфери.

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Передмова

У колективній монографії буде розглянуто напрями глобальних змін розвитку суспільства на зламі тисячоліть через призму педагогічних, соціологічних, філософських, психологічних, мистецтвознавчих, культурологічних, філологічних, історичних, спортивних, туристичних, рекреаційних, економічних, управлінських та правових аспектів.

Авторський колектив монографії представляють наступні науковці (інформацію подано мовою оригіналу рукопису автора): Arsenenko Iryna Anatoliivna, Donchenko Larysa Mykhailivna, Donets Iryna Anatoliivna, Kulyk Iryna, Maksymov Oleksandr, Nepsha Oleksandr Viktorovych, Nikolaieva Yuliia, Арестенко Валерій Вікторович, Бєлова Тетяна Геннадіївна, Бондаренко Катерина Вікторівна, Волощук Юрій Іванович, Гапотій Віктор Дмитрович, Григоренко Олена Василівна, Денисенко Єлизавета Олександрівна, Довгенко Яна Олексіївна, Дюжикова Тетяна Миколаївна, Дюжикова Юлія Юріївна, Завадська Юлія Сергіївна, Козар Юрій Юрійович, Кришевич Ольга Володимирівна, Круль Петро Франкович, Лавренко Дар'я Олександрівна, Лисенко Олена Вікторівна, Маслак Олександр Олександрович, Морозюк Назарій Сергійович, Моторнюк Уляна Іванівна, Павленко Наталія Вікторівна, Пеняк Павло Степанович, Пристайко Валерій Володимирович, Сисенко Владислав Володимирович, Тананайко Тетяна Сергіївна, Ціватий Вячеслав Григорович, Шиптур Роман Михайлович, Яценко Ольга Миколаївна.

Інформаційну базу дослідження становили правові норми чинних законодавчих та інших нормативно-правових актів України та закордонних держав, щорічні звіти профільних установ, методичні та статистичні матеріали підприємств, закладів, установ, Державної служби статистики України, матеріали експертних досліджень, аналітичні огляди, опитування, анкетування, наукові та методичні публікації.

людини є передумовою для захисту всіх інших прав людини та відіграє важливу роль у формуванні правової культури та суспільної моралі.

Для ефективного захисту гідності людини необхідна ефективна правова система та законодавство, але також важливі зміни в нашому суспільстві, такі як визнання рівності та недоторканності гідності кожної людини та формування правової культури. Всі ці заходи сприятимуть створенню справедливого, гуманного та розвинутого суспільства, де гідність людини є найвищою цінністю.

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1.3. The use of pedagogical argumentation at the lessons of chemistry in secondary school

Introduction. The theory of argumentation developed by S. E. Toulmin [17] back in 1958 has become a general pedagogical theory owing to the works of such scientists as R. Andrews [1], A. Reznitskaya et al. [12], A. Ivin [21], W. F. Roth and, J. M. Roth [13] and others. It was used and further developed in some didactics, for example in teaching Chemistry in secondary schools and higher education institutions (HEIs). It was S. E. Toulmin's model that became a crucial point for S. Erduran, S. Simon, J. Osborne [7] to develop some methodological approaches to the analysis of argumentation both in teaching the natural sciences and chemistry in particular.

Pedagogical argumentation as an effective method of persuasion that is aimed to scientifically explain the properties of substances, processes in technology and natural phenomena has added up to the methodological arsenal of chemistry teachers. The teacher's word as a means of argumentation together with a chemistry experiment can increase students' interest in chemistry and improve their academic performance. A chemistry experiment used in teaching gives a possibility to establish a learning (also scientific) fact. The facts give ground for the formation of a theoretical basis which helps students to explain the essence of chemical phenomena reasonably. This method is called "an empirical method of argumentation" [20], and it can prove or illustrate a principle, theory, law, or it can be an example for making a problem situation which can be solved in the course of studies. At the lessons of Chemistry an

experiment is a key element of argumentation that is an action of substantiation or denial of the suggested hypothesis. This fact has been proved by a number of researches. For instance, the pedagogical experiment [2] proved the impact of argumentation-based pedagogy on college students' conceptual understanding of properties and behaviors of gases. The intervention group (56 students) performed significantly better than the control group (52 students). Also, a laboratory experiment done by students can be reproduced as a historical fact which can be a strong argument. S. Erduran and A. Pabuccu [6] present research on argumentation in chemistry teaching and learning, and explore some examples. Characterizing practical exercises on History of Chemistry which require that students should give a reasoned account of an event, the authors prove the feasibility of using pedagogical argumentation. Researchers A. Cullinane and A. O'Dwyer [5] practically agree on the important role argumentation plays in chemistry education in secondary school. They describe some methods for students to study scientific facts, analyze scenarios of scientific discoveries posted on social networks and the tools such as cartoons or videos on chemistry topics which can serve the object of argumentation.

Video recordings of chemistry lessons or their fragments, virtual chemistry experiments play a significant role in the use of argumentation in teaching chemistry if they are commented by a teacher or tutor. Otherwise, watching a video with a lecturer's monologue turns a student into a passive observer. Unfortunately, some teachers overuse the narrative method even when they are explaining the chemistry experiment which is being demonstrated.

Hence, the research method in laboratories becomes an effective teaching method, which allows you to form the skills to reasonably substantiate scientific facts. Proof of this is the research of D. Katchevich et al. [15], in which the authors propose inquiry-based learning as a mean to develop students' argumentation skills in laboratory work. In another similar study, A. R. Sekerci and N. Canpolat [14] present study considers the chemistry laboratory on students conceptual understanding of argumentation aimed at in-depth examination. These pedagogical experiments were carried out with college and university students. A. R. Sekerci and N. Canpolat indicate students ages in the experimental group (47 students) vary between 19 and 24 while students ages in the control group (44 students) vary between 18 and 27 chemical experimentations in chemistry lessons at school was not carried out [14].

Therefore, the research presented in our article is aimed at developing students' skills to prove the message, confirm or illustrate theoretical knowledge through a chemistry experiment and interpret its results in a scientific way.

Methodology and Methods. O. Maksymov and other scholars [10] research about training future teachers to teach older teens the ability of argumentation as an intellectual and communicative activity were start in 2018 by Bogdan Khmelnitsky Melitopol State Pedagogical University and State Higher Education Institution Krivoy Rog State Pedagogical University in Ukraine. At same time, the pedagogical experiment with the use of

argumentation in teaching some topics of the chemistry course in secondary school was organized in secondary schools No. 5, 6, 8 in Melitopol (Ukraine) by the Department of Unorganic Chemistry and Chemical Education at Bohdan Khmelnytsky Melitopol State Pedagogical University. In these schools the teachers of Chemistry conducted lessons according to the teaching recommendations developed by us. The technique is based on the use of argumentation together with a chemistry experiment, an elaborate conversation or dialogue "teacher-student" and other available means such as the Internet, videos, models etc. During the lesson, a demonstration or student experiment is used as an argument aiming at: a) creating a problem situation to motivate students' learning activity; b) proving judgments or suggested hypotheses; c) illustrating the described principles, theories, regularities or laws of chemistry.

An important step in the use of argumentation is materialization of what has been seen or heard. That is why students make notes of the observed chemical phenomenon, fact, formulas, reaction equations, drawing of the device or its parts, etc. It becomes a basis for asking questions or giving answers in the dialogue, making sentences to prove a particular statement. As a result of argumentation in the conversation, students summarize the work done, derive definitions of concepts, interpret the results of a chemistry experiment and make scientifically grounded conclusions.

According to the fair statement of S. Erduran [3], argumentation becomes a form of scientific discourse. It plays a leading role in making explanations of the ongoing chemical process and serves to single out the main, essential things in the regularities found during the observed experiment. S. Erduran and her fellow-thinkers define argumentation as a scientific habit of the mind, that is, a skill that must be formed in the process of learning chemical science.

Let us give an example of a fragment of the lesson which aim was to form the concept of hydrolysis of salts. The lesson was conducted according to the technique developed by us for the use of argumentation together with a chemistry experiment and other teaching aids.

Before giving the new material, the teacher actualizes the basic concepts that will be required to learn about hydrolysis of salts. While holding on the conversation, students recall and write down the formulas of several strong (H_2SO_4, HCl, HNO_3, H_3PO_4, H_2SO_3, HBr) and weak (H_2S, H_2CO_3, HF, HClO, H_2SiO_3, CH_3COOH) acids, as well as strong (LiOH, KOH, NaO) and weak ($Cu(OH)_2$, $Fe(OH)_2$, $Al(OH)_3$, $Cr(OH)_3$) bases. Writing formulas in groups is an established scientific fact and a necessary argument for further action. Students also recall the information about an exchange reaction and about water as a weak electrolyte dissociating according to the scheme:

$$H_2O \leftrightarrow H^+ + OH^-.$$

In addition, it is necessary to remember the classification of salts (normal, acid and basic salts).

Then, students perform a chemistry experiment to test the medium of salt solutions with a methyl orange indicator. The results of the observed color change in the solution are put down in Table 1.

The fact of determining the medium of the salt solution, obtained independently by the students during the experiment, allows us to state that the salt solutions have a different medium. Then the problem arises: why do salt solutions have a different medium? Why do some solutions show excess of H^+ ions, and others – OH^- if the experiment was carried out with normal salts?

During conversation, the teacher convinces the students by giving strong arguments: if there are no H^+ and OH^- ions in normal salts, then in solution these ions can be formed only at dissociation of water molecules. Water dissociates weakly and it gives equal number of H^+ and OH^- ions which determines a neutral medium. Hence, we can observe an excess of any ions only as a result of a bond between other ions and the ions of the opposite charge which the solution contains.

Table 1

The results of the test portions on the medium of salt solutions

Salt formula	The color of the solution in the presence of methyl orange	Medium
K_2SO_4	Orange	Neutral
K_2CO_3	Yellow	Alkaline
$Sn(NO_3)_2$	Red	Acidic
$NaNO_3$	Orange	Neutral
Na_2SiO_3	Yellow	Alkaline

To give reasons for this thesis, the teacher pays attention to the formula of potassium sulfate K_2SO_4 and asks which base and which acid produce this salt? The answer is: KOH – a strong base, H_2SO_4 – a strong acid.

Since strong bases and acids dissociate well, salt and water ions will be free in solution:

$$K_2SO_4 \leftrightarrow 2K^+ + SO_4^{2-}, H_2O \leftrightarrow H^+ + OH^-.$$

The equation reveals the chemical mechanism of salt dissociation in water with the formation of a neutral medium.

The dissociation equations of K_2CO_3 and $Sn(NO_3)_2$ illustrate the dissociation of salts in water with the formation of alkaline and acidic media:

$$K_2CO_3 + H_2O \leftrightarrow 2K^+ + CO_3^{2-} + H_2O \leftrightarrow 2K^+ + HCO_3^- + OH^- \text{ (B)},$$
$$Sn(NO_3)_2 + H_2O \leftrightarrow Sn^{2+} + 2NO_3^- + H_2O \leftrightarrow SnOH^+ + 2NO_3^- + H^+ \text{ (A)}.$$

A reasoned explanation of the chemical mechanism of these equations convinces students that dissociation of some salts is an exchange reaction

between salts and water, which results in the formation of an acid (or acidic salt) and a base (or base salt). This reaction is called hydrolysis (from the Greek: hydra – water, lysis – to unbind). After that, it will be appropriate to demonstrate a video from the Internet, for example, hydrolysis of aluminum salt or any other. Such videos last from two to four minutes which concentrate the students' attention and help to convince them of the stated theses.

Students give the definition of the concept of "hydrolysis of salts" in conversation using the arguments of their judgments, based on the results of the experiment and equations.

Further, students can practice this concept in the independent work on writing the equations of hydrolysis of salts such as $NaNO_3$, Na_2SiO_3 and others.

The next technique of using argumentation in teaching chemistry concerns the confirmation of the hypothesis. For example, when studying glucose, students are told the gross formula of $C_6H_{12}O_6$ and problem questions are put: what is its structure? What are the functional groups in glucose?

Students hypothesize: if there are many oxygen atoms in the molecule, it may contain hydroxyl, aldehyde, or carboxyl groups. In case there are hydroxyl groups, glucose may exhibit the properties of a polyhydric alcohol. Such assumptions are verified experimentally by adding glucose solution to freshly precipitated copper (II) hydroxide. A bright blue solution is formed which actually confirms the above assumption. Then the teacher conducts conversation in the following sequence: "We have proved that the glucose molecule contains hydroxyl groups. How can we find out their number?" Students put forward a hypothesis about the existence of a characteristic reaction that confirms the presence of existing hydroxyl groups. The teacher continues: "Yes, there is a synthesis reaction of ester-penta-acetyl-glucose from glucose and acetic anhydride. This synthesis takes more than an hour, so it was done by students – members of the chemical club yesterday. They separated the precipitate of pentaacetyl glucose which I am showing to you. This fact explains that five hydroxyl groups were required to form ester. The presence of these groups in the glucose molecule contributes to good solubility in water. However, there is the sixth oxygen atom in the gross formula of glucose. Which functional group can contain the sixth oxygen atom? How can we prove it?" Students name the aldehyde group and the qualitative reaction to aldehydes – the "silver mirror" reaction. They themselves experimentally confirm the presence of an aldehyde group in the composition of glucose by acting on the glucose solution with ammonia solution of argentum (I) oxide.

The teacher concludes by saying that the students themselves proved that there are five hydroxyl groups and one aldehyde group in glucose. Based on the results obtained, it follows that all six oxygen atoms are part of functional groups which means that six carbon atoms can be directly connected to each other. On one side of the unbranched carbon chain there is an aldehyde group, and hydroxyl groups can be stable only by joining different carbon atoms. Thus, giving reasons for the conclusion, the teacher writes the formula of glucose on the board in this form (figure 1):

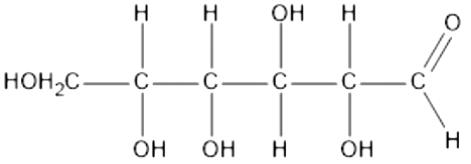


Figure 1. Glucose structural formula

The ball and stick model of the glucose molecule, assembled by the students themselves, convinces them in the best way possible that their assumption was correct.

The chemistry experiment, modeling and logically constructed conversation are important components of argumentation which help to form the visual-spatial representations of the glucose molecule and learn some of its chemical properties.

Statistical analysis of the results was carried out in addition to the dispersion analysis, the assessment of the reliability of the indicators in the control and previous groups of geese was started with the additional ANOVA test. The difference was taken as significant at $p \leq 0.05$, the software package SPSS v.23 and MS Excel 2013 were used.

Results. Data for the experimental work was collected for two academic years (2020-2021, 2021-2022). The lessons were given in two classes. One of them was experimental and the other was the control one. There were three teachers and 6 experimental classes with a total of 118 students who took part in the experiment. The data are presented in Table 2.

At secondary school No. 5 in 2020-2021 school year Class 8 was experimental and the students of this class continued to take part in the experiment the following year. At school No.8 the experiment was conducted among the students of Class 9 in 2020-2021 school year, and the same class took part in the experiment the following year. In the control classes there were 87 students. At school No. 5 there was one control class among the students of Class 10 in 2020-2021 and in 2021-2022 school years. At schools No. 6, 8 there were no control classes.

Table 2

Experimental classes

Schools No.	Academic years	
	2020-2021	2021-2022
	Class (a number of students)	Class (a number of students)
5	8 (23), 10 (20)	9 (23)
6	10 (16)	-
8	9 (21)	10 (15)

The assessment tests included tests and tasks related to the topics of those lessons where argumentation was used in teaching. For example, the tasks for the assessment of knowledge and skills on the topic “Hydrolysis of salts” were as follows:

Indicate which of the salt solutions will have an acidic medium in water: a) potassium carbonate, b) copper (II) chloride, c) iron (III) chloride, d) calcium bromide.

Indicate in which aqueous solution methyl orange will turn red: a) potassium carbonate, b) tin nitrate, c) sodium nitrate, d) sodium silicate.

Give reasons why an aqueous solution of aluminum chloride has an acidic medium.

Give evidence that an aqueous solution of sodium carbonate has an alkaline medium.

Establish correspondence between the named salts and the media of their aqueous solutions:

Salt name	*Solution media*
1) sodium nitrate;	a) alkaline;
2) potassium carbonate;	b) acidic;
3) tin nitrate;	c) neutral.
4) potassium sulfate.	

Why it is impossible to get iron (III) carbonate by mixing the solutions of iron (III)chloride and potassium carbonate? Give reasons for your answer using scientific explanation and reaction equations.

Explain how you can increase the hydrolysis of potassium sulfide in solution:

$$K_2S + H_2O = KHS + KOH$$

Give an example of a salt that is not hydrolyzed in water and explain why.

Write the equation of hydrolysis of the salt of lead (II) nitrate. Justify the reaction of the aqueous solution of this salt.

The maximum number of points that a student can receive for answers to 9 tasks of the assessment test is 12 points. You can receive a maximum of 4 points for answers to task 5, and one point for answers to the rest of the tasks. Since the 12-point scale of grades has been used in Ukraine since 2001, all assessment tests are compiled in such a way that the maximum for correct answers is equal to 12 points. The gradation of these points by levels demonstrated how well the students learnt the material: high level – 10-12 points; sufficient level – 7-9 points; average level – 4-6 points; low level – 1-3 points.

As for other assessment tests, the number of tasks could be less or more, but the total grade for all the tasks was a maximum of 12 points. For example, there were 6 tasks for the assessment of knowledge on the topic “Glucose”. The answer to each task was estimated by 2 points:

1. Prove that glucose contains hydroxyl functional groups. Give reasons by writing the reaction equation.

2. Prove that glucose contains an aldehyde group. Give reasons by writing the reaction equation.

3. Prove that there are five hydroxyl groups in the glucose molecule. Give reasons by writing the reaction equation.

4. What arguments can convince that carbon atoms in the glucose molecule are connected to each other in a chain?

5. What arguments should be given to prove the presence of an aldehyde group at the end of the carbon chain?

6. How can the opponent be convinced that glucose exhibits the properties of aldehyde alcohol?

In total, 8 lessons were given in Class 8. There were 11 lessons in each Class 9 and 11 lessons in each Class 10. After the lessons, where pedagogical argumentation was applied, the students' knowledge was assessed. The results of the assessment tests were distributed according to the levels of acquisition, the points were summarized and the average value was calculated for each experimental and each control class. This average value was calculated at the end of two semesters of 2020-2021 school year and at the end of the first semester of 2021-2022 school year (Table 3).

According to Table 3, it was in the first semester of 2021-2022 school year when students in experimental classes demonstrated higher results at all levels of academic performance compared to the students in control classes. Especially, it was evident for students in Class 9 (School No.5) and students in Class 10. It should be mentioned that students in Class 9 at School No. 5 were taught chemistry using argumentation through 2020–2021 school year when they were in Class 8. Students of Class 10 are high school students. Therefore, many of them intend to enter university, so they take their studies more seriously. This is especially true for students of Class 10 at School No. 8, where there are only 15 of them, and they are all motivated to continue their studies at a higher educational institution. In our opinion, this fact had a significant influence on the students' good results. The dynamics of the increase in the quality of knowledge in experimental classes are from +4.48% to + 17.61% at a sufficient level and from + 13.06% to + 20.54% at a high level.

Out of doubt, a high percentage of the increase in the quality of knowledge has an explanation. Its calculation was made on a small sample of respondents, the number of which went to a higher level in the experimental classes of no more than 1–3 people. In the experimental Class 9 at School No. 8 there were no students with high-level results, so in the control class the result of one student showed negative dynamics. However, this indicator was improved by the end of the second semester of 2020-2021 school year. These data indicate the absence of any influence on the learning process in the control classes for the period of the experimental study.

Table 3

Results of assessment tests. Dynamics in the distribution of pupils by levels (M ± SE, n = 1-18)

class / school	December 2019							May 2020							January 2021						
	Experiment			Control			D (%)	Experiment			Control			D (%)	Experiment			Control			D (%)
8	N	L	%	N	L	%	+/-	N	L	%	N	L	%	+/-	N	L	%	N	L	%	+/-
	4	h	17,40±1,86*	1	h	4,34±0,23	+13,06*	3	h	13,20±1,22*	-	h	-	+13,20*	-	-	-	-	-	-	-
	9	s	39,20±2,24*	7	s	34,72±0,21	+4,48*	12	s	47,47±3,21*	9	s	39,20±1,25	+8,54*	-	-	-	-	-	-	-
	8	a	34,75±3,12*	12	a	47,74±3,59	-12,99*	8	a	39,06±3,33*	11	a	47,60±2,38	-8,54*	-	-	-	-	-	-	-
No. 5	2	e	8,65±0,74*	3	e	13,20±0,35	-4,55*	-	e	-*	3	e	13,20±0,34	-13,20*	-	-	-	-	-	-	-
9	-	h	-*	1	h	4,76±0,31	-4,76*	1	h	4,76±0,49	1	h	4,76±0,45	0	-	-	-	-	-	-	-
	10	s	47,62±4,07*	6	s	33,56±2,17	+14,06*	12	s	57,06±6,85*	7	s	37,34±3,26	+19,72*	-	-	-	-	-	-	-
	10	a	47,62±4,93*	11	a	47,40±2,36	+0,22	8	a	38,18±2,10*	10	a	43,62±1,25	+5,44*	-	-	-	-	-	-	-
No.8	1	e	4,76±0,35*	3	e	14,28±1,83	-9,52*	-	e	-*	3	e	14,28±0,96	-14,28*	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	h	21,74±2,30*	2	h	8,68±0,97	+13,06*
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	s	47,74±4,89*	8	s	34,90±2,69	+12,84*
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	a	30,52±1,26*	10	a	43,40±2,34	-12,84*
No.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	e	-*	3	e	13,02±1,48	-13,02*
10	9	h	25,00±3,34*	2	h	9,52±1,29	+15,48*	11	h	30,06±3,65*	2	h	9,52±0,86	+20,54*	-	-	-	-	-	-	-
	18	s	50,00±6,72*	15	s	23,84±2,36	+26,16*	18	s	50,00±5,08*	3	s	14,30±1,57	+35,70*	-	-	-	-	-	-	-
	9	a	25,00±3,78*	12	a	57,12±7,24	-32,12*	7	a	19,94±2,14*	14	a	66,66±8,89	-46,78*	-	-	-	-	-	-	-
No.5,6	-	e	-*	2	e	9,52±1,25	-9,52*	-	e	-*	2	e	9,52±0,73	-9,52*	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	h	20,00±1,96*	1	h	4,76±0,52	+15,24*
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	s	66,67±4,57*	4	s	19,06±3,25	+47,61*
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	a	13,33±1,62*	14	a	66,66±6,38	-53,33*
No.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-		e	-*	2	e	9,52±0,35	-9,52*

Note: N – number of pupils; L – level; D – dynamic; level (h – high, s – sufficient, a – average, l - low).

The difference is reliable between experimental and control groups, at the level: * – $p \leq 0.05$.

Discussion. The argumentation in dialogical strategies is being more and more implemented in teaching chemistry in secondary school, especially together with other teaching aids. As our research shows, the most effective means of teaching chemistry is a chemistry experiment, with the help of which we can either confirm or refute a hypothesis, arguments for explanation of phenomena or described properties of substances, visualization of the processes under discussion. Pedagogical argumentation, supported by a chemistry experiment as a method and means of teaching, contribute to the development of the logic of constructing explanations, the ability to select the main, essential things in the observed process. It is important to note that the use of argumentation in chemistry education, as the pedagogical experiment has confirmed, increases academic performance in chemistry in semesters. As an assumption, one can speak of even more effective use of the argumentation method in teaching chemistry systematically, that is, at all lessons of each semester, and not only selectively as it was done in the research when topics with laboratory experiments were selected. Very useful for choosing the strategy and tactics of using argumentation in chemistry education is the study by M. Aydeniz [2] which reviews and thoroughly analyzes the already published research on the use of pedagogical argumentation in chemical education. Noteworthy is the statement of P. S. Cetin at al. [18] that the philosophy of chemistry is a relatively new branch of the philosophy of science, aimed at clarifying the theoretical and practical foundations of chemical education, in

which scientific knowledge is supported by reasoned evidence. This statement appeals to us, because this idea is quite possible to implement in grades 7-11 (12) of a secondary school in Ukraine in the study of chemistry. We intend to use the cited summaries and criticism of the researchers of the argumentation carried out in the field of chemical education, as well as the conclusions of these studies, the methodology for applying the problems of argumentation by secondary school chemistry teachers and teachers of primary courses of universities and courses for applicants [2], on students understanding of nature of science, their argumentation and quizzical skills [19], research conducted in laboratory environments has examined the development of students argumentation skills [8] and students argumentational qualities [11]. It is advisable to use the results of studies of online argumentation dialogue in both teacher training and pupil's education [4], which has become very relevant in connection with the COVID-19 pandemic.

However, we believe that it is necessary to take into account the age-related psychological characteristics of secondary school students, as well as the skills of argumentation that are in the development stage, and the lack of knowledge of the technique of chemical experimentation. For these purposes, an article [9] will be useful, which describes the technique to develop and validate Scientific argumentation skills test and investigate the 11^{th} – grade students` performance in scientific argumentation skills on acid-bace chemistry and research results [11] about argumentation in the school science laboratory exploring effects of task and Erduran S. et al. [7] about enhancing the quality of argument in school science.

Conclusions. In our opinion, it is necessary to apply argumentation from the beginning of the chemistry course which is introduced in Class 7 in secondary schools in Ukraine. In this case the skills to conduct a dialogue, to justify actions when performing tasks, experiments or solving chemical problems with calculations will develop into a cognitive skill that will also work for the study of other subjects. The issue of training teachers of chemistry (and not only chemistry) to use pedagogical argumentation in their practice remains open for discussion. According to Yilmaz Y. O. et al. [16] practical trainings of teachers on the use of argumentation in education are important in the formation of a scientific worldview; they contribute to the selection of specific training topics for the lessons based on argumentation. Such a strategy should be supported by the methodological recommendations and directives of the Ministry of Education and especially by the regional departments of education which are responsible for further teacher training.

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Післямова

У колективній монографії було розглянуто напрями глобальних змін розвитку суспільства на зламі тисячоліть через призму педагогічних, соціологічних, філософських, психологічних, мистецтвознавчих, культурологічних, філологічних, історичних, спортивних, туристичних, рекреаційних, економічних, управлінських та правових аспектів.

Над колективною монографією працювали автори, які представляють наступні профільні наукові, навчальні, науково-педагогічні, творчі та мистецькі заклади та установи (інформацію подано мовою оригіналу рукопису автора): Data Analyst, LoopMe, Державна установа «Інститут регіональних досліджень ім. М. І. Долішнього НАН України», Дніпропетровський державний університет внутрішніх справ, Дніпровський гуманітарний університет, Інститут українознавства ім. І. Крип'якевича Національної академії наук України, Київський національний економічний університет імені Вадима Гетьмана, Київський національний університет імені Тараса Шевченка, Луганський державний медичний університет, Мелітопольський державний педагогічний університет імені Богдана Хмельницького, Наукове товариство історії дипломатії та міжнародних відносин, Національна академія внутрішніх справ, Національний інститут стратегічних досліджень, Національний університет «Львівська політехніка», Національний університет харчових технологій, Національної академії наук вищої освіти України, Постійне представництво України при Відділенні ООН в Женеві, Прикарпатський національний університет імені Василя Стефаника, Сумський національний аграрний університет, Харківський національний університет внутрішніх справ, Центральноукраїнський державний університет імені Володимира Винниченка.

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