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013 «PRIMARY EDUCATION» SPECIALITY STUDENTS' DEMOCRACY CULTURE COMPETENCES FORMATION IN THE COURSE OF «MATHEMATICS»

ФОРМУВАННЯ КОМПЕТЕНТНОСТЕЙ КУЛЬТУРИ ДЕМОКРАТІЇ СТУДЕНТІВ СПЕЦІАЛЬНОСТІ 013: «ПОЧАТКОВА ОСВІТА» У КУРСІ «МАТЕМАТИКА»

The purpose of the article *is to highlight the experience and test the effectiveness of the democracy culture and intercultural dialogue competences formation in the process of studying the «Democratic Approach in Mathematics» content module by the 013 «Primary Education» speciality students at T.H. Shevchenko National University «Chernihiv Colehium» (Ukraine).*

Methodology. *The research criteria were worked out on the basis of the Model of the competences for the democracy culture proposed by the Department of Education of the Council of Europe. The questionnaires (initial and final), worked out by the authors, allowed to sustain the dynamics of the competences development in one group of the 1st year students (18 students). The results of the statistic processing of the experiment were analyzed using Student's t-criterion.*

The scientific novelty of the research. *For the first time, the educational process of the course of «Mathematics» was modernized through introducing the democracy elements: rich tasks, discussions, culture of democratic communication while studying basic mathematical theories. A characteristic of the «Democratic Approach in Mathematics» course is the introduction of the «Inverted class» technology, which provides students with the opportunity of the individual learning of the theoretical material based on the Google Classroom platform (a virtual class «Mathematics», code: 05b2lz) and passing a small self-control test.*

The outlines of the lectures and practical classes with the detailed description of work on their separate stages are given in the article. The rich tasks were selected in the way to reveal the use of the appropriate mathematical model (a certain type of the function, scheme, formula, way) of solving life and economic problems, or the students, while doing sums, should have focused on the mental ways of analyzing and assessing the situation (the tasks on «summarizing the concept», determining the condition by the known result, the use of the heuristic way of solving).

Conclusions. *It was found that the difference in the average indices in favor of the improved system of classes was statistically significant. However, the relatively low percentage (11,1%) of the high-level formation of some competences is justified by the non-systematic implementation of the democracy culture elements into the educational process, which should be paid the attention to in the future studies.*

Keywords: *Mathematics, rich tasks, democracy culture competences, «Inverted class» technology, functions, integers.*

Мета статті *– висвітлення досвіду й перевірка ефективності формування компетентностей культури демократії та міжкультурного діалогу у процесі вивчення змістового модуля «Демократичний підхід в математиці» студентами спеціальності 013 «Початкова освіта» Національного університету «Чернігівський колегіум» імені Т.Г. Шевченка.*

Методологія. *Критерії дослідження розроблені на основі Моделі компетентностей для культури демократії, запропонованої Департаментом освіти Ради Європи. Розроблені авторами анкети (вхідна та вихідна) дозволили з'ясувати динаміку розвитку компетентностей однієї групи студентів 1 курсу (18 осіб). Результати статистичного оброблення експерименту дослідження проаналізовано за допомогою t-критерію Стьюдента.*

Наукова новизна. Уперше модернізовано освітній процес курсу математики через впровадження елементів демократії: ціннісних задач, дискусій, культури демократичного спілкування під час вивчення основних математичних теорій.

Характерною особливістю курсу «Демократичний підхід в математиці» є впровадження технології «Перевернутий клас», що передбачає самостійне ознайомлення студентів із теоретичним матеріалом на базі платформи Google Classroom (віртуальний клас «Математика», код: o5b2lz) та проходження ними невеликого тесту для самоперевірки. У статті подані плани лекційних та практичних занять із детальним описом роботи над окремими їх етапами. Ціннісні задачі добирались у такий спосіб, щоб розкрити застосування відповідної математичної моделі (певного типу функції, схеми, формули, прийому) до розв'язування життєвих та економічних питань, або ж студенти мали сфокусуватись під час розв'язування на мисленнєвих прийомах аналізу та оцінювання ситуації (завдання на «підведення під поняття», визначення умови за відомим результатом, застосування евристичного прийому розв'язання).

Висновки. З'ясовано, що різниця в середніх на користь удосконаленої системи занять є статистично значущою. Однак, порівняно низький відсоток (11,1%) сформованості на високому рівні деяких компетентностей обґрунтовується, не систематичністю впровадження елементів культури демократії в освітній процес, на що потрібно звернути увагу у наступних дослідженнях.

Ключові слова: математика, ціннісні задачі, компетентності культури демократії, функції, цілі невід'ємні числа.

Problem statement in general and its connection with important scientific or practical tasks. Democracy plays a key role in the modern society of most countries of the world, including Ukraine. This is one of the main foundations of the state institutions work. However, not every citizen of a democratic society is guided by the values of democracy, aware of his own role in solving social and personal problems. The overwhelming majority of the Ukrainian citizens associate their democratic activity with the use of the right to vote (elections of different levels, participation budget, etc.). That is why one of the key tasks of reforming the Ukrainian education is to develop the cross-cutting competence of the democratic citizenship. Thus, the Basics of the Education Standard (2016) state that the mathematical education branch, among other things, has the potential to form social health and well-being competence, democratic citizenship, initiative and entrepreneurship competence. The tasks of socio-economic and entrepreneurial (optimization) content should become the resources for the formation of these competences.

Analysis of basic researches and publications on the problem raised. The problem of the educational environment of the Ukrainian comprehensive education institutions democratization and development of civic competence, providing methodological and professional support to teachers, coaches, scientists is studied by the Vergeland European Center (Oslo, Norway) – the European Education Expert Center for Democratic Citizenship, Human Rights and Intercultural Understanding. It was established by the Council of Europe and Norway in 2008 to support the Council of Europe member states in implementing the policy in this field. With the support of the Norwegian Ministry of Foreign Affairs in cooperation with the Ministry of Education and Science of Ukraine, the Council of Europe, the Center for Educational Initiatives and ISAR «The Unity», the Vergeland European Center implements the All-Ukrainian Program «The Democratic School» (the Program Leader Iryna Sabor, the Senior Advisor of the Vergeland European Center (Norway); the Program Coordinators in Ukraine: ChrystynaChushak, the Senior Researcher, Andrii Donets, the Project Manager of the ISAR «The Unity» and MazhenaRafalska (Poland), the Senior Program Trainer and the Expert of the Council of Europe. The official opening of the program was held on March 1, 2016.

The Department of Education of the Council of Europe (Siur Bergan, Villano Kiriazi, Christopher Reynolds, Mirei Wendlin, Claudine Marten-Ostwald) and the international education experts (Martin Barrett, Louise de Bivar Black, Michael Biram, Yaroslav Faltin, Lars Gudmundson, Giligievant Land, Claudia Lenz, Pascal Mompua-Gaillard, Milisa Popovich, Kalin Rus, Salvador Sala, NataliiaVoskresenskaia, Pavel Zagaga) worked out the Framework of the competences for the democracy culture. This is the document that proposes «a systematic approach to organizing the process of forming and assessing competences for the democracy culture and their implementation in the educational systems» from pre-school education to higher education [1, p.11].

A team of experts from the Vergeland European Center made the tasks and methodological recommendations for teaching the «Civic responsibility» content line, the aim of which is to form the competences for the democracy culture in the course of «Mathematics» in secondary educational institutions [4].

The problem of «Implementing the democracy in the future teacher's training process» is being studied by the team of the project «The democracy culture development in pedagogical education in Ukraine, Norway and Palestine» (CPEA-LT-2017/10037), the members of which are the Professors and Associate Professors at the Department of Pedagogics and Psychology at M.P. Drahomanov National Pedagogical University. Within the framework of the project the Associate Professor of Mathematics at the University of South-Eastern Norway Sikunder Ali Baber conducted the training for the teachers of higher educational institutions on «Implementing the democracy in the process of teaching mathematical disciplines» (November, 2018). Among the problems, which the work of the lecturers was focused on, were: the use of Mathematics in thinking (decision-taking) and communication, the concept of «a rich task» as a mean of forming the democracy culture competences and methods of work with it, the analysis of the Ukrainian textbooks in Mathematics for primary school concerning the democratic values.

The purpose of the article is to highlight the experience of the «Primary education» speciality students' democracy culture competences formation in the course of «Mathematics» in connection with the implementation of the international project *«The democracy culture development in pedagogical education in Ukraine, Norway and Palestine»* (CPEA-LT-2017/10037); test the effectiveness of implementing the improved system of classes of the «Democratic Approach in Mathematics» content module.

Coverage of the procedure of theoretical and methodological and experimental research with indication of the research methods. The research criteria were worked out on the basis of the Model of the competences for the democracy culture proposed by the Department of Education of the Council of Europe. The questionnaires (initial and final), worked out by the authors, allowed to sustain the dynamics of the competences development in one group of the 1st year students (18 students). The results of the statistic processing of the experiment were analyzed using Student's t-criterion.

Presentation of the basic material of the research with the obtained scientific results grounding. At the Faculty of Preschool and Primary Education and Arts at T.H. Shevchenko National University «Chernihiv Colehium» the lecturers at the Department of Preschool and Primary Education (As. Prof., Ph.D. N. Striletska and Lecturer, Ph.D. T. Zaporozhchenko with the support of the head of the Department Prof., Ed. D. S. Strilets) worked out and implemented the «Democratic Approach in Mathematics» content module in the educational process of teaching the discipline «Mathematics» to the students of the «Primary Education» speciality. The required amount of the module: 2 lectures (4 hours), 2 practical classes (4 hours). *The aim of the module:* to modernize the educational process of the course of «Mathematics» through the implementation of the democracy elements: rich tasks, discussions, culture of democratic communication while studying basic mathematical theories; to form students' idea of Mathematics as a mean of solving social and life problems and developing logical thinking, as a necessary condition for the personality formation in a democratic society.

Coverage of the theoretical and methodological and / or experimental study procedure with indication of research methods. While developing the study criteria, we used the Model of the competences for the democracy culture and intercultural dialogue (the criteria (II-IV)), with the descriptors defined in the model, their content and levels of the competences formation (Council of Europe, 2018, Volume 2, p.17, 19, 23). The criterion I is based on As. Prof. Sikunder Ali Baber's views on the role of Mathematics in the development of a democratic society from the Training Materials on «Democracy in teaching mathematical disciplines» (November, 2018) (see Table 1).

Note: the level below the baseline will be marked at 2 points.

While conducting the classes on the module we relied on the principles of *«learning through democracy»* – encouraging persistence in solving problems, encouraging the grounds of the correctness of decisions, approving the least success. As a result of its implementation, the students' ability to work on tasks and confidence in themselves are formed. The second principle is *«learning about democracy»*. By this we mean the actualization of knowledge about the democratic values of an active citizen of a democratic society. The third principle – *«learning for democracy»* is to use the developed skills in a specific situation. The students learned how to model democratic relations in a group, team based on the knowledge of democratic values. *The resource of the democracy culture competence formation is the «rich tasks». The focus of attention in such tasks is shifted towards students' thinking rather than using formulas and rules. A possible system of work with rich tasks is shown in Figure 1.

Criteria, indicators and levels of competences formation assessment

I. The ability to use Mathematics in solving social problems of a democratic society		
1.	The ability to understand the purpose of Mathematics	Basic
2.	The ability to explain the connection between Mathematics and thinking, Mathematics and democracy	(3 points)
3.	The ability to describe the scope of mathematics	Middle
4.	The ability to give examples of solving problems from his own experience using Mathematics	(4 points)
5.	The ability to ground the possibility of using Mathematics in assessing experts' statements containing numerical data	High
6.	The ability to suggest the way of assessing the statement containing numerical data	(5 points)
II. Knowledge and critical understanding of the world		
7.	The ability to explain the meaning of the basic political concept – «democracy»	Basic
8.	The ability to explain why everyone must respect the rights of others	(3 points)
9.	The ability to describe the effects of propaganda in the modern world	Middle
10.	The ability to explain how people can protect themselves from propaganda	(4 points)
11.	The ability to describe various ways of influencing citizens on politics	High
12.	The ability to explain how national economies work and how economic and financial processes affect the functioning of the society	(5 points)
III. Civic awareness		
13.	The will to interact and work with other people	Basic
14.	The ability to collaborate with other people for the sake of common interests	(3 points)
15.	The sense of duty not to stay away when the rights and dignity of others are being violated	Middle
16.	The ability to discuss what can be done to change the community for the better	(4 points)
17.	The ability to take the responsibility characteristic to the active citizenship, locally, nationally or globally	High
18.	The ability to make effort to be informed of public affairs	(5 points)
IV. Critical and analytical thinking		
19.	The ability to determine the similarity and difference between new and already known information	Basic
20.	The ability to use evidences to confirm the opinion	(3 points)
21.	The ability to assess the risks connected with choosing different variants	Middle
22.	The ability to think about the correctness of the information used	(4 points)
23.	The ability to identify any divergences, differences or deviations in the materials to be analyzed	High
24.	The ability to use certain criteria, values, principles for making judgments	(5 points)

The content of the module:

• *Functions* (The concept of a numerical function. The properties of the function: D(f), E(f), parity, oddness, extremes, monotony. Functions of the form f(x)=kx+b; f(x)=kx x≠0; f(x)=ax2+bx+c a≠0; f(x)=*kx*. Doing rich tasks.)

• *Integers* (The concept of a natural number and 0 in a set theory. The binary relation. Operations of addition, subtraction, multiplication and division. Their properties. Doing typical tasks).

A characteristic feature of the «Democratic Approach in Mathematics» course is the introduction of the «Inverted class» technology, which provides students with the opportunity of the individual learning of the theoretical material based on the Google Classroom platform (a virtual class «Mathematics», code: 05b2lz) and passing a small self-control test.

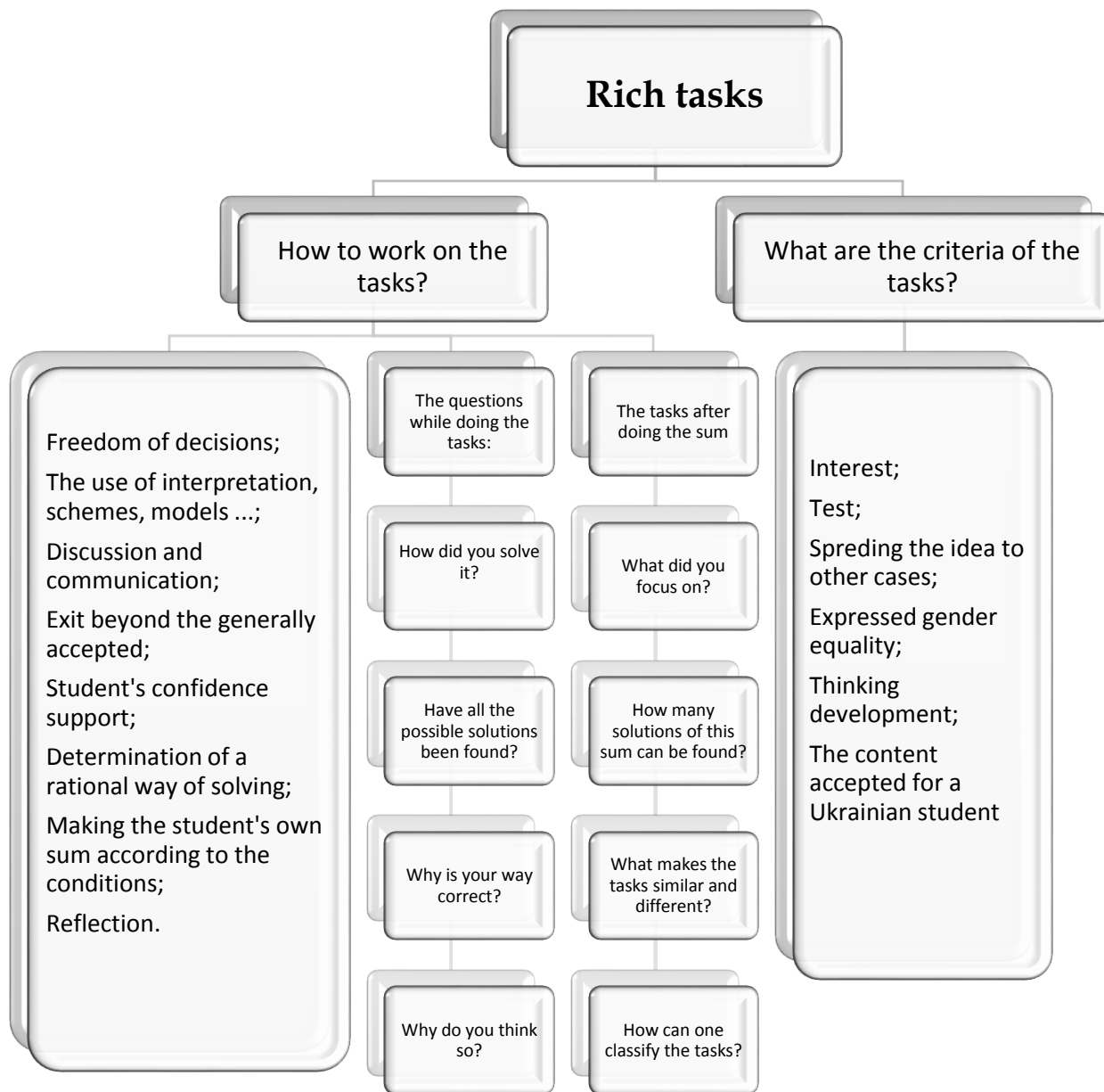The outline of the lecture on «Functions» is given below (see Table 2).

Rich tasks

How to work on the tasks?

- Freedom of decisions;
- The use of interpretation, schemes, models ...;
- Discussion and communication;
- Exit beyond the generally accepted;
- Student's confidence support;
- Determination of a rational way of solving;
- Making the student's own sum according to the conditions;
- Reflection.

The questions while doing the tasks:

- How did you solve it?
- Have all the possible solutions been found?
- Why is your way correct?
- Why do you think so?

The tasks after doing the sum

- What did you focus on?
- How many solutions of this sum can be found?
- What makes the tasks similar and different?
- How can one classify the tasks?

What are the criteria of the tasks?

- Interest;
- Test;
- Spreding the idea to other cases;
- Expressed gender equality;
- Thinking development;
- The content accepted for a Ukrainian student

Fig. 1. System of work on rich tasks

Table 2

The outline of the lecture (class) on the topic «Functions»

Introduction	5 min
Main part:	**65 min**
The task «Five key phrases»	10 min
The rich tasks on summarizing the concept of *«a numerical function»; determining the types of functions set out in a table, drawing their graphs*	15 min
The rich tasks the content of which contains the quantities related to the linear or direct proportionality	15 min
The tasks the content of which contains the inverted proportionality	15 min
The tasks on the use of the properties of the quadratic function	15 min
Summing up. Finishing the class («The reflexive circle»)	**10 min**

The rich tasks were selected in the way to reveal the use of the appropriate mathematical model (a certain type of the function, scheme, formula, method) of solving life and economic problems, or the students, while doing sums, should have focused on the mental ways of analyzing and assessing the situation (the tasks on «summarizing the concept», determining the condition by the known result, the use of the heuristic way of solving). The task on sense-making («Five key phrases») made by the authors is important at the class, the aim of which is to form the idea of the concept of «democracy in Mathematics», or possible connection between social and scientific subjects. Each group, communicating for 1-2 minutes, should offer 4-5 key phrases for each of the concepts of «doing Mathematics» and «implementing the democratic values», which would be based on their own experience. Then, the result of the work was analyzed by all the students.

The example of Task 2: a) set the correspondence (see Table 3); б) make the graphs of the functions that correspond tothe given functional dependencies. Use the Advanced Grapher program to do this.
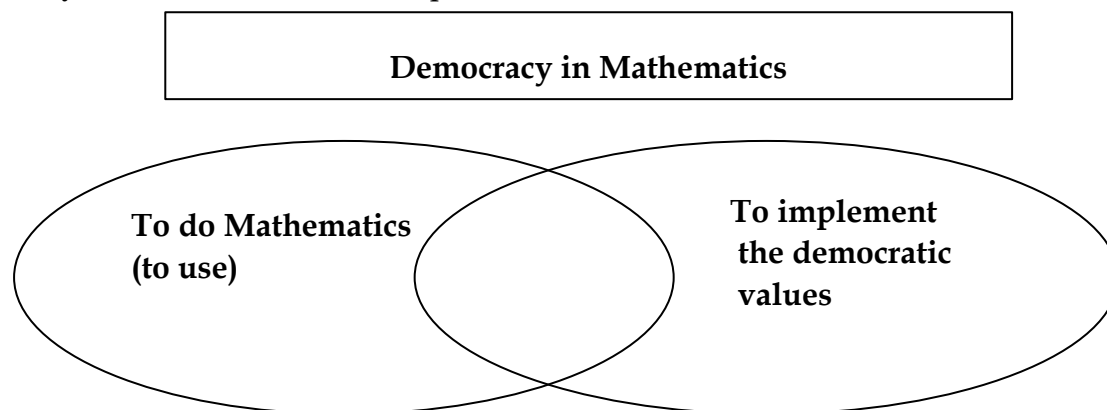
Democracy in Mathematics

Fig 2. Five key phrases

Table 3

Set the correspondence

a) direct proportionality	x	1	2	4	10	40
	y	20	10	5	2	1/2
	1.					
b) inverted proportionality	x	-5	-1	-3	6	12
	y	6	3	4	-2	-1
	2.					
c) linear dependence	x	10	15	20	23	27
	y	4,5	6	7,5	8,4	9,6
	3.					
d) another kind of dependence	x	10	15	20	23	27
	y	100	225	400	529	729
	4.					
e) quadratic dependence	x	2	4	-6	8	-10
	y	-2,4	-4,8	7,2	9,6	12
	5.					

Let's give some tentative thoughts for doing the sum.

In Table 2. the variable x increases, the variable y decreases (it can be shown that for any two values of x in this table such that $x_1 < x_2 \rightarrow y_1 > y_2$)

Let's compare these changes: the variable x increases by 2, 4, 10, 40 times, respectively, and the variable y, respectively, decreases by 2, 4, 10, 40 times (this property can be written by the correlation $x_1 / x_2 = y_2/y_1$). The constant is the product of the corresponding values of x and y: $1·20 = 2·10 = 4·5 = 10·2 = 40·1/2 = 20$.

The dependence is the inverted proportionality, expressed by the formula y = k/x, where k=20. The domain of the function is $(-\infty;0)\cup(0;+\infty)$

Let's make the graph of the function y=20/x.

The algorithm of making the graph in the Advanced Grapher program:

1. Choose the gap for the visible part of the image. To do this, consistently execute the commands of the main menu: *Graphs/ Document Properties/Construction. In the dialog box specify the intervals as in Figure 3). Click OK.*

2. To better determine the coordinates, add the grid (horizontal and vertical lines). To do this, execute the commands: Graphs/ Document Properties/Grid. Fill in the dialog box as in Figure 4. Click OK.
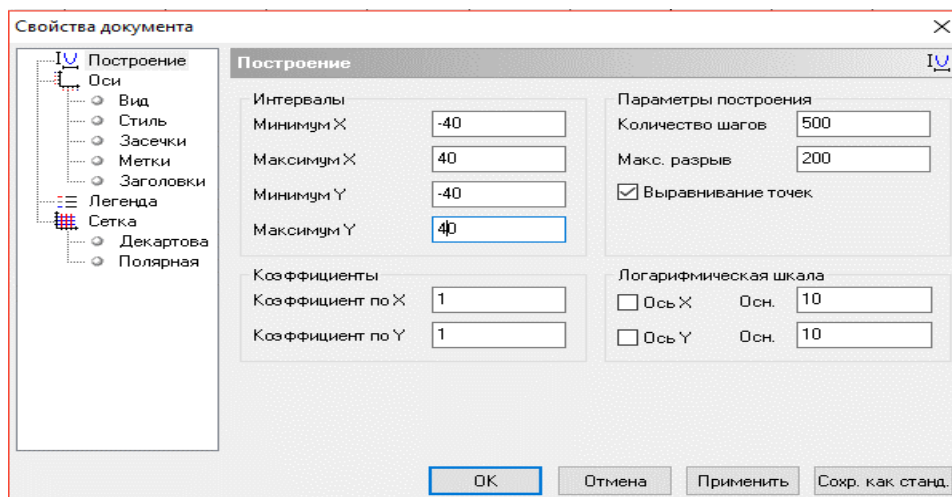
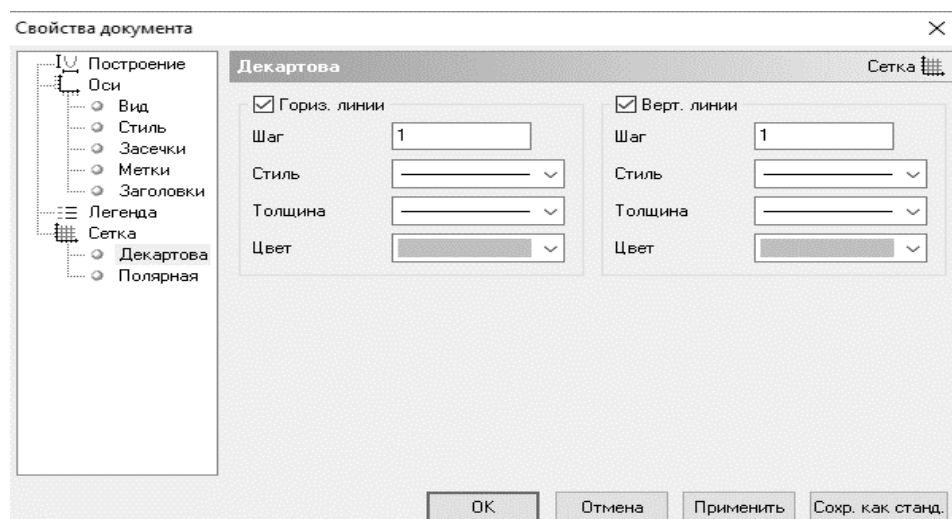**Fig. 3. Dialog box «Construction»**

Fig. 4. Grid settings

3. Set the graph of the function. To do this, execute the commands: *Graphs/Add a Graph/Properties. Fill in the dialog box as in fig. 5.* To show only the positive hyperbola branch (1st coordinate quarter), click the Advanced tab and change the minimum interval value by X=0 (see Figure 5.). Click OK.

The reflection

– A numeric function is called …

– Among the tasks, I particularly liked…

– While working on the tasks, I got (learnt)…

– The tasks made us think about/over…

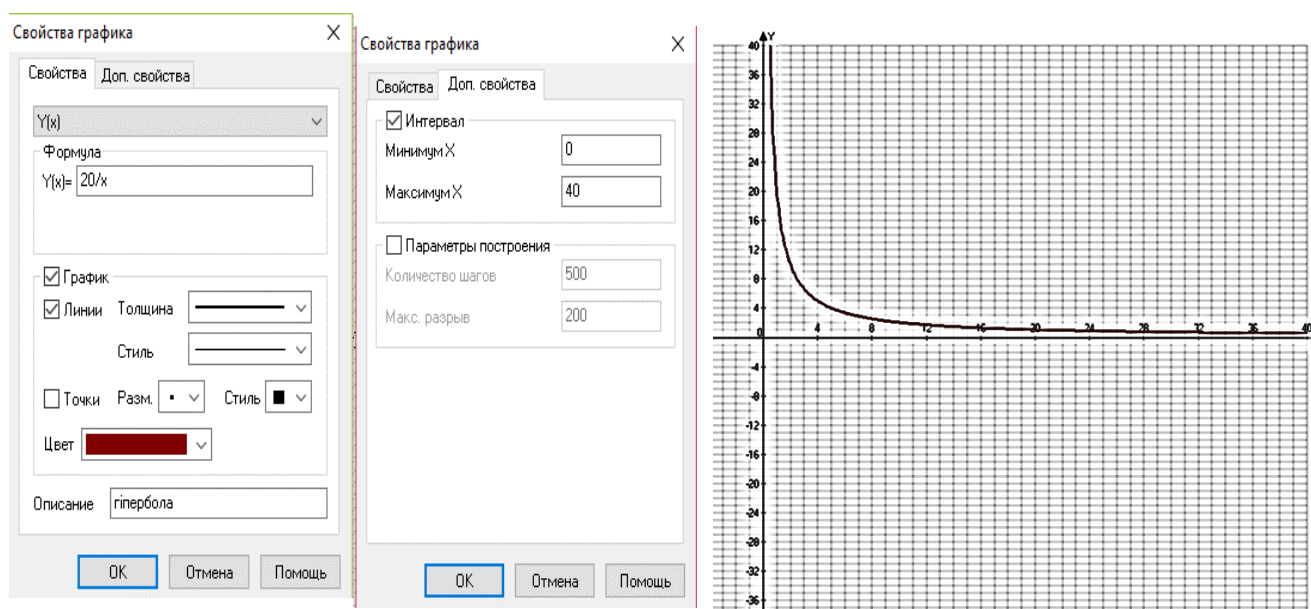The example of the class on «Negative integers. The democratic principles of studying integers» (see Table 4).

Fig. 5. Properties of the graph

Table 4

The outline of the practical class

Introduction	5 min
Main part:	**65 min**
1. Brainstorming «Integers are ...»	5 min
2. Task «Logical sequence of numbers»	5 min
3. Task «Thought numbers»	5 min
4. Task «Do rationally»	10 min
5. Task «Find unknown items»	5 min
6. Task «Magic Squares»	10 min
7. Task «Solve the equation»	10 min
8. Practical work «Find in the textbook»	15 min
Summing up. The metaplan method	10 min

Let's examine some of the tasks as the examples.

3. Task *«The thought numbers»*

The description of the task: frontal heuristic conversation. Making an expression using the selection method.

Conducting

Pair work:

– What two integers did you add and make 12?

The reflection

– What was your way of thinking?

– Which of two proposed by you variants is correct?

6. Task *«Magic Squares»*

The description of the task: logical filling in the squares.

Conducting

Individual work:

1) Arrange the numbers 1, 2, 3 in the square 3x3 so that each row and column contains all these numbers at a time.

2) Arrange the numbers 1, 2, 3, 4 in the square 4x4 so that each row and column contains all these numbers at a time.

The reflection

– Which task was easier?

– What was your way of thinking concerning the first task?

– What was your way of thinking concerning the second task?

– What difficulties did you face while doing the tasks?

– Is it possible to fill in the squares differently? How exactly?

– How can one modify or complement the condition of the tasks?

8. Practical work «Find in the textbook»

The description of the task: work in groups; finding in the textbook the exercises with logical load and changing their conditions.

Conducting:

– Find 4-5 logical arithmetic sums in the textbook. Change the condition and explain how the result will change.

The reflection

– Why did you choose this very task?

– How did you change the condition?

– Join together and discuss how else you can change the condition in each task chosen by you.

– Announce the opinion of the group. Why do you think so?

Description of the basic material of the research with the obtained scientific results grounding. Before conducting the classes, we made a survey among the students in order to find out the level of the democracy culture competence formation. 18 students participated. The questionnaire included the questions with open answersand required the respondents' detailed grounded responses. The questions proposed in the questionnaire:

– What does «to do Mathematics» mean?

– How do you understand the concept of «functional thinking»?

– In what situations can Mathematics help?

– How do you understand the term «democracy»?

– What is the connection between Mathematics and democracy?

– What is (can be) your role in a democratic society?

– How does Mathematics help critically assess the statements of people containing figures?

After completing the «Democratic Approach in Mathematics» course, we conducted the final survey of the students (18 people). The questionnaire included clarifying questions such as: «How did your opinion change after having completed the course?», «Give the example that confirms your opinion», «Was it at the classes?» The second question was replaced by the question «What is the use of mathematics for each person?» This method made it possible to make the preliminary qualitative assessment of the changes that have taken place in the students' minds in connection with the formation of the studied democracy culture competences.

Data Analysis

The qualitative analysis of the initial questionnaire showed the following results. It was found that under the concept of «doing Mathematics» students understand: «To study theory, do the tasks on certain mathematical operations, study figures, their properties» (61,1%); develop logical thinking and mental abilities (22,2%), «think logically, apply Mathematics in solving life problems» (16,7%).

66,7% of the students understand «functional» thinking as rational thinking, which is reflected in assessing the effectiveness of the result of solving the problem. 16,7% of the students understand it as the use of knowledge about functions in solving problems. 16,7% of the polled regard «functional» thinking as solving the problem from different points of view.

Responding to the third question of the questionnaire, 72,2% of the students gave the examples of using Mathematics in everyday life (calculating family budget, calculating materials for home repair, determining the content of ingredients for cooking, calculating the cost of shopping, etc.). 22,2% gave the examples of using Mathematics in the professional work: business – financial calculations, sewing workshop – creation of the product pattern, fine art – use of proportions in the image creation. 5,6% of the students gave only one example (purchase cost calculation, speed calculation).

The term «democracy» is understood by 61,1% of the students as a political regime under which the leadership of the state is exercised in cooperation with the people. 27,8% understand this term as a social system whose main values are the right to vote, freedom of speech, tolerance, respect for other opinions, culture, equality, participation of members of any association in decision making, based on the majority. 11,1% understand a certain political regime under this term.

To the fifth question of the questionnaire 44,4% of the students responded that the connection between Mathematics and democracy is in calculating the results of an election campaign. 33,3% of the respondents do not see a close connection between the concepts. 22,2% were of the opinion that everyone should express his point of view and ground it on the basis of the mathematical laws and rules.

The answers to the sixth question of the questionnaire were the following. 61,1% of the students see their role in a democratic society as participating in elections at various levels, 33,3% as participating in local initiatives (Budget of participation, debates, volunteering); 5,6% didn't take a decision.

Responding to the seventh question of the questionnaire, 66,7% of the respondents could not answer this question, 22,2% of the students regard it as the ability of the correct determining the priorities in life. 11,1% understand the use of Mathematics for critical assessing the arguments as an analysis of an opponent's statement based on the use of mathematical laws and rules.

So, before the beginning of the course, it was found that the vast majority of the students (more than 70%) use Mathematics in life, have a clear understanding of its structure, but most of the students have limited ideas about democracy (only as a political system) and citizen participation in a democratic society (as a free will of citizens during voting). Most students do not see a significant correlation between Mathematics and democracy, either at all (33,3%), or just as using Mathematics in election campaign calculations (44,4%). Only 11,1% of the students assume the possibility to use the mathematical laws and rules in analyzing their opponent's statements containing numerical data.

Let us examine the analysis of the students' final survey conducted after completing the «Democratic Approach in Mathematics» course.

To the first question of the questionnaire «What does «to do Mathematics» mean? Has your opinion been changed?» 44,4% of the respondents replied that their opinion had changed and, above all, it is: to think logically, to draw conclusions of various tasks, life examples and apply their knowledge in real life, rationally solving an emerging problem. 55,6% of the students are of the traditional view – that it is to study theory and do sums.

Concerning the second question of the questionnaire «What is the connection between Mathematics and thinking?», 72,2% of the students are convinced that most mental techniques are required when doing mathematical tasks. 11,1% – understand the connection in the construction of science «Mathematics» based on logical thoughts, a high degree of abstraction. 16,7% of the respondents answered that it was «inseparable», but without grounding.

Answering the third question of the questionnaire «What is the benefit of Mathematics for every person?», 55,6% of the respondents believe that the person who uses Mathematics to solve life problems will not let anyone cheat her, will assess information critically and succeed in the career. 33,3% of the respondents say that Mathematics develops computing skills, logical thinking and helps solve financial problems. 11,1% – find it useful to plan each action to achieve results, to order the time rationally.

Concerning the fourth question «How do you understand the term «democracy»? Was there democracy in the classroom? Why?», 44,4% of respondents define the term «democracy» as equality, respect for another person, appreciation of her opinion, finding a common rational solution, ability to find a compromise. The example of the grounding the statement «We cooperated with the lecturer, with each other, actively participated in lectures, and especially in practical classes, did the tasks together with the teacher». 33,3% of the respondents associate this term with the freedom of thought, 22,2% did not have clear grounds.

The fifth question of the questionnaire «What is the connection between democracy and Mathematics? Have you changed your mind after classes?» had the following distribution of the answers. 33,3% of the opinions have not been changed – it is «to study the theory, to do sums», 11,1% of the opinions have not been changed, they believe that Mathematics is an accurate science and no matter how we do the task, there must be one solution. 55,6% believe that the connection between Mathematics and democracy is based on the ability to express the opinions and ground them on the basis of mathematical laws and rules, a common definition of the most acceptable result. It is also not imposing the right decision on the audience by the lecturer, but pushing for independent sound decision making.

To the sixth question «What is your (possible) role in a democratic society?» the students gave the following answers: 72,2% of the respondents see their role as active participants in the public life of the country, patriotic associations, benefiting as specialists; 16,7% of the students see their role in voting in elections at different levels; 11,1% – define their role as «a role of an ordinary voter».

Answering the seventh question of the questionnaire «How can Mathematics help critically assess the arguments using numbers? Give an example». 44,4% believe that Mathematics will help verify other people's statements with numerical data, using specific calculations and arguing. Some of the examples: «1. Continue the number row: 1, 3, 5 … . 2. Guess the thought number: the two-digit number that has 4 divisors. What number was thought? (15), etc.» 11,1% of the students regard it as the ability to correctly determine the priorities in life. 44,4% regard it possible to assess the changes in the school educational process.

The results of the statistic processing of the study of competences formation for the democracy culture and intercultural dialogue on the basis of initial and final questionnaires were analyzed using Student's t-criterion, which is determined for the dependent samples by the formula [3, p.50]:

$$t = \frac{\sum_{i=1}^{n} \delta_i}{\sqrt{\frac{n \sum_{i=1}^{n} \delta_i^2 - \left(\sum_{i=1}^{n} \delta_i\right)}{n-1}}} \ ,$$

where n – the number of the students of the group, $\delta_i = x_i - y_i$, x_i and y_i are the corresponding values of the initial and final questionnaires (see Table 5).

Table 5

Comparative distribution of the initial and final questionnaire points

#	Critical and analytical thinking			Civic awareness			Knowledge and critical understanding of the world			The ability to use Mathematics to solve social problems of a democratic society		
	The initial questionnaire (points)	The final questionnaire (points)	t_{exp}	The initial questionnaire (points)	The final questionnaire (points)	t_{exp}	The initial questionnaire (points)	The final questionnaire (points)	t_{exp}	The initial questionnaire (points)	The final questionnaire (points)	t_{exp}
1.	3	4		3	4		3	4		4	5	
2.	4	5		4	5		5	5		5	5	
3.	3	4		3	3		3	3		4	5	
4.	3	4		3	4		3	4		3	4	
5.	4	4		4	4		4	4		5	5	
6.	3	4		3	4		3	4		4	5	
7.	2	3		2	3		3	3		3	3	
8.	3	4		3	3		3	4		3	4	
9.	3	4	**5,169**	3	3	**4,123**	3	3	**3,828**	4	5	**4,761**
10.	2	3		2	3		3	3		3	4	
11.	4	4		4	4		4	4		5	5	
12.	5	5		4	5		3	5		3	5	
13.	3	3		2	3		3	4		4	4	
14.	3	4		3	3		3	3		3	3	
15.	4	4		4	4		3	4		3	4	
16.	4	4		4	4		4	4		5	5	
17.	4	4		4	4		3	4		4	5	
18.	3	4		2	3		2	3		3	4	

The t-criterion (t_{exp}) calculated for each case is greater than the critical t-criterion (t_{cr}=2.110) at the number of d=17 (n-1) freedom degrees for the significance level (p=0.05) according to Student's quantile distribution table. Therefore, it can be accepted at the level of the statistic significance of 95% of the hypothesis reliability that the initial and final data of the questionnaire differ. This, in its turn, justifies the effectiveness of the studied competences formation influence on the implementation of the «Democratic Approach in Mathematics» module.

The comparative analysis of the competences levels formation is given in Figure 6.

Study findings and prospects for further exploration in this area. Taking into account the survey indices, we observe an increase in the percentage of the students who have acquired the competences at the high and middle levels by the criteria of the study. The highest indices were achieved in the formation of the competence «The ability to use Mathematics to solve social problems of a democratic society» (high level, 55,6%), which is explained by the effectiveness of the educational process of teaching Mathematics, namely the implementation of the «Democratic Approach in Mathematics» content module in the course of «Mathematics» on the basis of the principles of the democracy culture competences formation (learning through democracy, learning about democracy, learning for democracy) and the educational resource – «rich tasks». The relatively low percentage (16,7 and 11,1%) of the high-level formation of other competences (critical and analytical thinking, civic awareness, knowledge and critical understanding of the world) is grounded by the unsystematic introduction of the elements of the democracy culture into the educational process of both «Mathematics» and other disciplines, unexploration of the problem of the democracy culture competence formation in the courses of professionally oriented disciplines.

**The comparative analysis of the competences levels formation
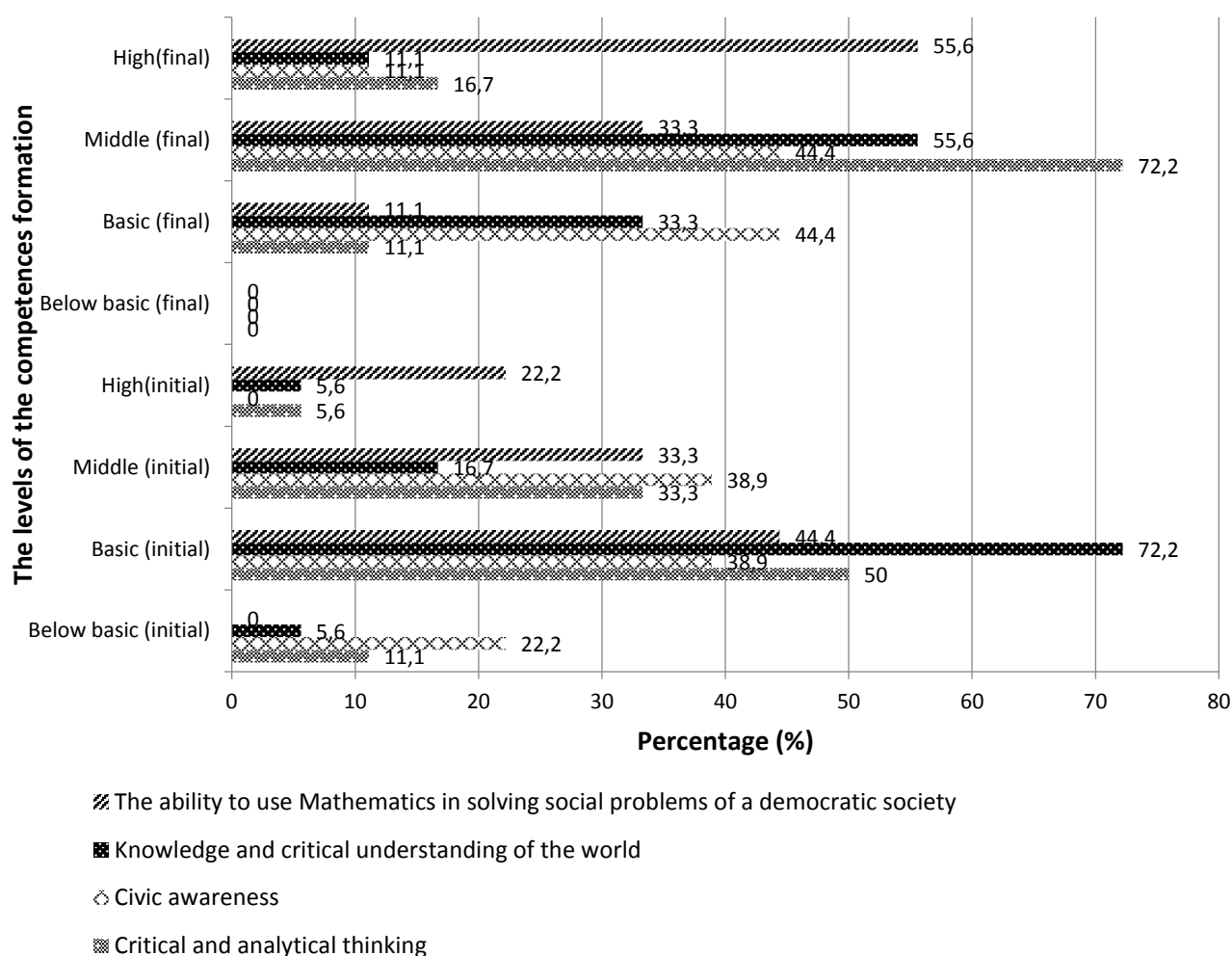for the democracy culture**

Fig. 6. The levels of the competences formation for the democracy culture

Conclusions on the study and prospects for further researches in this direction. Therefore, the importance of introducing the international educational experience and participation in the international projects are undeniable. The use of the leading ideas of the project «The democracy culture development in pedagogical education in Ukraine, Norway and Palestine» (CPEA-LT-2017/10037), in the educational process of the Ukrainian higher educational institutions allows to form future teachers' new vision of the objective of education, its role in training active citizens of a democratic society, to enrich their professional experience with regard to the content-processing component of teaching Mathematics. As the further study we consider the development of the levels of the democracy culture competence formation in the course of «Mathematics», the classification of rich tasks and the peculiarities of their solving.

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