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CRITICAL THINKING DEVELOPMENT OF PRIMARY SCHOOL PUPILS BY MEANS OF INVENTIVE PROBLEMS

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ABSTRACT

*The **purpose** of the research is to determine the effective tools for the critical thinking development for primary school pupils.*

***Methodology**. The retrospective analysis of the primary education systems development in Ukraine and in highly developed countries was used, the primary school is determined to be the initial stage of the pupils' critical thinking development. The material of the study is primary school educational programmes, branches of education, and existing academic subjects, it indicates the necessity to develop and implement the particular subject, and its aim is to develop critical thinking and the abilities to express one's own opinion, assess risks and solve problems. According to the State Standard of Primary Education the key competencies require the following skills: creativity; initiative; the abilities to justify one's position logically, to manage emotions constructively, to assess risks, to make decisions, to solve problems, to cooperate with others.*

***Results**. The article clarifies that critical thinking is a type of thinking aimed at solving problems, namely studying the argument line (hypotheses, criteria, definitions, arguments, facts, etc.), analyzing alternative solutions; forecasting and*

assessing consequences. It is proved in practice that inventive problems serve as an effective way to develop critical thinking. The basis of such problems is the theory of inventive problem solving (TIPS). It is determined that an inventive problem contains a cognitive contradiction, its solving promotes the pupils' critical thinking development. The authors' subject 'Eureka' for pupils of 2-4 classes is offered. Its aim is to develop pupils' critical thinking, creative and inventive abilities, and also primary skills to carry out natural science researches. The results of the subject approbation are given.

***Conclusions**. Primary school pupils' critical thinking development can be achieved through the introduction of a range of new subjects at the initial stages of the education. The aim of such subjects is to teach pupils to solve inventive problems.*

KEY WORDS: *creativity, critical thinking, eureka, inventive problem, primary school.*

INTRODUCTION

The convergence of NBIC-technologies (N – nano; B – bio; I – info; C – cogno) requires the formation of an integrated scientific and technological area of knowledge, which leads to the expansion of the human creativity boundaries. Therefore, it is of particular importance to train STEM-staff (Science, Technology, Engineering and Mathematics) as it can result in the formation of the national scientific and technical elite in the future.

This is emphasized in the documents of international organization's and projects, including UNESCO (Girls' and women's education in science, technology, engineering and mathematics), UNICEF (Techno Girl), the concepts of Convergence of knowledge and technology for the benefit of society (CKTS), Foresight Education project, 100Kin10 (Enriching America's classrooms with 100,000 more, excellent STEM teachers by 2021).

According to the results of the international study TIMSS (Trends in International Mathematics and Science Study) the assessment of primary school pupils' preparation level shows that 20% of the test tasks offered to the 4th form pupils were based on the rational ways to solve practical problems, find arguments and form hypotheses.

All this is connected with the pupils' critical thinking development. The results indicate that in 2007 Ukraine took the 25th place (out of 45 countries) in Mathematics and the 19th place in Natural Science, whereas in 2011 the country took the 19th place (out of 60 countries) and the 18th place respectively. Ukraine did not take part in 2015.

In view of this, it is quite reasonable that according to the State Standard of Primary Education the key competencies require the following skills: the ability to express one's own opinion orally and in writing; critical and systematic thinking; creativity; initiative; the abilities to logically justify one's position, to constructively manage emotions, to assess risks, to make decisions, to solve problems, to cooperate with others.

According to the results of the retrospective analysis of the primary education systems development in Ukraine and in highly developed countries (Singapore, China, Japan, USA, Finland, Great Britain, France, etc.), the primary school is determined to be the initial stage of the pupils' critical thinking development.

As stated in the analysis of psychological and pedagogical works (H. Kostiuk, V. Moliako, O. Muzyka, S. Witelson, etc.), the most sensitive period for the critical thinking development is the primary school age, which is facilitated by morphofunctional,

mental and personal features of the development of pupils of this age.

Morphofunctional features of primary school pupils are: the musculoskeletal system development, which requires the provision of a feasible complex load on certain muscle groups, which stimulates their development through the performance of special exercises; the brain development, which requires to carry out systematic and various activities that would have a positive effect on a brain and on the formation of its functional characteristics; the nervous processes development (processes of the nervous system excitation prevail over the inhibition processes), which implies greater mobility, frequent switch from one type of activity to another one. All these features are ought to be taken into account in the process of the critical thinking development.

Mental features of the primary school pupils' development are considered in the scope of a holistic system of their mental neoplasms: thinking (the transition from visual to verbal-logical); attention (stability); memory (the change of involuntary memorization to arbitrary and figurative to verbal-logical); imagination (the transition from reproductive forms of imagination to creative); speech (silent reading symbolizing the emergence of inner speech); sensation and perception (high visual acuity and hearing, good orientation in shapes and colours), etc.

Personal features of the primary school pupils' critical thinking development include such qualities as interest, activity, inventiveness, etc. (Dotsenko, 2018).

THEORETICAL FRAMEWORK

Today the problem of the critical thinking development is becoming relevant among teachers and psychologists. The problem is a generally accepted direction in foreign pedagogy and psychology. Various aspects of critical thinking are reflected in the works of famous psychologists and educators (B. Bloom, J. Dewey, M. Lipman and others) and are especially relevant today (K. Meredith, T. Oliinyk, O. Pometun, D. Steel, C. Temple, O. Tiahlo, D. Halpern, A. Khutorskyi and others).

Studies on the critical thinking development state that critical thinking is a type of thinking aimed at solving problems, namely studying the line of argument (hypotheses, criteria, definitions, arguments, facts, etc.), analyzing alternative solutions; forecasting and assessing consequences.

Critical thinking is a complex process of creative integration of sources, reassessment and restructuring of concepts and information. It is an active and interactive process of cognition, taking place simultaneously on many levels. In this way, critical thinking helps to analyze and form judgments, knowledge, regardless of the professional sphere of activity.

The requirements for critical thinking have resonated over the centuries in the works of great philosophers, beginning with Aristotle, Socrates. The pragmatism philosophy (J. Dewey) was the basis of critical thinking. It considered thinking as a necessary tool for active adaptation of a person to the outside world, and for the formation and application of one's concepts and judgments.

The study of the critical thinking development is connected with the Socratic critical analysis of concepts and considerations, which became the basis for the emergence of a new discipline, Logic.

It is worth noting that the Socratic method of considerations was widely used in the debates organization, in particular, in proving the opponent's ignorance, deviations in his/her judgments, etc. These ideas were further used by I. Kant in writing «Critique of Pure Reason». He proved the practical significance of critical thinking to justify one's own position, find errors in the opponent's speech, give strong arguments, etc. (Kant, 2000).

His opinion was supported by such philosophers as F. Nietzsche, M. Foucault, Z. Freud, M. Heidegger (Philosophy of education, 2009). They emphasized that critical thinking is based on «interpretive mind», which means to see new dimensions of the problem, to solve it through discussion. In modern philosophy, this idea was continued by K. Popper, who noted that critical thinking is aimed at solving problems, making assumptions and criticizing in order to eliminate errors.

D. Halpern (2000) determines not only the logical factors of critical thinking, but also creative, i.e. synthesizing factors that are formed in the process of interconnection of feelings, imagination and thinking and become crucial in the human criticism development. Therefore, modern education faces the challenge to educate a person who is independent, free, able to comprehend the phenomena of the surrounding reality by himself/herself, and to defend his/her own opinion.

Thus, critical thinking in the context of our study is defined as the ability of an individual to self-assess the surrounding reality, information, knowledge, opinions and statements of others, the ability to find effective solutions considering existing stereotypes and criteria.

The recent studies on the critical thinking development prove its significance in the modern world. Thus, the Concept of the New Ukrainian School (2016) and the State Standard of Primary Education (2018) regard critical thinking as a key competence and a common skill for all subjects (p. 12).

O. Pometun and I. Sushchenko in the methodical manual «Guide for the Critical Thinking Development of Primary School Pupils» (2017) mention the features of teaching critical thinking. They emphasize that «critical thinking involves an unbiased study of a subject or a problem.

The process begins with determining what is already known about a problem and what is to be learnt. Then, it is necessary to freely identify the facts, consider the options and move on to the fact-based thinking. Next, the information is compared, in particular one's own prejudice and prejudice of other pupils and specialists. Finally, the basis for one's own judgment is created» (p. 13).

Abdur Rahman As'ari, Ali Mahmudi, Elah Nuerlaelah (2014) specify the characteristics of critical thinkers. They are: (1) inquisitive, (2) eager to be well-informed, (3) ready to use critical thinking, (4) reasonable, (5) self-confident, (6) open-minded, (7) flexible, (8) receptive to others' opinions, (9) objective and fair-minded, (10) wise, and (11) ready to change their mind if it is necessary. Critical thinkers also: (1) maintain clarity, (2) work systematically, (3) persistently look for the necessary information, (4) stay practical, (5) and accurate, (6) never give up, (7) try to be as precise as possible.

So, the **purpose** of the research is to determine the effective tools for the critical thinking development for primary school pupils.

METHODOLOGY

A completely new approach to the development of students' algorithmic, logical and critical thinking is explained in the theory of inventive problem solving (TIPS). The founder of the theory is an inventor, a science fiction writer, Henrikh Altshuller (Altshuller, 1979).

This methodology was first tested in the 60s of the twentieth century in the technical creativity groups. The groups were taught by the engineers and the teachers who had been trained at the seminars by H. Altshuller. In those classes, students were taught to organize the creative process: to invent new never-before-seen aircraft, cars, ships, and then design their models.

Those inventions participated in regional and foreign competitions and became winners of exhibitions, received invention patents. It was then that the statement that

creativity is an innate talent was first questioned.

The basis of TIPS-pedagogy is a problem-solving method that associates this theory with developmental education. TIPS-pedagogy is aimed at teaching ways to solve inventive problems. The structural content of this theory is presented as a system of interrelated aspects: the critical thinking development, the creativity development, and the development of creative personality.

The main characteristics of critical thinking include the ability to find and determine patterns in a certain amount of information; skills of information systematization and structuring; the ability to use hidden resources to solve problems, skills to form hypotheses and test them, the ability to see, formulate and resolve contradictions.

The critical thinking development involves the purposeful formation of such a quality as consistency, since the inventive problems solving requires the ability to perceive any object or phenomenon comprehensively (system – supersystem – subsystem); the ability to establish connections (functional, causative, spatial, logical) between different systems.

In the scientific literature there is no unambiguous approach to the definition of «inventive problem». This concept is defined as:

- «a problem based on the contradiction between the known and the sought, which are found through a system of mental or practical actions» (I. Lerner, 1988, p.15);
- «a problem that contains a certain practical or theoretical contradiction that requires research activity, which leads to finding a solution» (V. Okon, 1990, p.220), etc.

We define an inventive problem as a problem that contains a cognitive contradiction, whose solution promotes the development of pupils' critical thinking, in particular, the ability to find analogies and connections between different objects and different characteristics of an object; to summarize known facts and identify particular cases; to establish cause and effect relations between objects; to carry out geometrical and physical interpretation of analytical characteristics, etc.

Considering the existing approaches to the definition of «inventive problem», we use the following classification: 1) the problems associated with studying mathematical objects; 2) the problems associated with comparing mathematical concepts and establishing relationships between them; 3) the probative problems; 4) the problems associated with studying mathematical hypotheses; 5) the generalisation problems.

In practice, the types of research problems are:

1. preparatory (reproductive problems, which can serve as a basis for solving higher level problems);
2. training (partially-reach problems). They are used to practice certain research skills in simple situations;
3. research. They are used to consolidate research skills in more complex situations.

The inventive problems structure is generally identical to the structure of thinking in professional activity: problem statement – problem solving – solution check and its justification – control and evaluation of the solution correctness.

The general approach to solving inventive problems can be represented by three different in aim and methods stages.

1. The analytical stage, the purpose of which is to analyze the development of the system (machine, mechanism) to identify contradictions and their causes.
2. The operational stage, which consists in a systematic, targeted search for possible ways to eliminate the identified contradiction.
3. The synthetic stage is aimed at making additional changes to the elements of

the system. These changes are required by the identified contradictions.

The categorical apparatus of TIPS is based on two basic concepts: the «contradiction» and the «ideal final result». The concept of the «contradiction» has different interpretations. In some cases it is a situation in which one excludes the other, something that is incompatible with it or opposite to it; in others – it is the incompatibility between two or more things; contradiction. According to the psychologists, people only tell us interesting information when we contradict them. The same goes for TIPS. Interesting ideas appear when contradictions are overcome.

When faced with an inventive problem with no clear solution, it is often unclear where to start. Usually such problems are solved «by trial and error». To solve any problem in TIPS it is necessary to define the ideal final result first. The «Ideal Final Result» (IFR) is a heuristic technique that reduces the influence of the psychological inertia and allows a person to focus on choosing the optimal solution based on the defined contradictions.

Considering the categorical apparatus of TIPS, we have developed a certain algorithm for solving an inventive problem for primary school pupils. It consists of the following stages:

1. Read carefully, understand and analyze the problem text.
2. Identify and formulate the contradiction between the real and the desired object state.
3. Formulate the ideal final result, i.e. identify the most effective one.
4. Suggest several options for achieving the ideal final result.
5. Choose the best solution.

RESULTS

The ability to solve inventive problems is developed in the course of 'Eureka' for project classes. The subject is taught to the pupils of 2-4 classes in the framework of the project «The Intellect of Ukraine». Considering the inevitable demand for specialists in the field of STEM education, the main task of this discipline is to form pupils' positive attitude to scientific creativity, to develop their logical and critical thinking, mathematical abilities, intelligence.

The conceptual aim of 'Eureka' is to form pupils' abilities to invent, as well as primary skills to carry out researches in the field of nature science. This is ensured through the implementation of competence, activity and personality-oriented approaches, the adherence to the principles of the scientific research in the natural science field, as well as the basic characteristics of the inventive problems solution theory.

The performance of the specified tasks is possible due to:

- the semantic lines aimed at the development of pupils' creative, systematic, algorithmic thinking;
- the implementation of the individual approach, cooperation and co-creation principles;
- the adherence to the activity approach principles;
- the educational process organization on the basis of developmental and heuristic education.

The first semantic line of 'Eureka' is the development of pupils' creativity and critical thinking.

When creating the tasks aimed to develop pupils' critical thinking, we consider the powerful potential of problems faced in primary school Mathematics tournaments to spark pupils' creative intellectual abilities. For this very reason 'Eureka' included a set of increased complexity Mathematics problems. It was developed on the basis of school tournament problems considering general didactic principles, as well as the basic characteristics of the mental actions gradual formation theory.

The second semantic line of Eureka is the formation of pupils' heuristic and research techniques (Gavrysh, Dotsenko, 2020).

In modern science, heuristic is understood as a complex branch of scientific knowledge, which is developed at the intersection of psychology, artificial intelligence theory, structural linguistics, information theory, pedagogy and psychology of creativity. It studies the patterns of the development of new actions in a new situation. The subject of heuristic, as a branch of scientific knowledge, is defined as special meta-methods of solving creative or heuristics problems, which are used to find new specific and semantic ways of solving problems.

By their nature, heuristics are universal ways of solving creative problems that do not depend on the content of a particular activity. They allow to intensify the process of generating ideas (hypotheses) and optimise the process of searching for solutions.

The selection of the heuristic tasks was carried out in accordance with the State Standard of Primary General Education. The assessment of the acquired knowledge and skills in the proposed educational and methodical course of 'Eureka' is carried out in the process of repetition and generalisation, regular tests, heuristic races. In accordance with the minimax principle the tasks include not only the mandatory minimum (necessary requirements) that must be learnt by all pupils, but also the maximum they can master.

The methods that allow us to solve inventive problems form the conceptual basis of 'Eureka'. We offer the algorithmic methods that form a conscious, controlled, purposeful and effective process of mental activity. Thus, we work to improve the culture of thinking.

As a result, pupils develop the way of thinking that helps them to operate the most general fundamental laws, to study scientific laws and to explain the surrounding reality phenomena (Dotsenko, Bulakhova, Dorozhko, 2013).

There are the examples of some inventive problems.

Problem 1: «Bird flocks are a big problem for modern airports around the world. But first of all it concerns the USA, in particular the Atlantic coast of this country where the air route network is extremely dense. Collisions of airplanes with birds always threaten a catastrophe. How do airport services scare away birds?»

Problem 2: «During the excavation of an ancient tomb, which was carried out 40 kilometers from Rome, the archaeologists found bas-reliefs that had been carved from quality marble. The scientists consider these sculptures to be one of the most valuable findings in recent times. The scientists were particularly amazed by the fact that on these ancient Roman bas-reliefs oranges were in the shape of cubes and vases. How did the gardeners manage to grow whimsical-shaped oranges?»

Problem 3: «In Sweden, as in other European countries, the population suffered from environmental pollution by cans for a long period of time. The trouble is that cans are covered with a layer of tin, which protects them from rust and destruction for decades. Therefore, the metal garbage thrown by tourists covered forest glades, river banks and lake shores, distorting landscapes. How did the Swedes manage to protect nature from this disaster?»

Pupils solve a problem in accordance with a certain algorithm:

1. Read carefully, understand and analyze the problem text.
2. Identify and formulate the contradiction between the real and desired object state.
3. Formulate the ideal final result, i.e. determine the best result you want to achieve. Expenditure should be reduced to a minimum.

4. Suggest several options for achieving the ideal final result.
5. Choose the best solution.

A teacher is ought to pay particular attention to the first stage of solving inventive problems. Before proceeding to the problem solving, it is necessary to analyze the problem as a whole, to get accustomed to it, to note its features, to outline roughly possible ways to solve it. As the practice shows, the majority of pupils are not able to solve inventive problems, and one of the reasons for that is a teacher's strict regulation of their activities.

Strict control restrains pupils' initiative, the constant fear of making mistakes leads to stereotyped actions. Another reason is self-doubt, which is caused by failures in previous educational activities. As a result, the majority of pupils is characterized by their cognitive inertia, which leads to their inability to abandon the usual reasoning, to notice their mistakes and correct them. A teacher's main task at this stage is to create a scenario for success (Gavrysh, Dotsenko, 2020).

The next step is to identify the contradictions. At this stage, using heuristic techniques, pupils formulate contradictions to the given problem. For example, at this stage pupils' teamwork should be implemented along with the brainstorming technique (A. Osborn), which is defined as a collective search for non-standard ways to solve problems. During a brainstorming session, a teacher writes all the information down, avoiding any displays of criticism (verbal, gestural) and supporting any idea.

Consider the process of identifying contradictions on the following problem example: «Nadiyka has a big friendly family. In the evening, everyone gathers around the kitchen table: grandma, grandpa, dad, mum, brother Serhiyko and sister Olenka. Unfortunately, the table is quite small and it is uncomfortable to have dinner together. However, during the day, when parents are at work and children are at school, this table is big enough for grandma to cook. How to make this table to be always comfortable?».

To identify contradictions, pupils use the words IF, THEN, BUT. For example, for the given problem, pupils should think in the following way: IF the table is small, THEN it takes up little space in the kitchen, BUT it is difficult for the whole family to gather around it during dinner. IF the table is big, THEN the whole family can gather around it during the dinner, BUT it takes up a lot of space in the kitchen and it is uncomfortable for grandma to cook. Having summarized their arguments, pupils fill in *Table 1* and determine the ideal final result.

Table 1.

1. IF… / THEN… / BUT…	the table is small, it takes up little space in the kitchen, it is difficult for the whole family to gather around it.
2. IF… / THEN… / BUT…	the table is big, the whole family gathers around it during the dinner, it takes up a lot of space in the kitchen and it is uncomfortable for grandma to cook.
3. THE OBJECT HAS TO / BE BOTH… / AND…	the whole family could gather around the table, the table has to take up little space
4. IDEAL / FINAL / RESULT	Folding table.

Practice shows that the effectiveness of solving the inventive problems depends on the following requirements: a) not to suppress a pupil's intuition; b) to encourage pupils to develop their intuition and to direct pupils to further logical analysis of the

proposed ideas; c) to cultivate pupils' self-confidence and belief in their abilities to solve problems.

Therefore, at the beginning, Eureka introduces a set of methods to stimulate and activate pupil's eagerness for creative and research activities. For example, pupils encounter the concept of «invention», «inventor» via video clips. Then pupils draw and describe an invention (for example, a device for pupils) that they dream of creating.

Many years' experience in implementing inventive problems in primary schools educational process shows that TIPS-technologies allow pupils to master their thinking skills, learn to solve creative problems, boost imagination. TIPS as a technology of creativity promotes pupils' and teachers' development and self-development.

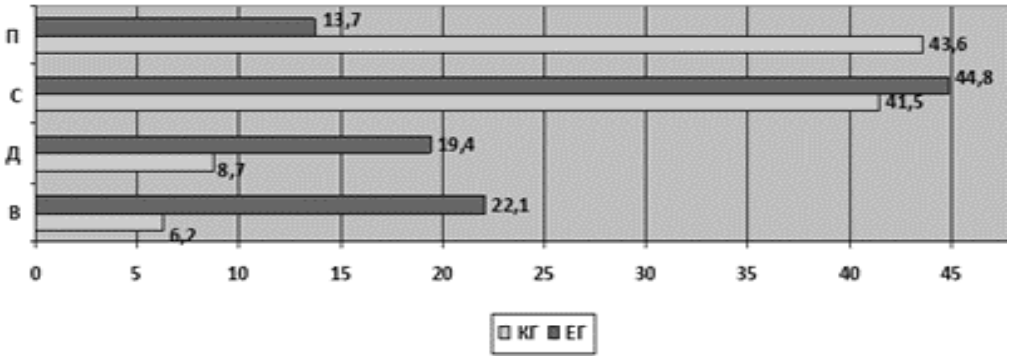
'Eureka' effectiveness was experimentally proved during 2010-2020 in 271 comprehensive schools (primary school), which represent the scientific and educational project «The Intellect of Ukraine».

682 pupils of 1-4 classes took part in the experiment. The experimental group (EG) included 340 pupils, the control group (CG) – 342 pupils.

The capacity for creativity and critical thinking was determined via the tests of J. Guilford and E. Torrance. Criteria and markers are defined:

- flexibility (the ability to see an object from a new angle, to find its new use and functional application in real life; the ability to change an object perception so that its new, hidden aspects can be seen; the ability to produce various ideas in an uncertain situation);
- originality (the ability to produce remote associations; the ingenuity of the ideas expressed; pronounced aspirations for intellectual novelty).

The obtained data is shown in histogram 1.



Histogram 1. *The development pace of creativity and critical thinking levels in control and experimental groups. (КГ – CG, ЕГ – EG)*

The obtained experimental results validity was verified by the mathematical statistics methods. Data, verified by Pearson's test and Student's t-test, confirmed the occurrence of positive changes in the creative skills development of primary school pupils while studying natural-mathematical cycle subjects. The experimental results prove the effectiveness of the developed and approbated didactic system of creative skills development. Primary school pupils acquire such skills while studying natural-mathematical cycle subjects.

According to the experiment results, Eureka is recommended for comprehensive schools and is approved by the Ministry of Education and Science of Ukraine.

CONCLUSIONS

The study proposes one of the ways to develop critical thinking of primary school pupils in the process of studying the natural-mathematical cycle subjects (Mathematics and Eureka).

1. A retrospective study of primary education systems development in Ukraine and developed countries (Singapore, China, Japan, the USA, Finland, the UK, France, etc.) proves the necessity to organize a thorough process of developing pupils' critical thinking.
2. According to historical, philosophical and psychological-pedagogical scientific literature analysis, critical thinking is a type of thinking aimed at solving problems, namely studying the line of argument (hypotheses, criteria, definitions, arguments, facts, etc.), analyzing alternative solutions; forecasting and assessing consequences.
3. In the framework of our study, critical thinking is defined as an individual ability to independently assess the surrounding reality, information, knowledge, others' opinions and statements, the ability to find effective solutions based on existing stereotypes and developed criteria.
4. It is practically proved that one of the approaches to pupils' algorithmic, logical and critical thinking development is the theory of solving inventive problems (TIPS), whose founder is H. Altshuller.
5. Inventive problem is defined as a problem that contains a cognitive contradiction, whose solution promotes the development of pupils' critical thinking, in particular, the ability to find analogies and connections between different objects and different characteristics of an object, to summarize known facts and identify particular cases, to establish cause and effect relations between objects, to carry out geometrical and physical interpretation of analytical characteristics, etc.
6. The ability to solve inventive problems is developed in the course of Eureka for project classes. The subject is taught to the pupils of 2-4 classes in the framework of the project «The Intellect of Ukraine». The conceptual aim of Eureka is to form pupils' abilities to invent, as well as primary skills to carry out research in the field of nature science. The main aim of Eureka is to form critical thinking of primary school pupils through the relevant content lines.
7. The experimental results prove the effectiveness of 'Eureka' that is demonstrated on the histogram and confirmed by data verification via Pearson's test and Student's t-test.
8. The subject 'Eureka' is recommended for comprehensive schools.

CONFLICT OF INTERESTS

The authors declare no conflict of interests.

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АНОТАЦІЯ / ABSTRACT [in Ukrainian]:

РОЗВИТОК КРИТИЧНОГО МИСЛЕННЯ УЧНІВ ПОЧАТКОВИХ КЛАСІВ ЗАСОБАМИ ВИНАХІДНИЦЬКИХ ЗАДАЧ

Мета дослідження *– визначення ефективних засобів розвитку критичного мислення учнів початкових класів.*

Методологія*. Було використано ретроспективний аналіз розвитку систем початкової освіти в Україні та у високорозвинених країнах; з'ясовано, що саме з початкової ланки потрібно організовувати процес розвитку критичного мислення учнів. Матеріалом дослідження стали типові освітні програми початкової освіти, освітніх галузей, та чинних навчальних предметів, що вказує на необхідність розробки та впровадження спеціального навчального предмета, метою якого є розвиток критичного мислення, вміння висловлювати власну думку, оцінювати ризики та розв'язувати проблеми. У Державному стандарті початкової освіти спільними для всіх ключових компетентностей визначено такі вміння, як ініціативність, здатність логічно обґрунтовувати позицію, вміння конструктивно керувати емоціями, оцінювати ризики, приймати рішення, розв'язувати проблеми, співпрацювати з іншими особами.*

Результат*. З'ясовано, що критичне мислення – це тип мислення, який спрямований на розв'язання проблем, зокрема: дослідження лінії аргументації (гіпотези, критеріїв, дефініцій, аргументів, фактів тощо), аналіз альтернативних рішень; прогнозування й оцінювання наслідків. Практично доведено, що ефективним способом розвитку критичного мислення є винахідницькі задачі, підґрунтям яких є теорія розв'язання винахідницьких задач (ТРВЗ). Визначено, що винахідницька задача містить пізнавальне протиріччя, процес вирішення якого сприяє розвитку в учнів критичного мислення. Запропоновано авторський навчальний предмет «Еврика» для учнів 2-4 класів, метою якого є формування в учнів критичності мислення, творчих здібностей та здібностей до*

винахідництва, а також первинних умінь здійснювати наукове дослідження в природничій галузі. Наведено результати апробації навчального предмета.

***Висновки**. Для розвитку критичного мислення учнів початкових класів потрібно з початкової школи впроваджувати нові навчальні предмети, метою яких є навчання учнів розв'язувати винахідницькі задачі.*

КЛЮЧОВІ СЛОВА: *винахідницька задача, еврика, креативність, критичне мислення, початкова школа.*

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