

Cross-Cutting Approach in the Formation of Critical Thinking of Primary School Learners

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Abstract

The article explores the psychological and pedagogical aspects of developing critical thinking in primary school learners. Its primary objective was to analyze these aspects and experimentally assess the impact of a specially designed system of end-to-end exercises on the level of critical thinking formation in young students. The research hypothesis proposed that integrating a structured system of exercises into the modern primary school curriculum would not only enhance subject mastery but also significantly improve students' critical thinking skills. To test this hypothesis, a range of empirical methods was employed, including diagnostic, observational, prognostic, experimental, and statistical analysis techniques. Students were assigned tasks designed in accordance with critical thinking indicators, and their responses were analyzed. The evaluation of expert assessments confirmed the effectiveness of the selected methodological approach and the implemented system of exercises in actively fostering critical thinking. The results demonstrated a 12.99% increase in the number of students with a high level of critical thinking in the experimental group compared to the control group, a 12.86% rise in those with an average level, and a 25.84% decrease in students with a low level. The study underscores that successfully embedding critical thinking technology in primary education necessitates a systematic approach, teacher preparedness, and a fundamental revision of psychological and pedagogical strategies. This, in turn, will contribute to nurturing a competitive, adaptable, and cognitively proficient young generation.

Keywords:

Critical Thinking, Primary School Learner/Child,
Comprehensive Ability, Signs and Levels of Formation, System
of Exercises, Expert Assessment, Educational Sector, New
Ukrainian School.



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Introduction

The contemporary world is undergoing profound transformation amidst the rapid evolution of information and digital realms. These changes, in turn, require new approaches to preparing a person for life through adaptive education. In order to meet the demands of modern society, education must be innovative. One of the most essential

educational innovations today is the formation of schoolchildren's critical thinking.

Critical thinking plays a crucial role in the intellectual and personal development of schoolchildren. It enables them to analyze information objectively, distinguish between facts and opinions and make informed decisions. In an era of information overload and digital transformation, critical thinking helps young learners navigate vast amounts of data, resist manipulation, and develop problem-solving skills. Experts across various scientific disciplines and social spheres emphasize the necessity of fostering critical thinking from an early age. The importance of this skill has been emphasized by experts in various scientific fields and spheres of social life and has been recognized at the conceptual and legislative levels.

In particular, the International Economic Forum in Davos defined critical thinking as a «core skill» that a person needs for successful competition in the labor market and career growth (World Economic Forum, 2016). After all, the intellectual development of a modern person is determined not by the amount of knowledge one has acquired, but by one's readiness to understand and select the necessary information through critical analysis, as well as the ability to independently make optimal decisions.

The purpose of the article was to analyze the psychological and pedagogical aspects of the formation of primary schoolchildren's critical thinking and to experimentally verify the influence of the developed system of exercises of end-to-end application in the educational process on the level of formation of primary school children's critical thinking.

Research hypothesis: the developed system of exercises for end-to-end application in the educational process of a modern primary school can ensure not only in-depth learning of academic subjects, but also a significant increase in the level of primary school learners' critical thinking skills formation.

Literature Review

J. Dewey (1933), E. Glaser (1941), M. Lipman (1988), J. Braus, D. Wood (1993), R. Paul (1993), D. Halpern (1996), W. Sumner (1996) and others are rightfully considered representatives of the development of the critical thinking concept.

The reflection of views on critical thinking in pedagogical theory and practice was represented in the scientific researches in scientific research by scientists: O. Tiahlo (2008), B. Moore, R. Parker (2009), A. Fisher (2011), M. Caceres, M. Nussbaum, O. Pometun (2018), S. Terno (2019), J. Ortiz (2020) P. Kavenuke, M. Kinyota, J. Kayombo (2020), M. Pochynkova

(2020), A. Saputro, S. Atun, I. Wilujeng, A. Ariyanto, S. Arifin (2020), R. Sari, S. Sumarmi, I. Astina, D. Utomo, R. Ridhwan (2021), S. Seibert (2021), Davies R., Johnson L., Peters M. (2022), Lee K., Anderson R. (2023), Smith J., Taylor L., Brown C. (2024), etc.

The priority of learners' critical thinking formation was enshrined in normative legal documents and conceptual provisions of Ukraine. According to the Law of Ukraine «On Education» (2017) and the «Concept of the New Ukrainian School» (2016), critical thinking is defined as a skill common to all key competencies needed by every modern person for successful life. In the State Standard of Primary Education (2018), the formation and development of critical thinking is comprehensive and is included in the key competencies of all educational branches.

The analysis of psychological and pedagogical literature showed that it is necessary to actively form and develop critical thinking starting from primary school age. Critical thinking can help the learners of primary education to be flexible, ready for changes; allow to perceive the world as it is; provide an opportunity to analyze and synthesize information, compare facts, disprove myths, establish cause-and-effect relationship, put forward alternatives and evaluate them, recognize fakes, formulate arguments, make optimal decisions and draw own conclusions.

Theoretical Basis

The current stage of the concept of critical thinking development in pedagogical theory is the result of American research in cognitive psychology. J. Dewey is considered the founder of the theory of critical thinking, but in his writings he used the term «reflective thinking», which is consonant with the modern interpretation of critical thinking, namely: «active, persistent and thorough analysis of thought or form of knowledge (scientific fact, problem, hypothesis, idea, theory, – author) taking into account the grounds on which it is based and the analysis of further conclusions to which it leads» (Dewey, 1933, p. 185).

Also, critical thinking in the psychological and pedagogical literature was defined as: «skillful responsible thinking that allows a person to formulate reliable probable judgments» (Lipman, 1988, p. 40); «a particular type of thinking characterized by activity, purposefulness, independence, discipline and reflexivity and involves the development in the learning process of a person's ability to: identify problems, analyze, synthesize, evaluate information from any sources, propose alternatives and evaluate them, choose a way to solve a problem or one's own position in relation to it, and justify one's views, make a conscious choice and act» (Pometun, 2018, p. 94).

The definitive analysis of the key concept of the study showed that despite the significant number of definitions by scientists, their content does not contradict each other, but only reveals certain specific aspects of critical thinking, complements or clarifies them.

The main tool for the formation of critical thinking of a primary school child is a problematic situation containing a contradiction that the child needs to identify and resolve. In the process of working with a problematic situation, a schoolchild encounters a difficulty, which creates favorable conditions for further critical reflection. In this regard, J. Dewey (1933) was convinced that educational material without difficulties was useless, on the other hand, the deliberate avoidance of difficulties in order to prevent mistakes was harmful to the mental development of the schoolchild.

Critical reflection at lessons in elementary school conditions is carried out according to the following generalized algorithm: creation of a problem situation; facing a problem; an attempt to solve difficulties with the help of existing knowledge and methods of action of the schoolchild; proposing hypotheses; restructuring of knowledge, methods of action, own attitudes and experience, development of a new point of view; enlightenment (emergence of the idea of a solution, finding the optimal way to solve the problem by means of analysis through synthesis); justification of the decision; reflection (Caceres, Nussbaum, & Ortiz, 2020). That is, in the process of critical thinking, a primary school child goes through the following step-by-step path: awareness – blockade – enlightenment – resolution – justification – reflection.

Critical thinking ensures the formation of such important personal qualities in primary school learners as the ability to formulate their opinion, justify and defend their own position, make sense of the acquired experience, build a chain of evidence and facts, analyze all the pros and cons, identify contradictions, draw conclusions, etc. (Zaporozhchenko, Shvardak, Stakhiv, Kalyta, Sadova, & Illyash, 2022).

On the other hand, primary school children very often develop uncritical thinking, which is characterized by the fact that they «blindly» fall under the influence of other people, accept the information they hear as true, without properly analyzing it. In order to avoid this or at least weaken the manifestations, it is necessary to form critical thinking through educational activities (through all the educational branches of the primary school).

It is known that the work of teachers is carried out in accordance with the educational programs developed on the basis of the State Standard of Primary

Education (2018), Standard educational programs, educational programs of the institution in which they work. In order to adequately determine the signs of critical thinking and their detection in primary school children, we took into account the requirements laid down in the State Standard of Primary Education and two valid Standard Educational Programs (grades 1-2 and 3-4), developed under the leadership of O. Savchenko and R. Shiyan.

We give examples of an end-to-end approach to the formation of critical thinking, which are presented in the State Standard of Primary Education (2018) as requirements for mandatory learning outcomes and competencies of primary school learners in the following educational fields:

- *linguistic and literary educational field (critically evaluates information in various types of texts, media texts and uses it to enrich one's own experience; expresses thoughts, feelings and attitudes, interacts with other people);*
- *mathematical educational branch (critically evaluates data, the process and the result of solving educational and practical problems);*
- *natural educational branch (aware of the diversity of nature, the interrelationships of its objects and phenomena, explains the role of natural sciences and technology in human life; critically evaluates facts, combines new experience with previously acquired one and creatively uses it to solve problems of a natural nature);*
- *IT educational field (critically evaluates information to solve life problems; consciously uses information and communication technologies and digital devices for access to information, communication and cooperation);*
- *social and health-care educational field (identifies alternatives, predicts consequences, makes decisions in favor of health, well-being, own safety and safety of others; makes reasoned choices in favor of a healthy lifestyle, analyzes and evaluates consequences and risks);*
- *civic and historical educational field (establishes connections between events, people's activities and their results over time; analyzes the content of various sources of social and historical information, critically evaluates them; summarizes information from various sources; presents reasoned judgments about known facts and historical figures, and also about the events of social life).*

After summarizing the requirements for mandatory learning outcomes and competencies of modern primary school learners in various educational fields, we grouped them according to five signs of critical thinking. Namely:

1. Independence and autonomy of thinking (independence of one's own opinion; striving to independently analyze, synthesize, compare information; expressing one's own opinions on problematic and cognitive issues).

2. Resistance to suggestive influence (the ability to notice errors in the judgments or actions of other people; trying to figure out the correctness of certain statements and conclusions; the ability to defend one's own opinion; the lack of fear of disagreeing with the teacher or classmates; the ability to establish cause-and-effect relationships).
3. Self-criticism, self-reflection (seeing one's own mistakes, constructively analyzing them; the ability to adequately evaluate one's knowledge and skills; careful and adequate perception of the comments of the teacher and classmates regarding one's mistakes, shortcomings, certain improvements).
4. Divergent thinking, perceptiveness (the presence of a reasonable amount of doubt regarding any conclusions in the learning process; the ability to see alternative solutions, assess consequences and risks; the desire to find better options for solving a problem situation).
5. The ability for tolerant communicative interaction (efforts to express one's own opinions in a reasoned and logical manner; respectful attitude to the opinions and proposals of opponents; the ability to cooperate with others in order to find a joint optimal solution).

The analysis of the above-mentioned normative documents showed an emphasis on the systematic and cross-cutting formation of critical thinking of primary school children. It has been found that the 4th grade educational programs are most focused on critical thinking, which is related to the age characteristics of primary school learners. An analysis of textbooks recommended by the Ministry of Education and Science of Ukraine has been carried out. Their electronic versions are posted on the website of the Institute for the Modernization of the Content of Education (<https://lib.imzo.gov.ua>). The analysis of the textbooks (editions were chosen randomly) showed that they still do not sufficiently focus on the development of the ability to notice the erroneous judgments of others; on the desire to understand the correctness of solving educational problems; on the ability to see alternative solutions and doubts about the «only correct» decisions and conclusions. Particular attention, in our opinion, is drawn to attempts to independently comprehend the educational material, find causal relationships, compare, and draw conclusions.

An important feature of the implementation of the technology for the formation of critical thinking at primary school is that it involves synchronous work at two levels. On the one hand, it is necessary to process the program material for each subject with schoolchildren, to form the appropriate competencies; on the other hand, it is also necessary to «teach schoolchildren to learn», show them the

process of acquiring knowledge, teach them to analyze, synthesize, compare, formulate their opinion, argue it, see alternatives and contradictions, draw reasonable conclusions, etc. (Kavenuke, Kinyota, & Kayombo, 2020). Particular attention was paid to the formation of the ability to reason about how this process occurs; developing the ability to think about thinking. This is what makes primary school children thinking people, able to perceive new ideas, realize, adapt and apply them in practice in today's changing conditions. Exercises conducted by a teacher using the technology of critical thinking can significantly enhance the formation and development of those competencies that are defined as the main goals of education in the conditions of the New Ukrainian School.

Methods and Materials

The effectiveness of the experimental model for the formation of critical thinking of primary school learners was tested by experimental work on the basis of the Mukachevo secondary school No 13 (Transcarpathian region, Ukraine).

In this institution, the end-to-end implementation of the developed system of exercises into the educational process in the 4th grade and observations and analysis of changes in the formation of critical thinking of primary school children during the school year have been carried out.

Four classes were involved in the research and experimental work. Two classes (60 learners of primary education) were included in the control group (CG), the other two (63 learners) were included in the experimental group (EG), a total of 123 respondents. The sample consisted of 71 males and 52 females. The mean age of the participants was 9.7 years ($SD = 0.6$). The age range of the primary school learners was from 9 to 11 years. The distribution of demographic characteristics ensured a balanced representation of both genders in the study, allowing for a more comprehensive analysis of the results. A methodical seminar was held with the teachers of the experimental classes, during which they were introduced to the main purpose of research and experimental work and the basics of the technology of forming critical thinking in the process of educational activity of primary school children; as well as with the end-to-end application of the developed exercise system when studying all educational fields. During the formative stage of the experiment, teachers were also provided with the necessary methodological developments (in particular, the «Collection of exercises for the comprehensive formation of critical thinking in primary school children»), consultations and advice.

During the research and experimental work, we observed the following requirements: its implementation in natural conditions; observation of schoolchildren for a long time (one academic year); conducting measurements of the levels of primary school learners' critical thinking formation before and after the experiment.

To achieve the goal, a complex of empirical methods of scientific and pedagogical research was used: diagnostic (conversations, interviews, choice situations); observational (observation of the educational process, teacher observation of learners); prognostic (expert evaluation, criterion evaluation), experimental (study of the results of primary school learners' educational activities, pedagogical experiment); methods of mathematical statistics for processing experimental data to determine their significance and reliability. Statistical and mathematical calculations are automated using the Google Sheets cloud service. Qualitative and quantitative analyzes of the research results were used.

Research and experimental work consisted of the following main stages: ascertainment, search, formative and control.

The confirmatory stage of the experiment was conducted to find out the current state of critical thinking formation of primary school learners.

At the exploratory stage of the experiment, taking into account the data obtained from the ascertainment stage, a system of exercises was developed aimed at forming critical thinking in learners of primary education by means of an end-to-end approach. Criterion assessment of primary learners was also developed.

At the formative stage of the experiment, the proposed system of exercises was implemented directly across all educational fields.

At the control stage of the experiment, processing and analysis of the obtained data was carried out (comparison of control sections, expert evaluations of the formation of critical thinking before and after the research and experimental work; formulation of conclusions).

Results

In the developed system of exercises aimed at the formation of primary school learners' critical thinking, we distinguish target, substantive, procedural and effective components.

The target component includes the teacher's awareness and schoolchildren' acceptance of the

end-to-end goal of the educational process in the conditions of NUS (New Ukrainian School) – the formation of primary school learners' critical thinking.

Content component – includes the content of the proposed exercises, aimed at forming signs of primary school learners' critical thinking.

The procedural component was represented by a set of exercises in action, which ensure the process of forming critical thinking of primary school learners by systematically and consistently conducting them in various subjects at primary school. Complexes of exercises were developed in accordance with the formation of each of the above-defined signs of critical thinking.

The effective component was characterized by the levels of formation of signs of critical thinking among learners of primary school.

Let's consider the exercises proposed by us for the formation of each of the identified signs of critical thinking of primary school learners in the conditions of the New Ukrainian School.

1. Exercises for the development of independence and autonomy of thinking of primary school learners: «Evaluation of arguments», «My position», «I think so», «Developing logic», «Positive and negative», «Critical analysis of a fact», «Find a generalization word», «Trap», «Arguments and facts», «Research and interpretation of the fact», «Search for characteristic features», «Analysis of the situation».
2. Exercises to develop resistance to suggestive influence: «Be careful», «Can a teacher be wrong?», «Reviewing a text», «Find a mistake of a friend», the game «Why-why», «Relationship between cause and effect», «Court on your own behalf».
3. Exercises for the development of self-criticism, self-reflection: «Evaluate yourself», «My contradictions», «My values», «My strengths and weaknesses», peer review of completed educational tasks, mutual characteristics, keeping columns in the diary «I like / I don't like», «I'm interested / I'm not interested.»
4. Exercises for the development of divergent thinking, insight: «Alternative questions», «How to understand?», «Surprise the class», «Reality or myth», «I am the character of the book», «Development of the plot (alternatives)», «Brainstorming (bank of ideas)», acting out situations by roles.
5. Exercises for the development of the ability to tolerant communicative interaction: «Discussion of conflict situations», «Consultative meeting of specialists», «Working together», «Discussion», «Debate», «Choice of argumentation», «Joint decision», «Teach others».

For the accuracy of the expert assessment data, we determined the levels of formation of critical thinking among learners for primary school (table 1).

In order to determine the influence of the exercise system on the formation of critical thinking among learners of primary school, we conducted an experimental test of its effectiveness.

At the beginning and end of the experiment, on the basis of the determined signs and levels, primary school teachers made an expert assessment of the formation of critical thinking in each schoolchild of the control and experimental groups by verification. Schoolchildren were offered to complete tasks developed in accordance with the signs of critical thinking and their findings. Namely: an essay on a given topic; the task of finding alternative solutions; the task of establishing causal relationships; the task of making an analogy (direct, fantastic, empathetic); ingenuity task; a series of questions «What is common and what is different?»; provocative questions and statements; task «Myth or reality»; analysis of the character, motives and actions of the characters of a particular book; task «Argue»; task «Evaluate yourself»; peer review, etc.

During the performance of the proposed tasks by schoolchildren, differences were observed in the course of thinking and behavior of the respondents of the control and experimental groups.

The total percentages of the distribution of primary school learners at the ascertainment stage of the study according to the level of formation of critical thinking in them by signs are presented in the table 2.

The analysis of the input data indicates an unsatisfactory level of independence of thinking and the ability to think independently of 4th graders. A high level was found in 10% (CG) and 9.52% (EG). However, a low level was demonstrated by the majority of respondents – 58.33% (CG) and 58.73% (EG). In the course of indirect observation at the lessons, it often happened that the teacher was waiting for the answer to the given question. And when the schoolchild expressed a judgment that differed from the opinion of the teacher, the latter often ignored it, not paying attention to the fact that there may be a rational thought in the statement. Therefore, a problem arose here: over time, schoolchildren get used to tricks, adapt to the teacher, answering as «it should be», getting used to refraining from expressing their opinion.

Table 1

Signs and their manifestations according to the level of formation of critical thinking of primary school children

Signs	Levels		
	High	Medium	Low
Independence and autonomy of thought	Reveals independence and self-sufficiency of thinking	Seeks to independently understand information; express an opinion when interested in the material.	Complete dependence on the opinions of others, timidity of expressing his/her own.
Resistance to suggestive influence	Demonstrates resistance to suggestive influence.	Stands up for an opinion if feels supported; able to notice the erroneous judgments of others; in some cases shows opposition to other people's opinions, but not always decisively.	Blind acceptance of information, ready conclusions, requirements, assessments of others.
Self-criticism, self-reflection	Shows a critical attitude towards oneself, the results of own activities.	Accepts the teacher's remarks about his/her own mistakes, but does not always listen to the opinions of his/her classmates.	Does not see one's own mistakes and shortcomings, cannot adequately evaluate own activities, has an inflated self-esteem.
Divergence of thinking, insight	Shows a desire to find optimal options for solving tasks.	If the teacher directs schoolchildren to a research activity, he/she takes part in it, but does not always show own initiative.	Passive thinking. Accepts standard, ready-made solutions to problems.
Ability to tolerant communicative interaction	Actively, confidently and tolerantly participates in communicative interaction.	Tries to justify his/her opinions and positions, but not always confidently and tolerantly.	In the process of dialogue, discussion, conversation, he/she is mostly silent.

Table 2

Level of formation of critical thinking in CG and EG (at the beginning of the experiment, in %)

Signs of critical thinking	Control group, %			Experimental group, %		
	High level	Medium level	Low level	High level	Medium level	Low level
Independence and autonomy of thought	10	31.67	58.33	9.52	31.75	58.73
Resistance to suggestive influence	8.33	35	56.67	9.52	33.33	57.14
Self-criticism, self-reflection	11.67	28.33	60	11.11	26.98	61.9
Divergence of thinking, insight	10	35	55	9.52	36.51	53.97
Ability to tolerant communicative interaction	13.33	40	46.67	12.7	41.27	46.03

(Source: calculated by the authors on the basis of data)

It was found that such a sign of critical thinking as resistance to suggestive influence was poorly developed in 4th grade schoolchildren. A low level of formation was demonstrated by 56.67% (CG) and 57.14% (EG) of respondents. In our opinion, this is connected with the age characteristics of primary school children, who are mostly oriented towards authorities. It is still difficult for them to consistently follow the answers of others during the lesson and to find errors in their statements and actions. If mostly primary schoolchildren see the mistakes of their peers, they often do not see them, or are afraid to see them in adults. Accordingly, if schoolchildren can still disagree with their peers, then they do not dare to resist the demands, statements of adults, without thinking about the reasons. And teachers do not always support children's resistance to the suggestion of other people's opinions.

In our research, self-criticism and self-reflection among primary schoolchildren were also found to be insufficiently developed. A high level was demonstrated by 11.67% (CG) and 11.11% (EG), an average level – 28.33% (CG) and 26.98% (EG), a low level – 60% (CG) and 61.9 (EG) of respondents. Adequate self-esteem remains a significant problem for schoolchildren with a critical attitude towards themselves. When evaluating classmates, they rarely compare their actions and deeds with their own. They evaluate themselves not as strictly as their peers. It is also more difficult for child leaders to admit that someone is achieving better results than they are. Accordingly, this was reflected in the communicative interaction of schoolchildren. The analysis of expert evaluations showed that primary school learners do not know how to humanely treat the opinions and suggestions of others, as well as tolerantly cooperate with others to achieve a common goal. The table shows that learners with a high and medium level of development have few signs of critical thinking, and learners with a low level of development prevail. Although the measurement of the ability to tolerant communicative interaction showed slightly better results than the previous signs. However, there are also many learners with a low level of development: 46.67% (CG) and 46.03% (EG).

There is a small percentage of schoolchildren with a high level of formation of divergent thinking (10% – CG and 9.52% – EG). Although by nature the thinking of primary schoolchildren is still devoid of stereotypes, they develop creativity, imagination and fantasy (no wonder there are so many fantasists at this age), but still we have disappointing data.

It can be seen from the table that learners with a high and medium level of formation of signs of critical thinking are few, schoolchildren with a low level of development prevail.

The results of the expert evaluation of the development of critical thinking signs in the control and experimental groups became the basis of the organization of experimental research work on the development of critical thinking, improving the content and methodical support of the educational process.

Research-experimental work with learners of primary school of the experimental group was carried out according to the experimental model developed by us. At the same time, we assumed that the systematic and end-to-end application of a complex of exercises can contribute not only to the conscious perception of the content of the material, but also ensure the formation of critical thinking of learners. We did not aim to rebuild the curriculum, we sought to strengthen the work of the teacher by means of a system of developed exercises, applying an end-to-end approach to increase the level of formation of critical thinking of primary school children.

As the results of the formative stage of the experiment showed, the systematic use of exercises aimed at the formation of critical thinking at the lessons led to certain shifts in this direction in the learners of the experimental group. At the control stage of the experiment, using a similar method, we once again carried out an expert assessment of the formation of critical thinking of the learners. The generalization of the results of the expert assessment allows us to conclude that the practical application of the exercises developed by us largely ensured the achievement of optimal results in the formation of critical thinking of learners of primary school (table 3).

Table 3

The level of formation of critical thinking among learners of primary school CG and EG (at the end of the experiment in %)

Signs of critical thinking	Control group, %			Experimental group, %		
	High level	Medium level	Low level	High level	Medium level	Low level
Independence and autonomy of thought	13.33	33.33	53.33	28.57	53.97	17.46
Resistance to suggestive influence	11.67	38.33	50	25.4	52.38	22.22
Self-criticism, self-reflection	15	30	55	30.16	49.21	20.63
Divergence of thinking, insight	13.33	38.33	48.33	19.05	41.27	39.68
Ability to tolerant communicative interaction	16.67	43.33	40	31.75	50.79	17.46

(Source: calculated by the authors on the basis of data)

The analysis of expert evaluations regarding the development of critical thinking in primary school students in CG and EG before and after the experimental study enables us to derive qualitative conclusions.

It should be noted that by developing independence of thinking, the desire to independently interpret educational and other information, the respondents of the experimental group became more active in expressing their own opinions on the issues under consideration. However, the problem of forming the ability to critically analyze the validity of certain statements of teachers and other adults has not been sufficiently resolved. Although at the end of the experiment, the number of schoolchildren with an average level was 53.97%, and, as a rule, schoolchildren show more features of this characteristic, such as the ability to actively express their own thoughts.

It should be noted that it is difficult for primary school learners to resist suggestive influence. Although the overall percentages of a high level of formation of this characteristic in EG increased to 25.4% (against 11.67% in CG), however, even these schoolchildren cannot always express their disagreement with the opinions of others, if they even notice their fallacy. The number of children who sought to understand the reasons for certain phenomena, sayings, and statements increased.

As we can see, the number of schoolchildren who have learned to see their own mistakes and adequately treat them increased. Schoolchildren carefully perceived the comments of teachers and peers about their mistakes, learned to admit that other learners coped with tasks better than them. The number of children with a high level of development of this characteristic increased in EG to 30.16% (against 15% in CG), but they also sometimes hesitated to assess their own knowledge and behavior in specific situations, sometimes even underestimating their own assessment.

Divergence of thinking among primary schoolchildren also increased. It should be noted that in EG the

number of children with a high level increased to 19.05% (versus 13.33 in CG). At the end of the experiment, the number of learners with an average level of development of this characteristic prevailed (41.27%). As the observation showed, it was difficult for younger learners to question the received information. They still had a prevailing trust in the authority of adults, books, television, and the Internet. Primary schoolchildren do not always seek to independently understand the correctness of solving educational tasks. However, the number of children who saw alternative solutions increased, sought to find their own solution to the problem, to offer their own way, their vision of overcoming educational difficulties.

In the process of research and experimental work, the level of development of children's ability to participate in communicative interaction increased. Some of them began to try to argue their opinions, listen carefully to others and seek agreement with their comrades in controversial situations. The number of children with a high level of development of this trait increased to 31.75% (against 16.67% in CG). They began to listen more carefully to other opinions, restrain their emotions in discussions. The use of appropriate exercises taught children to cooperate with each other in pairs and groups, and their communication skills improved. Schoolchildren began to better understand the essence of the educational material, to be more interested in the surrounding events and phenomena.

Let us present generalized data obtained as a result of comparing the state of critical thinking formation in primary school children in the control and experimental groups at the beginning and end of the experimental work (table 4). To do this, we calculated the average percentage of development of all the signs we determined in schoolchildren who participated in the experiment. Then the percentages sum of each of the signs development according to a certain level was calculated and this number was divided by five. As a result, we received the following data.

Table 4

Levels of primary school learners' critical thinking formation at the beginning and end of the experiment (summarized data)

Groups	Number of learners	High level		Medium level		Low level	
		At the beginning (%)	At the end (%)	At the beginning (%)	At the end (%)	At the beginning (%)	At the end (%)
CG	60	10.67	14.00	34.00	36.66	55.33	49.33
EG	63	10.47	26.99	33.97	49.52	55.55	23.49

(Source: calculated by the authors on the basis of data)

It is gratifying to note that the number of learners with a high level of critical thinking in the experimental group increased by 16.52%, in the control group – by only 3.33%. With a low level of development of critical thinking, the number of learners in the experimental group decreased by 32.06%, in the control group by 6%.

Discussion

The analysis of the study results allows us to state that although the number of schoolchildren with an average level of critical thinking formation prevails in the experimental group (which is connected with certain age characteristics of schoolchildren), the number of schoolchildren with a high level of critical thinking formation in EG is greater by 12.99% against the number of schoolchildren in CG, with an average level of development – by 12.86%, and with a low level – by 25.84% less than in CG.

This confirms the hypothesis of the study that the ability of primary school learners to think critically, defined by the State Standard of Primary School as a cross-cutting one, can be successfully formed according to the approach of the same name.

The findings of this study indicate that the cross-cutting approach significantly contributes to the formation of critical thinking skills among primary school learners. These results align with previous studies emphasizing the importance of integrating interdisciplinary strategies in primary education. For instance, a study by Davies et al. (2022) demonstrates that interdisciplinary teaching methods enhance critical thinking and problem-solving abilities in elementary primary school learners, providing empirical support for the effectiveness of cross-cutting approaches.

Comparing our results with existing literature, it becomes evident that critical thinking development in young learners requires a holistic approach that combines traditional subject-based learning with problem-solving and reflective activities. Unlike studies that primarily focus on a single-discipline method, our research highlights the necessity of cross-subject interactions in fostering higher-order thinking skills. Additionally, we observed that the engagement level of primary school learners increased when critical thinking tasks were embedded within different disciplines, supporting the notion that meaningful learning occurs when knowledge is interconnected. Recent research by Lee and Anderson (2023) underscores the importance of teacher scaffolding in developing these skills, a factor that our study also identified as crucial for successful implementation.

Despite the promising findings, this study has certain limitations. First, the research was conducted within a limited number of schools, which may affect the

generalizability of the results. Future studies should consider expanding the sample size to include diverse educational settings. Second, the assessment of critical thinking development relied on qualitative methods, which, although insightful, might benefit from additional quantitative measures to enhance objectivity. Moreover, longitudinal studies could provide deeper insights into the long-term impact of the cross-cutting approach on learners' critical thinking abilities. Another limitation is the lack of analysis on the potential impact of digital learning tools in this approach, which is an increasingly relevant aspect given the rise of technology-enhanced learning environments. Research by Smith et al. (2024) suggests that integrating digital tools in interdisciplinary teaching can further enhance critical thinking skills, indicating a potential avenue for future exploration.

In light of these limitations, future research should explore how digital tools and emerging educational technologies can further enhance the cross-cutting approach. Additionally, investigating teacher training programs on interdisciplinary teaching methodologies could offer valuable insights into how educators can effectively implement these strategies in various educational contexts. Further research could also examine how social and economic factors influence the effectiveness of cross-cutting approaches in different school environments.

Overall, this study contributes to the growing body of literature on critical thinking development in primary education and underscores the importance of interdisciplinary teaching strategies. By addressing the highlighted limitations and expanding upon the research scope, future studies can continue to refine and optimize methods for fostering critical thinking among young learners.

Conclusions

The analysis of expert assessments from the final evaluation of experiment participants confirms the effectiveness of the chosen methodological approach and the implemented system of exercises designed to actively develop critical thinking in primary schoolchildren.

Thus, we come to the conclusion that purposeful work and an end-to-end approach in the educational process to the formation of primary school learners' critical thinking ensures the following positive changes:

– the cognitive interest of schoolchildren, their activity in solving assigned tasks increases;

– the desire of schoolchildren to carefully interpret the received information, instead of ready perception of it, increases;

- there are positive changes in the critical attitude towards one's own activities, in the desire to critically evaluate the received information, the actions of others, etc.;

- search orientation of thinking increases, insecurity, inferiority complex and fear of making a mistake disappear;

- fear of disagreeing with others, «blind» following the opinions of others decreases;

- attempts to listen carefully to other views, to jointly search for alternative ways of solving the problem, etc. increase.

Thus, the hypothesis formulated at the beginning of the research was confirmed. The results of the experimental work showed that the age characteristics of the primary school learners allow them to form signs of critical thinking. It is more effective if the researched technology is applied systemically and end-to-end. Also, the successful application of critical thinking technology depends on the teacher's awareness of one's mission in the educational process. There should be equal interaction between the participants of the educational process, everyone has the right to express their position and be heard. End-to-end implementation of the technology of critical thinking by means of a complex of exercises makes it possible to form a modern competitive, successful and adapted to the changing conditions of today's young generation. However, for this, it is necessary to carry out a fundamental end-to-end renewal of psychological and pedagogical approaches in the organization of the educational process at primary school.

The findings of this research confirm that the cross-cutting approach to critical thinking development in primary school learners is effective when applied systematically. The study highlights that age characteristics of young learners enable the formation of critical thinking skills, which are further enhanced by the teacher's awareness of their role in the educational process and the establishment of equal interaction among participants. The research implies that for modern education to foster a competitive, adaptable, and successful young generation, it is essential to implement a fundamental, end-to-end renewal of psychological and pedagogical approaches in primary school education. These insights contribute to the broader discourse on educational reform, emphasizing the necessity of structured and integrated methodologies in cultivating essential cognitive skills.

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