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ВЛИЯНИЕ ТЕХНОЛОГИЙ НА РАЗВИТИЕ ОБРАЗОВАНИЯ

EVOLUTION OF TEACHING AND LEARNING THROUGH TECHNOLOGY

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Formation of schoolchildren' divergent thinking in the conditions of additional education when working with timelines

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Abstract. *Problem statement*. One of the most important tasks that digital school teachers face is preparing a graduate, who is ready to use the acquired knowledge in his future life and find non-standard, original solutions, overcoming the usual patterns and established opinions. The study aimed at substantiating the effectiveness of the use of timeline services for the development of divergent thinking in schoolchildren in the conditions of additional education. *Methodology*. Theoretical and methodological analysis and generalization of fundamental scientific works on the research problem, processing of test results and timelines were applied. The pedagogical experiment involved 130 students of the state budgetary educational institution of Moscow "School No. 1506". To diagnose and assess the formation of divergent thinking, the method of F. Williams (adapted by E.E. Tunik) was used. Pearson's chi-square test was used as a statistical processing method. *Results*. The timeline in additional education was carried out when displaying historical facts in chronological order, compiling algorithms, creating biographies, and presenting statistics. The didactic potential of the timeline as a kind of quantitative infographics is revealed, which offers a graphical implementation of digital data in relation to each component in the structure of creativity: flexibility, originality, elaboration, fluency. Statistically significant differences in qualitative changes in the pedagogical system were determined. *Conclusion*. The use of timeline services in the conditions of additional education contributes to the development of divergent thinking of students due to the possibilities of interactive presentation of events and facts, reuse, multimedia, technical minimalism.

Difficulties that complicate the use of virtual timelines are noted: time resource management, the need to develop criteria and indicators for the effective use of web services for the corresponding purpose.

Keywords: intellectual development, digital technology, information interaction, creative activity, research, Timeline JS

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Формирование дивергентного мышления школьников в условиях дополнительного образования при работе с лентами времени

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Аннотация. *Постановка проблемы.* Подготовка выпускника, готового применять полученные знания в дальнейшей жизнедеятельности и находить нестандартные, оригинальные решения, преодолевая привычные шаблоны и устоявшиеся мнения, – одна из важнейших задач, которые стоят перед педагогами цифровой школы. Цель исследования – обоснование эффективности использования таймлайн-сервисов для развития дивергентного мышления школьников в условиях дополнительного образования. *Методология.* Применялись теоретико-методологический анализ и обобщение фундаментальных научных работ по проблеме исследования, обработка результатов тестирования и лент времени. В педагогическом эксперименте приняли участие 130 обучающихся государственного бюджетного общеобразовательного учреждения г. Москвы «Школа № 1506». Для диагностики и оценки сформированности дивергентного мышления использовалась методика Ф. Вильямса (адаптированная Е.Е. Туник); в качестве метода статистической обработки – хи-квадрат Пирсона. *Результаты.* Таймлайн в дополнительном образовании задействовался при отображении исторических фактов в хронологическом порядке, составлении алгоритмов, создании биографий, представлении статистики. Выявлен дидактический потенциал таймлайна как разновидности количественной инфографики, предлагающей графическую реализацию цифровых данных в отношении каждого компонента в структуре креативности: гибкость, оригинальность, разработанность, беглость. Определены статистически достоверные различия в качественных изменениях, произошедших в педагогической системе. *Заключение.* Использование таймлайн-сервисов в условиях дополнительного образования способствует развитию дивергентного мышления

обучающихся за счет возможностей интерактивного представления событий и фактов, многократного использования, мультимедийности, технического минимализма. Отмечены трудности, которые осложняют использование виртуальных лент времени: управление временными ресурсами, необходимость разработки критериев и показателей эффективного применения веб-сервисов соответствующего назначения.

Ключевые слова: интеллектуальное развитие, цифровая технология, информационное взаимодействие, творческая деятельность, исследование, шкала времени, Timeline JS

Заявление о конфликте интересов. Авторы заявляют об отсутствии конфликта интересов.

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Problem statement. The development alternatives, which deals with sustainable development issues in cooperation with the UN, determines that one of the tasks of modern education is to develop in all students the ability to solve problems, as well as, the skills of critical, independent and original thinking. According to experts, an education focused only on the intelligence is no longer enough. A. Dilekci, H. Karatay consider that a radical reorientation of the content of education should [1]:

– include the transfer of knowledge gained from past experience;

– be aimed at expanding the knowledge, skills and capabilities that will be required in the future;

– adapt and respond creatively to the future that is still envisioned.

The development of divergent (creative) thinking of younger schoolchildren in modern conditions is an urgent problem for both Russian and foreign educational systems [2]. The digital society in the 21st century requires a person to have such qualities, that would help to solve the problems facing society quickly, nonstandard and effectively in the new millennium. According to S.Kh. Khaknazarov, the "education-teaching" model should be replaced by the "education-interaction" model [3]. As S.Yu. Stepanov, I.V. Ryabova, E.V. Gavrilova conclude, in connection with the changed strategy in the Russian educational system, it is necessary to review approaches to teaching children in specific educational institutions, and to work to identify creative, non-standard thinking students [4]. In particular, to use the tools of the new information environment for the development of divergent thinking. This activity of teachers is the most effective and productive in terms of additional education.

According to S.Kh. Khaknazarov, additional education today is an important socializing factor that ensures the productive use of schoolchildren's free time, as well as direct career guidance for their intellectual development [3].

In this regard, the Ministry of Education of the Russian Education ensures the development of a system of measures for the development of additional educa-

tion for children. Within the framework of the federal project "Success of Every Child" of the national project "Education" by 2024, additional education should cover 80% of children aged 5 to 18 years. The federal project provides:

– updating the content of additional education in all areas;

– improving the quality and variability of educational programs and their implementation in a network form so that they meet the challenges of the time and the interests of children with different educational needs;

– modernization of the infrastructure and improvement of professional skills of pedagogical and managerial personnel.

The Concept for the Development of Additional Education for Children until 2030 also focuses on the development of the creative abilities of students and the individualization of their education, taking into account the interests and inclinations for a particular creative activity[1].

However, as noted by S.Yu. Stepanov, I.V. Ryabova, E.V. Gavrilova, the biggest risks for the development of children's thinking are associated with screen gadgets that are used for entertainment purposes [4]. According to the conclusions of scientists, the earlier a child begins to use digital devices, the more severe the consequences for the formation of higher mental functions can be: delays in the development of speech, attention, memory and thinking. This begins to affect especially strongly in school years the ability and readiness for learning, for self-development, as well as for creative activity. At the same time, as shown by E.N. Malova, V.G. Shubovich, M.M. Shubovich, if gadgets are used moderately and taking into account the norms of SanPiN for developmental and educational purposes, then we can count on positive dynamics in the formation of higher mental functions in the younger generation [5].

Social services of the Internet, according to the conclusions of N.Ya. Ageev, Y.A. Tokarchuk, A.M. Tokarchuk, E.V. Gavrilova, when used in education, are universal, interdisciplinary in nature [6]. But it is natural that the technological features of some services can be better revealed in teaching one subject or a topic. So, timelines are ideal for: getting acquainted with events for analysis and a holistic view of the phenomenon under study; creation of ribbons with the results of research within the framework of project activities; use as a task for independent work. All of the above factors, of course, represent a certain didactic potential for the inclusion of time tapes in various forms of additional education [7].

An analysis of the scientific works listed above makes it possible to identify a problem associated with the need for additional study of the development of divergent thinking in schoolchildren in the conditions of additional education when working with timelines.

The study aimed at substantiating the effectiveness of using services for creating timelines for the development of divergent (creative) thinking of schoolchildren in conditions of additional education.

Methodology. Theoretical analysis and generalization of the literature were used to identify problems and prospects for the use of timeline services in the con-

[1] Concept for the development of additional education for children until 2030 (with amendments as of May 15, 2023). Available from: https://docs.cntd.ru/document/350163313 (accessed: 26.05.2023).

text of additional education while clarifying the didactic potential of digital technologies for the formation of divergent thinking.

Digital services for timelines were analyzed: StoryMap JS, Tiki-Toki, Sutori, Timeglider, Preceden, MyHistro, SmartDraw, Timeline JS.

Comparison criteria: information about the developers, year of release, paid/free, the ability to choose the Russian language for the interface, the convenience and clarity of the registration form, the functionality and principles of work (working with text in Russian, the ability to download graphics and videos, the saving form: publication on the service / publication on any site). For detailed study and practical application in the conditions of additional education, Timeline JS was chosen. Its advantages:

– the service is free, simple, and versatile and allows you to embed the result in the page of any website;

– the service "creates" a timeline based on a Google spreadsheet;

– information can be accompanied by a link to a photo, video or code, for example, to a map or infographic;

– by clicking "Open Preview in a new window", the timeline will open in a new window. This link can be distributed, for example, in social networks.

The base for experimental work is the state budgetary educational institution of Moscow "School No. 1506". The school works in the spirit of continuous improvement, striving to meet all the state requirements of the modern level of education. The school staff works on in-depth and extended programs, provides preprofessional and specialized training for students in the humanities, physics and mathematics, natural sciences, and teaches two foreign languages. The school positions itself as "an open innovative educational environment focused on providing conditions for the social and intellectual success of students and teachers". Additional education at the school is represented by technical, natural sciences, social and humanitarian, artistic, tourist and local history areas.

The use of timeline services for the development of divergent thinking was carried out during classes in the clubs "Web-design", "School propaganda team" and in the group for the development of cognitive abilities (game activity).

To diagnose and assess the formation of divergent thinking, the technique "Test of divergent (creative) thinking" was used. Written by Frank Williams (adapted by E.E. Tunick). This is a series of drawing tests that reveal the student ability for creative self-expression in five indicators: fluency of thinking (productivity), flexibility of thinking (mobility), originality, elaboration, name (richness of vocabulary and figurativeness of speech). These indicators correspond to the essence of divergent thinking by J. Guilford. According to him, "divergence is the basis of creativity. Key indicators: fluency, flexibility, productivity and complexity (development)" [8].

130 students were involved in the study. The average age of respondents is 15 years (55% of girls and 45% of boys). The study was conducted in 2021–2023.

Empirical methods: pedagogical experiment (stating, forming, control); study and generalization of the experience of using the timeline in the conditions of additional education.

Mathematical methods: methods of quantitative processing of research results; methods of mathematical statistics (Pearson's χ^2 criterion).

Results and discussion. Divergent thinking is defined by D.E. Delany, C.S. Cheung as a kind of thinking going in different directions, resulting in an original solution [9]. Such thinking allows you to change the direction of the search in the process of finding answers to various questions. As a consequence, a new spectrum of diverse (unexpected) solutions and outcomes emerges. Moreover, several answers can be given to one question, which is the condition for generating extraordinary ideas and self-expression of the individual [10].

The pioneer of divergent thinking, J. Gilford indicated that the main goal of its development is the formation of research interest aimed at finding new forms of activity [11]. Whereas in the works of L.S. Colzato, S.M. Ritter, L. Steenbergen, divergence has a broader meaning and is defined as the creative quality of all cognitive processes (and not just thinking) involved in creative processes. Divergence is manifested in the ability to see the unique properties of phenomena; in the ability to see the phenomenon in a multipolar space, in retrospect and perspective; in the ability to simultaneously take into account or combine several (including opposite) conditions, prerequisites and principles [12].

S.S. Bykova, I.B. Buyanova, L.A. Serikova defined divergent thinking as a type of thinking that promotes the search for extraordinary ideas aimed at developing research interest and non-standard forms of activity [11]. Many foreign researchers conduct a comparative characteristic of convergent and divergent thinking, reveal their interaction in the context of the creativity development in adolescents. Prior to the emergence of divergent thinking, convergent thinking abilities develop to a certain level, and only then divergent thinking begins to play a significant role in scientific creativity [13].

Yu.A. Karvunis, M.B. Lozhkina, L.V. Kapilevich explore the possibilities of using e-learning components in additional education for children on the example of sports and tourism programs. They come to the conclusion that such forms of work are based on the principle of blended learning: modern technologies make it possible to increase the efficiency of the intellectual development of schoolchildren due to greater visualization of the material [14].

V.V. Uranova, O.V. Bliznyak, M.V. Mazhitova, R.R. Isyakaeva substantiate that a timeline – a time tape – can become an effective tool for creating a spectacular, attractive "packaging" of educational material. This is a graphic interactive scale that contains labels with information about an event, process, phenomenon in chronological order. They describe the digital timeline as a web application that is designed to view, create, edit and publish interactive graphical timelines [7].

E.V. Soboleva, T.N. Suvorova, N.Yu. Blokhina, E.L. Batakova describe the possibilities of "virtual walls" for the formation of group creative thinking. The authors note that virtual communication, online collaboration, work with digital objects, the use of software and hardware have become an indispensable element of modern (including additional) education [15].

So, using the service, we get a visual history of the development of any process. Events can be presented in the form of text, pictures, video and audio recordings. When describing an event, you can insert a hyperlink to Internet resources associated with this event. In other words, there are new opportunities for the development of students' thinking: the content of concepts is enriched, the student

learns to identify essential and secondary features, to notice connections and relationships between them, etc.

The specifics of additional education make it possible to create conditions for the formation of self-awareness, self-determination and self-realization of the child. Moreover, the process of socialization is mediated by creativity, creative activity in the team. It has its own logic of development, involves overcoming and removing contradictions. This means that it can contribute to the adaptation of the student personality and the development of their creative abilities under certain pedagogical conditions.

The main purpose of the experimental work was to test the effectiveness of using web services to create timelines for the development of divergent (creative) thinking of schoolchildren in the conditions of additional education.

At the preparatory stage, the teacher analyzed the potential of innovative digital technologies for the development of schoolchildren divergent (creative) thinking in the conditions of additional education [16].

The integration of educational areas when working with timelines organically fits into the project method, which, according to the requirements of additional education, is the leading method in working with children. It is the "timeline" that can help students understand the retrospective of the world around them. Indeed, the formation of a vision of time and historical development causes particular difficulties for schoolchildren. It is rather difficult to imagine such words as "algorithm", "computer device", "artificial intelligence", "computer network" without visualization. The tape as a time scale allowed schoolchildren to perceive these abstract concepts and apply in practice.

It was determined that the timeline must be distinguished from other types of information visualization. In particular, on the basis of the following features: "volumetric text component; obligatory fixation of time intervals; the possibility of a fully functional existence only on the Internet".

Digital services for timelines, such as: StoryMap JS, Tiki-Toki, Sutori, Timeglider, Preceden, MyHistro, SmartDraw, Timeline JS, were analyzed. It was the latter, which was used in the conditions of additional education of the school.

In the presented study, the "timeline" is understood as an infographic tool that allows you to create a visual story unfolding in time based on events and facts organized in chronological order, and present it as a time axis.

Further testing was carried out according to the conditions of the modified and adapted Williams divergent thinking test. Twelve drawings were offered to the students.

Instruction for schoolchildren: "Work fast. Try to draw such an unusual picture that no one else can come up with. You will be given 20 (25) minutes. When creating an image, use a line or shape inside each square to make it part of your painting. You can draw anywhere within the square, depending on what you want to represent. You can use different colors to make the drawings interesting and unusual. After completing each drawing, think of an interesting title and write the title in the line below the image. Don't worry about correct spelling. Creating an original name is more important than handwriting and spelling. Your title should tell what is shown in the picture and reveal its meaning".

Test notebook consisted of three separate sheets of a standard A4 format. Each sheet of paper contains four squares. There are stimulus figures inside of them.

The result is five indicators, expressed in points:

– fluency (B) – maximum possible score – 12;

– flexibility (G) – the maximum possible score – 11;

– originality (O) – maximum possible score – 36;

– elaboration (P) – maximum possible score – 36;

– name (N) – the maximum possible score is 36.

The highest possible total score for the entire test is 131.

In the course of interpreting the results, scores were calculated for each of the indicators. Further, according to the sum of points of all indicators, high (total number of points from 89 to 131), medium (69–88 points) and low (up to 68 points) levels of development of divergent thinking were determined.

Based on the materials of the control work, a control group (65 schoolchildren) and an experimental group (65 schoolchildren) were formed.

Further, in the classes of the clubs "Web-design", "School propaganda team" and in the group for the development of cognitive abilities (game activity), the students of the experimental group studied the Timeline JS service. The work was organized according to the algorithm:

1. Carry out preparatory work with information. Events were collected in a text file and were entered into the timeline later. For each event, a date was determined, and a link to a photo, video, or code was added. For example, on a map or infographic.

2. Go to the Timeline JS[2] web service. You do not need to register for the service. To get started, click on the green button in the center of the "Make a Timeline" screen.

Then – on the blue button "Get the Spreadsheet Template".

3. Create a new Google Spreadsheet using the service template. It was copied to your Google Drive account when you clicked on the "Make a copy" button.

4. Fill in the table. Preview and modification.

The use of the timeline in additional education was carried out in the following cases: to display historical facts in chronological order; prepare a chronicle of current events; create a biography; illustrate the statistics.

Working with web services for creating timelines influenced the key indicators of the formation of divergent thinking in the following way:

1) originality, i.e., the ability to see non-standard solutions, develops when drawing up a plan (starting points, milestones, division scales) on the timeline;

2) fluency – a variety of associations that students have when visualizing history. For example, when designing a timeline on the history of the development of artificial intelligence (web, human brain, fantastic character);

3) flexibility – manifests itself when the teacher formulated and gradually supplemented the system of requirements for the timeline. For example: place at least ten events on the line; consider having two or more events starting at the same time, etc.;

[2] Timeline JS. Available from: https://timeline.knightlab.com/

4) elaboration – manifests itself when students find and visualize cause-and-effect relationships between phenomena. For example, “The invention of the printing press is considered one of the events that influenced the formation of the information society. Before Gutenberg came up with a way to mass-produce books, they were reproduced by hand. The production of manual copies of the books meant that the number of copies was limited. With Gutenberg's printing press, the reproduction of books became mechanical. Science, culture and history could spread throughout the world, changing the course of history”;

5) name, i.e., the students skillfully and witty used linguistic means and vocabulary when arranging the text on the timeline. Timeline text is the content element of an infographic that integrates multimedia components.

Examples of timelines created by the participants of the experimental group: the chronology of the development of minerals or geographical discoveries, the phases of the development of the organism (plants or the stages of the transformation of a caterpillar into a butterfly), an algorithm for solving an equation, stages of a chemical reaction.

A timeline was developed and used directly within the framework of the “Web-design” club classes. It represented the stages of a site design. Example: stage 1 – “Brief”, stage 2 – “Analysis of a niche and competitors”, stage 3 – “Design”, stage 4 – “Collection of references (works of other designers)”, stage 5 – “Prototype”, stage 6 – “ Final design”, stage 7 – “Preparation of design for development”.

In the group of development of cognitive abilities (game activity), algorithms for playing chess were compiled. Here are some options: opening, middlegame, endgame; position evaluation, tactical strikes and combinations, calculation of necessary options, positional play.

The students in the control group were also involved in the “Web-design”, “School propaganda team” and in the group for the development of cognitive abilities. However, they were not involved in the study of web services for creating timelines.

An example of a task that was performed by the participants of the “School propaganda team” using information resources: compiling cards with the rules of safe behavior on the road, analyzing the number of traffic accidents, depicting road signs and logos.

Information about the results of evaluation “before” and “after” experimental and search work after using web services to create timelines for the development of divergent (creative) thinking of schoolchildren in the context of additional education is given in Table.

The influence of working with timelines on divergent thinking formation of schoolchildren in the conditions of additional education

Level of divergent thinking formation	Groups			
	Experimental group (65 students)		Control group (65 students)	
	Before the experiment	After the experiment	Before the experiment	After the experiment
High	7	20	8	18
Average	26	35	25	22
Low	32	10	32	25

Thus, χ^2obs.1 < χ^2crit (0.086 < 5.991), and χ^2obs.2 > χ^2crit (9.499 > 5.991). Therefore, the shift towards an increase in the level of divergent thinking of schoolchildren in the conditions of additional education in the experimental group can be considered non-random.

The teachers used the resulting timelines at other school events (art meetings, brainstorming sessions, knowledge auctions, etc.).

Thus, work with the "timeline" creates additional conditions for the development of imagery, originality and speed of perception in schoolchildren. It is the "timeline" that helps students understand that a person purposefully changes the objects around him, making them more convenient and useful.

The obtained conclusions about the didactic potential of digital services for the development of students' creative thinking confirm the results of N.Ya. Ageev, Y.A. Tokarchuk, A.M. Tokarchuk, E.V. Gavrilova [6]. A significant result of the study is the description of the basic ideas of the approach that expand the ideas of S.Yu. Stepanov, I.V. Ryabova, E.V. Gavrilova about the impact of the digital environment and additional education on the intellectual and creative abilities of schoolchildren [4].

Conclusion. The results of the study made it possible to highlight the following positive aspects of the use of web services for creating timelines for the development of divergent thinking of schoolchildren in the conditions of additional education:

– multiple use – the work can be embedded in a blog, website and repeatedly referred to, create an archive of timelines. At the right time (in the future) one can return to the information resource;

– sociality – the work can be viewed by a large number of students, commented and evaluated, distributed through a blog, social networks;

– multimedia – on the timeline you can place not only text messages, but also graphics and video;

– aesthetic education–the development of accuracy, aesthetics of perception. The desire to design an information resource in a single style; create a design relevant to this work. The student has the opportunity to show creativity, individuality;

– technical minimalism – installation of special software is not required. Such services are supported by most Internet browsers;

– a combination of different types of training materials. There are opportunities to systematize various types of information, analyze and establish cause-and-effect relationships.

As difficulties that complicate the use of the timeline in the conditions of additional education, we note: the need for a systematic study of the experience of evaluating the effectiveness of the use of services for working with timelines; development of criteria and indicators for the effective use of web services for the appropriate purpose in the institution of additional education for children (managerial, educational, educational, personnel, and other aspects).

The results obtained can be used in various additional education programs to support and promote the ideas of the federal project "Success of every child" of the national project "Education".

References

[1] Dilekci A, Karatay H. The effects of the 21st century skills curriculum on the development of students' creative thinking skills. *Thinking Skills and Creativity*. 2023;47: 101229. http://doi.org/10.1016/j.tsc.2022.101229

[2] Avcı Ü, Yildiz-Durak H. Innovative thinking skills and creative thinking dispositions in learning environments: antecedents and consequences. *Thinking Skills and Creativity*. 2023;47:101225. http://doi.org/10.1016/j.tsc.2022.101225

[3] Khaknazarov SKh. Parents' satisfaction with the quality of additional education of children in their native languages and literature. *Bulletin of Ugric Studies.* 2022;12(2):386–397. (In Russ.) http://doi.org/10.30624/2220-4156-2022-12-2-386-397

[4] Stepanov SYu, Ryabova IV, Gavrilova EV. The impact of the digital environment and additional education on the intellectual and creative abilities of schoolchildren. *Questions of Psychology*. 2021;(1):61–70. (In Russ.)

[5] Malova EN, Shubovich VG, Shubovich MM. Information and communication technologies in supplementary education of primary students: health aspect. *Theory and Practice of Physical Culture*. 2019;12:70–72. (In Russ.)

[6] Ageev NYa, Tokarchuk YA, Tokarchuk AM, Gavrilova EV. The interaction of digital technologies with the development of cognitive and communication processes of adolescents and young adults: a review of empirical research. *Psychological-Educational Studies.* 2023;15(1):37–55. (In Russ.) http://doi.org/10.17759/psyedu.2023150103

[7] Uranova VV, Bliznyak OV, Mazhitova MV, Isyakaeva RR. Role of visualization of educational information in the educational process of medical and biological students in the "Analytical chemistry" discipline. *Russian Journal of Education and Psychology*. 2022;13(6):19–44. (In Russ.) http://doi.org/10.12731/2658-4034-2022-13-6-19-44

[8] Guilford J. Structural model of intelligence. In Matyushkin AM. (ed.) *Psychology of Thinking*. Moscow: Gardariki Publ.; 2005. p. 37–45. (In Russ.)

[9] Delany DE, Cheung CS. Transactions between adolescents' after school activities and divergent thinking. *Psychology of Aesthetics, Creativity, and the Arts.* 2020;14(4):462–474. http://doi.org/10.1037/aca0000266

[10] Ibraeva ES. Development of interest in STEM education among primary school children in the system of supplementary education. *Perspectives of Science and Education*. 2023;(1):276–290. (In Russ.) http://doi.org/10.32744/pse.2023.1.16

[11] Bykova SS, Buyanova IB, Serikova LA. The development of divergent thinking in younger adolescents by the means of TRIZ-Pedagogy. *Perspectives of Science and Education*. 2020;45(3):323–335. (In Russ.) http://doi.org/10.32744/pse.2020.3.24

[12] Colzato LS, Ritter SM, Steenbergen L. Transcutaneous vagus nerve stimulation (tVNS) enhances divergent thinking. *Neuropsychologia*. 2018;111:72–76. http://doi.org/10.1016/j.neuropsychologia.2018.01.003

[13] Durnali M, Orakci S, Khalil T. Fostering creative thinking skills to burst the effect of emotional intelligence on entrepreneurial skills. *Thinking Skills and Creativity*. 2022;47:101200. http://doi.org/10.1016/j.tsc.2022.101200

[14] Karvunis YA, Lozhkina MB, Kapilevich LV. E-training (distance learning) elements for supplementary sports tourism education service: benefits analysis. *Theory and Practice of Physical Culture*. 2021;10:64–65. (In Russ.)

[15] Soboleva EV, Suvorova TN, Blokhina NYu, Batakova EL. Formation of group creative thinking when working with virtual walls. *Perspectives of Science and Education*. 2021;(3):465–480. (In Russ.) http://doi.org/10.32744/pse.2021.3.33

[16] Kechaeva MV, Salynina SU. The role of the system of additional education of children in the process of socialization of the individual. *Modern Problems of Science and Education.* 2023;(1). (In Russ.) http://doi.org/10.17513/spno.32367

Список литературы

[1] *Dilekci A., Karatay H.* The effects of the 21st century skills curriculum on the development of students' creative thinking skills // Thinking Skills and Creativity. 2023. Vol. 47. http://doi.org/10.1016/j.tsc.2022.101229

[2] *Avcı Ü., Yildiz-Durak H.* Innovative thinking skills and creative thinking dispositions in learning environments: antecedents and consequences // Thinking Skills and Creativity. 2023. Vol. 47. http://doi.org/10.1016/j.tsc.2022.101225

[3] *Хакназаров С.Х.* Удовлетворенность родителей качеством дополнительного образования детей по родным языкам и литературе // Вестник угроведения. 2022. Т. 12. № 2. С. 386–397. http://doi.org/10.30624/2220-4156-2022-12-2-386-397

[4] *Степанов С.Ю., Рябова И.В., Гаврилова Е.В.* Влияние цифровой среды и дополнительного образования на интеллектуальные и креативные способности школьников // Вопросы психологии. 2021. № 1. С. 61–70.

[5] *Малова Е.Н., Шубович В.Г., Шубович М.М.* Здоровьесберегающий аспект использования информационно-коммуникационных технологий в дополнительном образовании младших школьников // Теория и практика физической культуры. 2019. Т. 12. С. 70–72.

[6] *Агеев Н.Я., Токарчук Ю.А., Токарчук А.М., Гаврилова Е.В.* Связь цифровых технологий с развитием когнитивных и коммуникативных процессов подростков и юношей: обзор эмпирических исследований // Психолого-педагогические исследования. 2023. Т. 15. № 1. С. 37–55. http://doi.org/10.17759/psyedu.2023150103

[7] *Уранова В.В., Близняк О.В., Мажитова М.В., Исякаева Р.Р.* Роль визуализации учебной информации в условиях образовательного процесса у студентов медико-биологического профиля по дисциплине «Аналитическая химия» // Russian Journal of Education and Psychology. 2022. Т. 13. № 6. С. 19–44. http://doi.org/10.12731/2658-4034-2022-13-6-19-44

[8] *Гилфорд Дж.* Модель структуры интеллекта // Психология мышления / под ред. А.М. Матюшкина. М.: Гардарики, 2005. С. 37–45.

[9] *Delany D.E., Cheung C.S.* Transactions between adolescents' after school activities and divergent thinking // Psychology of Aesthetics, Creativity, and the Arts. 2020. Vol. 14. No. 4. Pp. 462–474. http://doi.org/10.1037/aca0000266

[10] *Ибраева Э.С., Шаушекова Б.К.* Развитие интереса к STEM-образованию у детей младшего школьного возраста в системе дополнительного образования // Перспективы науки и образования. 2023. № 1 (61). С. 276–290. http://doi.org/10.32744/pse.2023.1.16

[11] *Быкова С.С., Буянова И.Б., Серикова Л.А.* Развитие дивергентного мышления младших подростков на основе педагогической технологии решения изобретательских задач // Перспективы науки и образования. 2020. Т. 45. № 3. С. 323–335. http://doi.org/10.32744/pse.2020.3.24

[12] *Colzato L.S., Ritter S.M., Steenbergen L.* Transcutaneous vagus nerve stimulation (tVNS) enhances divergent thinking // Neuropsychologia. 2018. Vol. 111. Pp. 72–76. http://doi.org/10.1016/j.neuropsychologia.2018.01.003

[13] *Durnali M., Orakci S., Khalil T.* Fostering creative thinking skills to burst the effect of emotional intelligence on entrepreneurial skills // Thinking Skills and Creativity. 2022. Vol. 47. http://doi.org/10.1016/j.tsc.2022.101200

[14] *Карвунис Ю.А., Ложкина М.Б., Капилевич Л.В.* Эффективность внедрения компонентов электронного обучения в дополнительном образовании спортивно-туристской направленности // Теория и практика физической культуры. 2021. Т. 10. С. 64–65.

[15] *Соболева Е.В., Суворова Т.Н., Блохина Н.Ю., Батакова Е.Л.* Формирование группового творческого мышления при работе с виртуальными стенами // Перспективы науки и образования. 2021. № 3 (51). С. 465–480. http://doi.org/10.32744/pse.2021.3.33

[16] *Кечаева М.В., Салынина С.Ю.* Роль системы дополнительного образования детей в процессе социализации личности // Современные проблемы науки и образования. 2023. № 1. http://doi.org/10.17513/spno.32367

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