



**Inna Lipchevska** — PhD candidate at the Institute of Pedagogy of the National Academy of Educational Sciences of Ukraine, research fellow of Ethnic Minorities Languages and Foreign Literature Teaching Department at the Institute of Pedagogy of the National Academy of Educational Sciences of Ukraine.

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**e-mail:** [innalipchevska@gmail.com](mailto:innalipchevska@gmail.com)

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## VISUALIZATION OF INFORMATION: EXPERIENCE OF SOVIET INNOVATIVE TEACHERS AND ITS ACTUAL PROSPECTS IN EDUCATIONAL PROCESS

The article is devoted to the research of soviet innovative teachers experience in introduction of visualization of information in the school educational process – a technology of intensified learning based on the scheme models and sign models of educational material, and a technology of perspective-forestall learning with the use of reference schemes in management-commenting. Conceptual foundations and algorithms for implementation of these technologies are described. The analysis of their implementation into the school education practice is given and the relevance of the obtained results in the context of education modernization is determined.

The author also outlined the modern possibilities for visual presentation of information using IT- and communication technologies, argued the expediency and relevance of this approach in the educational process, determined the prospect for further development of the problem.

**Key words:** visualization of information; visual thinking; visual literacy; supporting schemes; supporting notes; intensification of the educational process.

**Formulation of the problem in general and its relationship to important scientific and practical tasks.** During some last decades the education paradigm has got big changes. The vector of priority learning tasks has shifted from mastering of knowledge and skills to development of thinking, creativity, personality competences formation. According to requirements of modern society, the integration education tasks dominate over subject tasks, which causes the integration of subject areas and the competence-based approach to education's content is being implemented. The role of teacher is also rethought. Now he/she is, first of all, the guide, navigator in the boundless world of information. Authoritarianism in pedagogic relations changes to cooperation, partnership in cognition process and activity. A student plays main role in the educational process. Active and creative research methods are determined like priority.

An introduction of visualization of information into the educational process is one of innovations in Ukrainian education. That is defined by State Standard of Primary Education 2018 and related curricula. This novelty is defined by modern researches in the field of human's perception of information streams. Globally, we can say that within the school curriculum, attention is paid to

this issue, but: 1) there is no comprehensive methodology of using visualization; 2) the term «visual information» is perceived too narrowly. It equals to presentation of various information in the form of graphs, schemes, diagrams, tables, etc. However, such a definition reveals only an illustrative function of the visualization process. Scientifically-substantiated is understanding of visualization like process of information transformation. In particular, A. Verbytskyi defines the visualization process as «compressing of the thought process content into a visual image. Being accepted, it could be expanded and serve as a footing for correct mental and practical activities.

**Analysis of recent research and publications on the issue.** Theoretical foundations of visualization of educational information were researched by S. Aranova, V. Davydov, P. Erdniiev, L. Zankov, V. Zinchenko, H. Lavrentiev, N. Manko, O. Pieskova and others. Learning theories were developed by F. Bartlett and R. Anderson (Schema Theory in education), Marvin Minsky (Frame Theory). The features of visual thinking were researched by— R. Arnkheim, N. Rieznic, V. Zinchenko, V. Zinchenko and others. Writings of G. Reynolds, P. Durand, S. McCloud, D. Little and P. Felten, J. Jones, H. Wang, D. Roam, J. Novak, G. Casey, S. Few and many others are dedicated to practical applications of visualization of information [1].

The use of visualization in the educational process, as a foundation of educational activity, is covered in the works of Soviet innovative teachers Viktor Shatalov (a technology of intensified learning based on the scheme models and sign models of educational material) [2], [3], [4], [5] and Sofia Lysenkova (a technology of perspective-forestall learning with the use of reference schemes in management-commenting) [6], [7].

**Problem statement.** Thanks to the technologies of V. Shatalov and S. Lysenkova, students can learn subject material better, forestalling the curriculum. Thus frees up the time for a deeper study of the educational material and forming the independent work skills. Moreover, it helps to develop the personal qualities required for successful independent work.

One of the key components of both these technologies is the use of visualization of educational information, which's integration to the educational process is an actual problem for today. Therefore, the purpose of the article is to analyze how the visualization of information is applied in these technologies, and to determine the possibility of its implementation into the modern educational process.

Let us consider their heritage in the context of modern perspectives of information visualization in the educational process.

**Main material.** V. Shatalov defined next main priorities in his work: 1) formation of students' knowledge and skills; general, comprehensive and cross-curricular ways of thinking; 2) upbringing of a holistic, strong-willed, hard-working, creative, high-moral personality with active social position; 3) elimination of learning-failure and intensification in education; 4) prioritizing of health-saving and physical development for students. In his studying conception humanism, active interaction of teacher and students basing on didactocentrism, personality-oriented and activity-based approaches, implementation of a formative assessment of students' achievements take place. At the same time, rigorous mandatory step-by-step monitoring of each student's current achievements, exemplary discipline (but not the authoritarianism of the teacher), high level of training complexity and parents involvement in the educational process are crucial. The route to high educational achievements is determined by the author of the technology as symbiosis of 6 components: «reference signals, control, sport, tasks, repeating, job assessment» [2, c. 175].

This technology was applied in elementary, secondary and high schools in mathematics, physics, chemistry, biology, geography, Russian, history.

V. Shatalov's technology focuses on theoretical knowledge: «only when you know theory well, you can start practice» [3, c. 4]. But, simultaneously, accents are made on inadmissibility of overdosing of theoretical materials. The educational process should provide all students with deep theoretical knowledge and a high level of practical skills. «Through the knowing of theory, after a first successful experience, a taste to individual work comes» [3, c. 5]. Consequence of this is

students striving for scientific search, expanding of their own outlook. Exactly in the presentation of new theoretical material by the teacher, during its processing and mastering by the students, the visualization of verbal material in the form of **supporting notes** is used. It is a “systematized set of structurally related support signals, which create the visual construction of a system of terms, values, concepts and ideas as interrelated elements”. According to V. Shataliv, support signal is an «associative symbol, which replaces some semantic meaning. It can instantly restore previously learned information in memory». [5, c. 159-167]. Examples of support signals are key words, drawings, special characters, numbers etc.

The theoretical justification for the use of support notes is based on the claim that it is inherent for human to think with images. Fixing of a large number of semantic associations in the consciousness is a natural property of the human brain. Transformation of thoughts-images (which are subjective, personal) into an expanded speech utterance is the process of forming general scheme of expression, finding the necessary lexical units, and, finally, sounding the corresponding image.

Speech perception is a reverse operation: according the verbal interpretation, the essence of the message - the narrator's thoughts – is recovering. This process includes prediction (deployment) and recoding (collapse) of speech, which operate simultaneously within the listener memory amount. Under the process of recoding, the message is compressing and transforming into meaningful image-symbols. [8, c. 187]. According to the research of psychologist J. Miller, the possibility of simultaneous perception is characterized by the number of  $7 \pm 2$  pieces of information that could be "held" by a person in memory.

Visualization tools allow to increase the capacity of information unit, thereby increasing the memory amount, and to realize multilevel structuring of the message (text), and, finally, to improve its perception. Thus, supporting notes significantly increase the mastering of knowledge and formation of students' skills.

The technology defines clear requirements for supporting notes:

✓ The material of the supporting notes is presented sequentially, step by step. Supporting signals are organized into blocks, based on logical connections that should be understood and mastered by students.

✓ Quantity of printed symbols in supporting note has not to exceed 150-200 characters for primary school and gradually increase up to 500 for high school students. [2, c. 169]

✓ Quantity of supporting signals in support note has not to exceed 30 units, quantity of logical blocks – 8 units. [2, c. 169]

✓ Supporting characters has to be content-rich and contain not just separated term, fact or number, but represent complete logical unit of information.

✓ Graphic supporting signs are realized in a generalized form, their detailing and refinement is an integral part of the teacher's speech.

✓ Supporting signals should be non-ordinary - arouse live curiosity of students and be spontaneously remembered, what corresponds to the psychological characteristics of a schoolchild.

✓ The supporting notes should be easily reproducible by students.

✓ It is unacceptable to use templates for creating of supporting notes, “The variety of forms is a powerful psychological and pedagogical tool, its possibilities are almost inexhaustible” [4, c. 31].

In common V. Shatalov compares the supporting notes with the blackboard, which every student takes home.

Introducing of new material for students starts with teacher's detailed explanation without using supporting notes. In the second stage, the teacher demonstrates the supporting notes and explain the material shortly again, doing references to them. Then the students obtain their own copies of the supporting notes, review and analyze them independently. This is the third stage. Fourth stage – student's processing the lesson material at home, using the textbook and the supporting notes. On the next lesson fifth and sixth stages are performed – a written reproduction of the supporting notes mastered by students and an oral survey with their freely use.

This approach, which uses visualization materials and repeated repetitions allows:

1. to achieve mastering, understanding of theoretical material and its systematization, generalization. The learning of the material takes place in logically interconnected large blocks. In fact, it is a purposeful generalization of material, what is the core of students' knowledge;
2. to develop logical thinking;
3. it forms students' speaking skills (increasing the rate of speech, reducing pauses, the disappearance of parasite words).

The above is confirmed by research, performed by specialized SRI of Pedagogical Sciences Academy of the USSR in Donetsk. Also the advantages of using supporting notes include:

✓ Developing students' arbitrary attention, ability to work thoughtfully and focused, to spot details and capture them in the mind.

✓ The development of creativity in creating students' own supporting notes. The ability to convert information to a visual form becomes a convenient and reliable tool in students' independent creative cognitive activity.

✓ Intensification of teaching of material with, simultaneously, improving the quality of learning by students. Formation of time reserve in the lesson.

✓ Facilitating memorization and introduction of new terms, names, dates into the vocabulary of students.

✓ Simplified structuring of student answering - the answer plan is present in the supporting notes. Therefore, there is no need for a student to perform several mental operations at the same time.

✓ Defining bounds of answer, that increases the speaker's confidence and common psychological comfort at the lesson.

✓ Optimizing time, spent on processing of theoretical material by student at home: secondary/high school students process a textbook with the use of supporting notes up to 20 minutes (practical average time 10-15 minutes).

Except V. Shatalov, another famous soviet innovative teacher, Honored USSR teacher – S. Lyсенkova paid a special attention to the work with visualization tools. She developed the technology of perspective-forestall learning with the use of support schemes in management-commenting and successfully implemented it in primary school.

Her technology is primarily oriented on eliminating of learning-failure, mastering of knowledge and skills in accordance with the educational standards at a high/sufficient level by all students of the class. Much attention is paid directly to the formation of the ability to learn: «Struggle for success in learning - it means teaching children to learn, helping everyone to believe in their capabilities, nurturing self-organization, self-independence, responsibility, work discipline» [6, c. 49]. It defines the humanistic basis in teacher – student relationships, positivism in assessment as the foundation of motivation («Kids love to study successfully!» [7, c. 3]) and a personality-oriented approach in learning, including task differentiation. Much attention is paid to the comfort of the educational environment, the upbringing among students of friendliness, respect for each other, courtesy, development of mutual assistance skills.

The technology is based on tree cores:

1. Management-commenting (a method of holding a lesson: the teacher or student "leads" the class, commenting their actions during the lesson according to the scheme " I think – I say – I write"), which develops an evidence-based commentary-opinion when solving tasks in the third and fourth grades.

2. Supports – which represent "conclusions, that are formed with students during the explanation and are fixed in the form of tables, cards, typesetting, drawings, schemes" [6, c. 7]

Management-commenting and Supports form a synchronous activity of students during the lesson, which allows to create a reserve of time for forestall learning.

1) forestall learning is the early introduction of complex aspects of the study program into the learning process, what, therefore, extends the time of learning this material. The result is a

significant improvement in the academic achievement of the class and the formation of additional time reserve due to the accelerated passage of material in the allotted program time.

Let us dwell on the aspect of information visualization in the educational process, i.e. supports. In children of primary school age an imaginative concrete thinking dominates mostly (logical thinking is on forming stage yet). This causes the complexity in information unification during the transition from the processing of bright didactic material to generalization and self-independent formation of appropriate judgments, based on the learned conclusions. According to S. Lysenkova, supports are a visual-image "bridge" between concrete and abstract. They have active essence that means that they serve as a basis for successful and confident thinking, doing conclusions, solving problems, writing, reading and other learning activities. «Students build their answer using the scheme, reading it, working with it» [7, c. 13]. They focus their attention not on the reproduction of the learned information, but on the awareness of the essence of the educational material, causation and relationships. By the technology, the use of supports is an integral part of every lesson. Only under this condition they become a means of increasing the efficiency of the educational process and forming of time reserve.

The advantages of using visualization tools in the context of technology of perspective-forestall learning with the use of reference schemes in management-commenting include:

- ✓ Improving the mastering of the lesson material
- ✓ Developing of logical and systemic thinking, attention
- ✓ Developing of speech skills
- ✓ Increasing the pace of the lesson
- ✓ Mistakes prevention
- ✓ Optimization, intensification of repetition and generalization of the material
- ✓ No need to cram rules and definitions by heart - students reproduce them using supports

#### **Conclusions and prospects for further research.**

The above technologies determine the leading role of visualization tools in the optimization and improvement of the learning process. They activate the perception, thinking, cognitive activity of students, increase motivation for studying. *Supporting notes* (by V.Shatalov) and *supports* (by S. Lysenkova) are not just the demonstration material. In conjunction with appropriate usage methods, they form technologies of visualization of learning information. The prospect of this direction in the educational process improvement is conditioned by:

1. features of perception, memory and thinking of modern children
2. focusing of educational programs on the development of critical, systemic and logical thinking

3. wide possibilities of implementation of visualization tools using modern IT-technologies, which transform educational content into multimedia interactive environment. At the same time, they eliminate the complexities associated with the large amount of specific didactic material required and, as a consequence, the volume of the teacher preparations for the lessons. The use of smart boards, computers, tablets extends the boundaries of educational didactic materials: it becomes possible to apply new types of visualization based on interactivity, dynamics and multimedia in the educational process (presentations, smart cards, interactive images, educational games, graphics (static and dynamic), animation, video, supporting notes with animation elements, e-magazines with video and audio inserts, etc.). At the same time, traditional visuals (illustrations, paintings, diagrams, tables, etc.) have their own advantages and are still actual too.

Therefore, the use of visualization technologies of educational information with integrated play and research components in the school educational process increases its cognitive, as well as the activity and motivation of students.

**Використані джерела**

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*Инна Липчевская, аспирантка Института педагогики НАПН Украины, научный сотрудник отдела обучения языкам национальных меньшинств и зарубежной литературы Института педагогики НАПН Украины, г. Киев, Украина.*

**ВИЗУАЛИЗАЦИЯ ИНФОРМАЦИИ: ОПЫТ СОВЕТСКИХ ПЕДАГОГОВ-НОВАТОРОВ И СОВРЕМЕННЫЕ ПЕРСПЕКТИВЫ ЕГО ИСПОЛЬЗОВАНИЯ В ОБРАЗОВАТЕЛЬНОМ ПРОЦЕССЕ**

Статья посвящена исследованию опыта советских педагогов-новаторов в сфере внедрения визуализации информации в школьный учебный процесс, а именно технологии интенсификации обучения на основе схемных и знаковых моделей учебного материала и технологии перспективно-опережающего обучения с использованием опорных схем при управлении-комментировании. Раскрыты концептуальные основы и алгоритмы реализации указанных технологий. Приведен анализ их использования в практике школьного обучения и определена актуальность полученных результатов в контексте модернизации образования. Также автором обозначены современные возможности реализации визуального представления информации средствами информационно-коммуникационных технологий, аргументированы целесообразность и актуальность данного подхода в образовательном процессе, определены перспективы дальнейшей разработки проблемы.

**Ключевые слова:** визуализация информации; визуальное мышление; визуальная грамотность; опорные схемы, опорные конспекты, интенсификация образовательного процесса.

*Інна Ліпчевська, аспірантка Інституту педагогіки НАПН України, науковий співробітник відділу навчання мов національних меншин і зарубіжної літератури Інституту педагогіки НАПН України, м. Київ, Україна.*

### **ВІЗУАЛІЗАЦІЯ ІНФОРМАЦІЇ: ДОСВІД РАДЯНСЬКИХ ПЕДАГОГІВ-НОВАТОРІВ ТА СУЧАСНІ ПЕРСПЕКТИВИ ЙОГО ВИКОРИСТАННЯ В ОСВІТНЬОМУ ПРОЦЕСІ**

Статтю присвячено дослідженню досвіду радянських педагогів-новаторів щодо впровадження візуалізації інформації у шкільний навчальний процес, а саме технології інтенсифікації навчання на основі схемних та знакових моделей навчального матеріалу і технології перспективно-випереджувального навчання з використанням опорних схем під час управління-коментування. Розкрито концептуальні засади та алгоритми реалізації цих технологій. Наведено аналіз їх упровадження у практику шкільного навчання та визначено актуальність отриманих результатів у контексті модернізації освіти. Візуалізація навчальної інформації розвиває сприйняття, мислення, пізнавальну діяльність учнів, підвищує мотивацію до навчання. Опорні конспекти (за В. Ф. Шаталовим) та опори (за С. М. Лисенковою) є не тільки демонстративним матеріалом – у поєднанні з відповідними методами використання вони утворюють технології візуалізації навчальної інформації. Перспективність цього напрямку вдосконалення освітнього процесу зумовлена: 1) особливостями сприйняття, пам'яті та мислення сучасних дітей; 2) спрямованістю освітніх програм на розвиток критичного, системного та логічного мислення; 3) широкими можливостями реалізації засобів візуалізації сучасними інформаційними технологіями, які трансформують навчальний контент у мультимедійне інтерактивне середовище. Останнє водночас нівелює складності, пов'язані зі значним обсягом необхідного специфічного дидактичного матеріалу, та, як наслідок, об'ємністю процесу підготовки вчителя до уроків. Застосування мультимедійних дошок, комп'ютерів, планшетів розширює межі навчальних дидактичних матеріалів: стає можливим застосування в освітньому процесі візуалізації, заснованої на інтерактивності, динаміці та мультимедійності. Традиційна наочність також має свої переваги та не втрачає актуальності. Отже, використання в освітньому процесі технологій візуалізації навчальної інформації з інтегрованими ігровим та дослідницьким компонентами підвищує його когнітивність, а також активність та вмотивованість учнів.

**Ключові слова:** візуалізація інформації; візуальне мислення; візуальна грамотність; опорні схеми; опорні конспекти; інтенсифікація освітнього процесу.