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**SYNERGISTIC EFFECT OF USING “GRAPH-THESAURUS” MODEL  
IN THE FORMATION OF OCEANOGRAPHIC KNOWLEDGE  
OF PROSPECTIVE GEOGRAPHERS**

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Synergistic Effect of Using “Graph-Thesaurus” Model in the Formation of Oceanographic Knowledge of Prospective Geographers

The article is devoted to the use of the scientific direction modern pedagogic, as a synergetic in research on teaching geographical subjects (for example, “Fundamentals of Oceanology”).

Views of contemporary scientists on synergetic in pedagogy are analyzed and generalized. Pedagogical experiment is done. As a result of the experiment a positive synergistic effect of using the model of “graph-thesaurus” is identified (connection thesaurus and a graph-tree oceanographic concepts, implemented with the help of a special computer program author’s “The Concept Instrument of Science” (“PAN”)) in the process of formation of the system of oceanographic concepts in preparation for future geographers (for example, the topic „geological and geomorphologic structure of the World Ocean”, training course „Fundamentals of Oceanology”). The computer software „The Concept Instrument of Science” has been elaborated with the aim of illustration (introduction) and retrieval of thesaurus as a tree of concepts and respective graph.

Key words: synergistic effect, the formation of a system of concepts, „graph-thesaurus” of oceanographic concepts

The task of education – to form a person who is fluent in professional conceptual apparatus, uses it in its activity, improves it throughout the life. In the theory and methods of teaching geography, it is advisable to consider the problem of formation of scientific concepts on the example of Oceanography – the science that reveals the processes and phenomena occurring in the most natural combination of the Earth, and therefore has a planetary scale, determines the state of the components of the geographical envelope. Geographers’ understanding of basic oceanographic concepts provides systematic and structural thinking, awareness of the geographical

world view and man's place in it. Oceanographic knowledge is part of the professional knowledge on geography, an element of specialized and professional competence of future geographers. The conducted research [24] suggests that using, both separately and together, the graph-tree and thesaurus of oceanographic concepts in the process of formation of future geographers improves the overall formation of knowledge on oceanography. The use of graphs and thesaurus of oceanographic concepts as basic elements of a single system (model "graph-thesaurus"), creates a synergistic effect of this application. The study of particularly synergistic effect is an important step in detecting the efficiency of the proposed method of forming oceanographic knowledge.

In general, the idea of synergy is quite widely used in modern pedagogical researches [7, 11, 16, 19]. For the purpose of application elements of synergy (i. e. a synergistic effect) in this study, first we analyze and summarize the views of scientists, and review some basic concepts of synergy.

Synergy, synergism, synergetic derive from Greek word *sunergos* (*sun* – common, *ergos* – action) which means "acting together, common activity, collaboration".

Thus, by **synergy**, it is understood the interaction of several factors, the result of which is more than can be obtained, provided by the summation of individual system components.

The term **synergism** came into the scientific lexicon from medicine, where it means 1) the muscles which provide some movement only if the joint action and are called synergists (physiology); 2) medicines which together enhance the therapeutic effect (pharmacology).

Later the term was used in the natural sciences in studies of physical and chemical systems far from equilibrium. Therefore it has been developed a new model of science, which is called "synergetic".

Actually the term synergy was introduced to science in 1969 by German scientist H. Haken [25]. The development of synergy as scientific field is associated

primarily with the names of I. Prigozhyn [15], H. Haken [20], and others whose ideas were crucial to the emergence of synergetic paradigm.

It should be noted that in contemporary scientific community (including pedagogy), there is no clear understanding of synergy. There are various synonymous concepts: complexity theory, the theory of evolution, chaos theory [18, p. 93], the theory of self-organization and others. In general, three main “interpretation” of synergy are defined: synergy as a science, as overall methodology and as a basic post-neoclassical picture of the world [12].

In the most general interpretation, synergy is a scientific trend, the theory of self-organization and self-development systems that has acquired the status of one of the most popular and promising areas of interdisciplinary approaches to the disclosure of the most common mechanisms of self-organization of open, unbalanced and nonlinear systems of any nature within the field of strong action of a variety of different factors, i.e. the rules of creation, preservation and destruction of ordered structures of these systems [4, 13, 21].

A new educational paradigm is built on principles of fundamentality, humanity, integrity [13, 21 and others]. The purpose of this paradigm advocates the providing of students’ holistic understanding of the world, the laws of which are common for nature, man and society. Its application in teaching practice is conditioned by the need to integrate knowledge, globalization of social processes and needs of a new synthesis. It is a holistic view of the world and also the formation of the modern scientific worldview that can be provided by synergy, the essence of which is to recover the holistic worldview [13].

Considering the abovementioned statements, at present there can be defined several approaches to the use of synergy in teaching ideas dependently of which self-organizing systems (in terms of hierarchical subordination) are considered as the object of study:

- student [8, 25],
- teacher [17, 25],

- system of education in general (the main components are students and teachers in their interaction through knowledge) [9, 10, 22].

Let us detail the last one, because these views reflect the possibility of using the synergy of ideas in teaching methods (including oceanography).

The relevance of the ideas of self-organization in pedagogy is related to the recognition of synergistic ability to self-development, not only due to external influences, but mainly due to the sustainable use of its internal reserves [9]. This idea is implemented through the use of innovative technologies, interactive technologies, project method, technology of situational training, etc. when applying different forms of learning and also conditions the search for new ways of shaping their content [22].

We support the opinion of L. A. Blonskiy [3], who notes that in the practice of the educational process it must be born in mind that teaching methodology is synergetic by content, and as any other modern educational technology for learning, it should be student- oriented.

The proposed model "graph-thesaurus" is an element of self-development and self-improvement within the student's educational system, the formation of his professional competence in matters of research, the understanding of phenomena and processes in the most natural complex Earth – Ocean. It provides the basic requirements of a professional-centered learning: centralizes the educational process at the personality of student, organizes an educational process as focused management of independent educational activity of students, directs training and education processes to development and economic self-teaching and teaching activities: teacher and student. Thus the implementation in the learning process two coupled elements (graphs and thesaurus) should give some synergistic (systemic) effects resulting from the integration, merging of separate parts into a single system by i.e. systemic effect [2], which is known to be both positive and negative [14]. Most often synergistic effect is understood as exactly positive effect that is reflected by mathematical formula “ $2+2=5$ ” [5]. Thus, the synergistic effect in education as a complex social information system - is an additional effect from coordinated actions

of the teacher and student with using various methods and means of education as a whole.

The main purpose of this paper is to identify the presence or absence of a *synergistic effect of combined application of thesaurus and graph* on the example of the topic “Geological and Geomorphologic Structure of the Ocean Floor” in discipline “Fundamentals of Oceanography”. It is this “branch” of oceanographic concepts that is characterized by the highest level of formation of concepts.

For this purpose, it was held a teaching experiment, which was attended by 52 2-nd year students of Dnipropetrovs’k National University named by Oles Gonchar. Experiment participants were divided into three groups: EG-G (13 people) that during the formation of oceanographic concepts practiced elements of graph theory (terms-“tree”); EG-T (12 people) - the application of information retrieval thesaurus, EG-HT (13 people) – use of “graph-thesaurus”. The results were compared with a group of KG (14 people), which occurred in the conditions of formation of the traditional approach to learning. To determine the sample, we used the method of calculation by W. Cochran [6], which is based on the formula:

$$n = \frac{1}{\Delta^2 + \sqrt{\frac{1}{N}}}, \quad (1)$$

in which  $n$  – the amount of sample needed for the reliability of the results;  $\Delta$  – a significance level (0,05);  $N$  – the population of all possible study participants.

The sample is representative (formula 1 is the minimum required sample size of 7 items).

At the beginning of the study of topic, all groups that participated in the experiment were tested to detect the entry-level of understanding the oceanographic concepts of the upper levels of generalization. After the learning process of the topic, we conducted a final test. Tests were the same, which allowed us to identify progress in the formation of oceanographic concepts as a result of the learning process.

All groups have a positive result (Fig. 1).

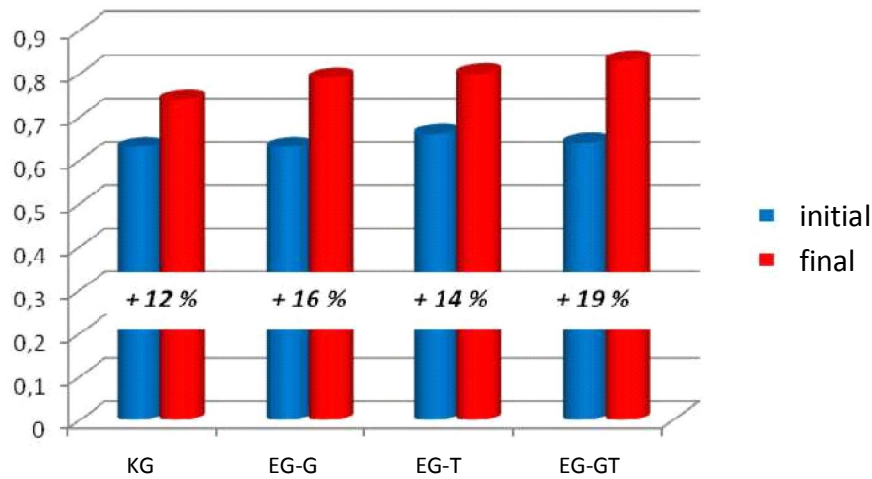


Fig. 1 The efficiency of formation of oceanographic concepts based on the results of the initial (blue) and final (red) tests in control groups with traditional teaching conditions (KG), the use of separate graphs (EG-G), separate thesaurus (EG-T), graph and thesaurus together (EG-GT)

However, distinct synergistic effect of combined application of thesaurus and graph exists. Thus, the use of a separate graph-tree as a mean of learning in order to develop oceanographic concepts is effective than traditional teaching by 4%. Active input of information-retrieval thesaurus into the learning process improves the result of formation of oceanographic concepts by 2%. Conjoint use of graph tree and thesaurus improves the result by 7%, which allows mentioning about synergistic effect of using “graph-thesaurus” as a special medium of instruction (computer program “PAN” [1]) in the formation of oceanographic concepts of future geographers.

After analyzing the main trends in formation of basic oceanographic concepts by levels of formation [23], we can note a positive trend in all these approaches (Figure 2). Negative values in Fig. 2 show at which levels the number of students has decreased at the expense of switching to other levels that take positive values on the chart.

In all groups, there is a shift of students from poor levels of formation (I-II) to the top. Using “graph-thesaurus” creates the highest positive trends in the IV – V levels of forming the concepts, which allows to make a conclusion about a

synergistic effect mostly in the system character of formed oceanographic knowledge.

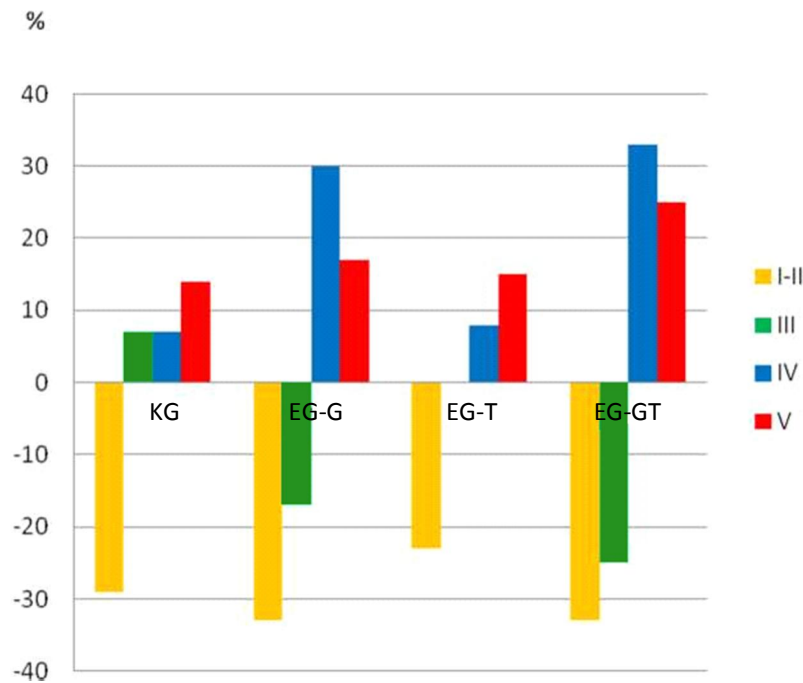


Fig. 2 Trends according to levels of formation of oceanographic concepts (I – V) based on the results of the initial and final tests in the group with the traditional teaching (KG), the use of separate graphs (EG-G), separate thesaurus (EG-T), graph and thesaurus together (EG-GT)

Thus, use of “graph-thesaurus” model (graph tree and thesaurus oceanographic concepts through a special authoring software “PAN”) in forming oceanographic concepts of future geographers creates a synergistic effect and contributes a new professional level to students knowledge and form their system of worldview (synergistic), gives understanding how oceanographic knowledge correlate with the knowledge in other fields of science, and, above all, geographical.

The conducted study suggests the feasibility of using the “graph-thesaurus” model in the study of related geographic disciplines: physical geography of continents and oceans, general hydrology etc., which will improve the formation of common basic geographic concepts of future geographers.

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Чудіна О. Л.

Синергетичний ефект застосування моделі “граф-тезаурус” при формуванні океанологічних знань у майбутніх фахівців-географів

Стаття присвячена питанням застосування такого наукового напрямку сучасної педагогіки, як синергетика у дослідження з методики викладання географічних дисциплін (на прикладі “Основ океанології”). В роботі проаналізовано і узагальнено сучасні погляди вчених на синергетику у педагогіці. Проведено педагогічний експеримент, який виявив наявність додатного синергетичного ефекту застосування моделі “граф-тезаурус” (сумісне використання тезаурусу і графу-дерева океанологічних понять, реалізоване засобами спеціальної авторської комп’ютерної програми “ПАН”) в процесі формування системи океанологічних понять при підготовці майбутніх географів (на прикладі теми “Геолого-геоморфологічна будова дна Світового океану” навчальної дисципліни “Основи океанології”).

*Ключові слова:* синергетичний ефект, формування системи понять, “граф-тезаурус” океанологічних понять.

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Синергетический эффект использования модели “граф-тезаурус” при формировании океанологических знаний у будущих географов.

Статья посвящена вопросам использования такого научного направления современной педагогики, как синергетика в исследованиях по методике

преподавания географических дисциплин (на примере “Основ океанологии”). В работе проанализированы и обобщены взгляды современных ученых на синергетику в педагогике. Проведен педагогический эксперимент в результате которого выявлен положительный синергетический эффект использования модели “граф-тезаурус” (соединение тезауруса и графа-дерева океанологических понятий, реализованное с помощью специальной авторской компьютерной программы “ПАН”) в процессе формирования системы океанологических понятий при подготовке будущих географов (на примере темы “Геолого-геоморфологическое строение дна Мирового океана” учебной дисциплины “Основы океанологии”).

Ключевые слова: синергетический эффект, формирование системы понятий, “граф-тезаурус” океанологических понятий.

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