SYNERGETICS OF THE SCIENCE EDUCATION AND INNOVATIVE TEACHING

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INTRODUCTION

At the present stage in the process of mastering the sciences and technologies in the higher education establishment's considerable attention is mainly focused on a significant amount of material and its unstructured nature, insufficient interconnection and correlation with other disciplines and their practical application. This indicates to the need for the presentation and perception of information on an intuitive level, using visualization tools, modern advances in information technology, especially computer modeling and object-oriented programming [1,2]. There is a relationship between the different branches of education, science, technology and their very sections that can be demonstrated using a fractal approach. This means that in teaching one of the sections (subsections), an algorithm can be determined that is produced and realized in the following sections and, thus, a complex structure is formed while maintaining the integrity of material perception using computer modeling. It is important to note that the formation of this and subsequent iterations retain the "algorithm" of the fractal structure incorporated for the previous iteration that ensures the self-sufficiency and localization of perception [2].

THE CONCEPTS AND METHODS

A fractal is a branched or dispersed structure, whose dimension is different from that of an integer [2]. There are geometric, algebraic and stochastic fractals [3], applied in various fields of physics in modeling of nonlinear processes, such as turbulent fluid flow, diffusion processes, plasma, porous materials. One of the properties of fractals is self-similarity on spatial and temporal scales, which predetermines the usage of one algorithm in the formation of complex structures with a minimum dissipation of energy [3, 4].

An example of the formation of a fractal structure on the information perception in the teaching of sections of physics "Geometric optics", "Wave optics" is given: **The first step – *Physics*, The second step - *Physics and computer modelling*, The third step - *The intuitive perception of information by students and the formation of the fractal structure*, The fourth step - *The hyper sensibility and distribution of fractal structure in the integrated environment,* The five step - *The formation of an integrated fractal structure.*** (It should be noted that this approach can be combined and synchronized with other subject areas, for example, mathematics, economics, geography, society, etc.).

Each iteration (section of physics, mathematics, biology, economics and other subjects) is characterized by a synergy - adding new iteration provides a qualitative perception of the new information. The possibility of using this approach in other sections of physics, and research fields related to physics has been demonstrated. It manifests the formation of a fractal structure and the corresponding iterations, reflecting the integrity and spontaneity of information perception (Fig. 1). Based on the proposed synergetic approach to the use of subject areas of knowledge and computer modeling, the fractal structure is formed on an intuitive level. The functioning of this structure manifests itself in a qualitative transition to self-sufficiency of students, which involves the use of a creative approach and the desire to apply the received information in radically new fields [1].

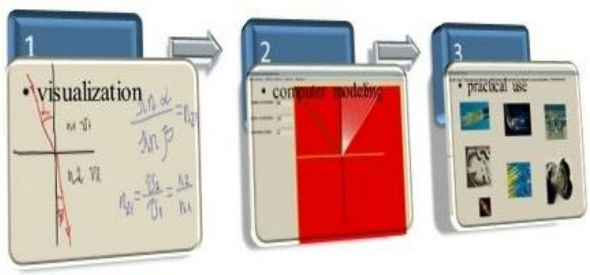

Fig. 1. An example of one of the branches for the fractal structure

Students have the opportunity to directly modify the parameters of the optical system (angle of incidence α, refractive index n, the factors of reflectivity and diffuseness), means of visualization of the rays in Delphi environment (colors of the incident and reflected rays, types of lines) and become active self-sufficient participants in conducting computer experiment in Fig. 1. It is important to develop the algorithm of information perception by students on the intuitive level that will be used and developed further in later iterations (lectures) [2]. It is important, however, that the laws of optics are not perceived separately, not standardized as reports of forced execution and duplication, but they come to life through synergy and principles of object-oriented programming of computer simulation: encapsulation (self-sufficiency), inheritance (creation of a new), polymorphism (distribution in new environments).

Students get the opportunity to be self-sufficient, to create a radically new, to perceive different environments (physical environment, programming environment, information environment), which become not passive (as in the traditional approach), but active - complementary, interpenetrating. It also determines the ability of accumulation and spontaneity in other areas of knowledge, including economics, information technology, mathematics, engineering, and others. That is, the tandem "student-teacher" is filled with activity, ability to develop and rich functioning [3]. This is not an over-saturation with inadequate information, namely the spontaneous, self-organized acquisition and receipt of information objects through the formation of an appropriate fractal structure (Fig. 2). This iteration, this step is essential for the further functioning of the complex structure of the student-teacher and the transition to a new level of perception of information, to the formation of a unique branched structured system (Fig. 2).

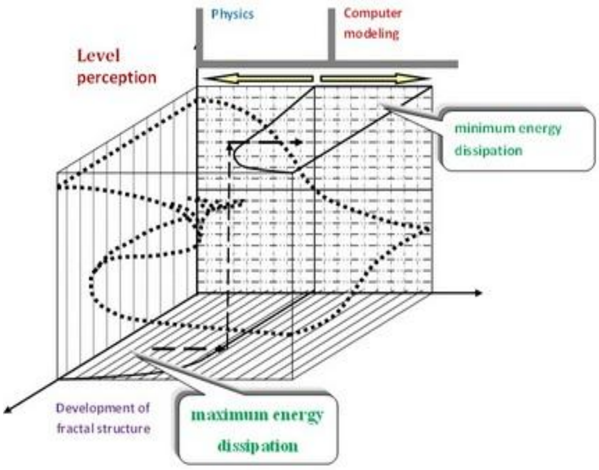

Fig. 2. Computer modeling and level perception

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The concept of object-oriented programming implies that the basis for managing the implementation of the program is the transmission of messages to objects. Therefore, information objects are defined in conjunction with the messages they must respond to when executing the program. This is the main difference between object-oriented programming from procedural programming, where separate data structures are passed into procedures (functions) as parameters. Thus, object-oriented programming consists of information objects - individual pieces of code that interact with each other through certain interfaces [3].

This shows the perfect implementation of synergy - the complementarity of information objects. This also manifests itself in the main difference between the approach proposed and adapted in this book to the teaching of natural sciences. The above fractal approach to teaching natural sciences in higher educational institutions reproduces the integrity of the dissemination and perception of information, the involvement of natural processes of the formation of self-organized self-sufficient structures. It should be noted that it is not tied to specific disciplines (although it can easily be applied to them), since it is based on synergistic integrity and reproduction of the whole (Fig.3)

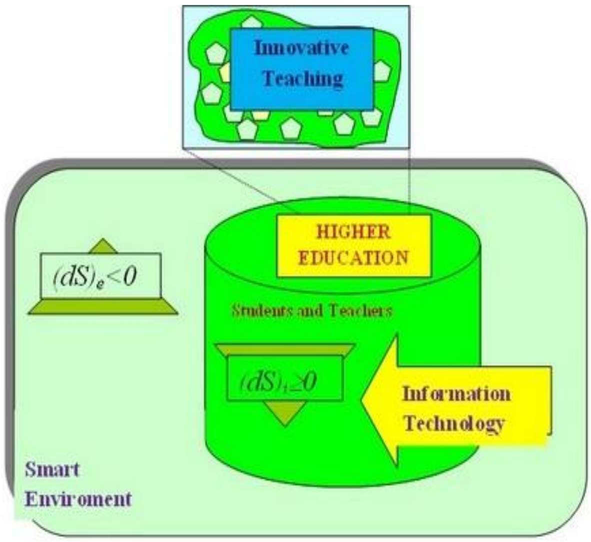

Fig. 3. Synergetics of the science education

CONCLUSIONS

Essential and necessity application of the computer modeling, which determines the cross-cutting nature and the spontaneity of the material presentation, the features of object-oriented programming languages developed on the principles of encapsulation, inheritance and polymorphism is shown. Because of this, each iteration makes use of the properties of the previous one, and, at the same time, it must contain new information (property, method). Synergetics of instability and randomness define new types of ordering and branching out this fractal structure is investigated.

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