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Research Article

Innovative Education as a Basis for Sustainable Development in the Context of Global Changes

Tatiana Yehorova-Hudkova*

Chair Management and Innovation of Economic Low Department, Odesa National Mechnikov's University, Odesa, Ukraine

Abstract

Modern civilization is developing in a period of constant transformations and complication of existing socio-economic conditions. The concept of "singular vertical", "complex system" or "complex structure", "non-linearity" is increasingly used to characterize the contemporary phenomenon. The large-scale, sweeping and rapid changes occurring in the socio-cultural sphere, in the all kinds of environment, revolution changes in technical and technological development predetermine the need for the ability not only to adapt to above changing conditions, but also to manage these changes. It is obvious that it is possible to analyses the state, determine the problems and directions of development, bifurcation points for a complex system on the basis of a transdisciplinary approach, complexity theory and synergetic, project management as base of modern education's system. In the conditions of singularity and increased frequency of crises and crisis situations, the modern paradigm of education can have a significant impact on the quality and speed of decision-making in rapidly changing conditions. Since management is an information process, the speed and quality of management decision-making in crisis conditions will depend on the development of systemic and non-linear thinking during education. Managers with such qualities can solve complex problems of stability and resilience in non-standard crisis conditions.

Keywords

Innovative Education, Transdisciplinary, Sustainability, Singularity, Crisis

1. Introduction

On the context of sweeping changes in global socio-economic processes and phenomena, the need to form a civilizational choice of a new paradigm of education by Humanity is obvious.

The disadvantage of many sciences is due to the fact that they do not take into account the General principles that in modern conditions determine the core of knowledge and its applications. These principles, namely: Measure, Integrity, Harmony, Systems synthesis and they are the basis of a transdisciplinary approach [2, 6].

Only on the basis of the use of General Principles of knowledge we can science, knowledge and the education system be adequately built. It is obvious that the General Principles are transdisciplinary, since they are Universal [8, 11]. The singular vertical of the spread of crises, the emergence of structural crises requires a change in the existing paradigm of education. [18, 19].

*Corresponding author: tatiana1yeg@gmail.com (Tatiana Yehorova-Hudkova)

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2. Education in a Time of Change

2.1. The New Paradigm of Modern Education

The main tasks of changing the existing paradigm of education can be considered:

1. Application in modern education of the main principle of dialectics of bifurcation of the single. It is Universal as the law of knowledge and the law of the objective world.
2. Development and implementation of innovative courses of transdisciplinary content, in order to form a systemic view of events and phenomena;
3. Development of self-education skills.

The main aspects of the modern education system can be defined as:

Factological:

1. Provision of a volume of knowledge within the framework of the approved programs of primary, secondary and higher education;
2. Provision of a volume of knowledge of transdisciplinary content within the variable part of the curricula.

Methodological - how to study after completing education in order to ensure compliance with the conditions of a changing environment and conditions.

Increased attention to the use of General principles of knowledge implies:

1. To change in the level of philosophical training as the basis for the methodological component of education and self-education;
2. The need for fundamental mathematical training (today it is often insufficient);
3. The need to teach "technological" special courses to familiarize students with the basics of technology;
4. The need to teach methodologies, such as project management methodology;
5. The need to teach self-education methodology;
6. A combination of teaching traditional and innovative courses to ensure that students have a "potential difference" in perceiving information to stimulate interest in learning;
7. Inclusion in the variable part of the curriculum or on an optional basis of innovative courses, primarily transdisciplinary, ideological and historical areas;
8. Teaching modern disciplines of transdisciplinary content for students of various specialties [6].

The concept of sustainable development is ensured by the presence of a system of innovative education in order to create the human resources potential of countries to implement the tasks of the strategy of transition to a new technological order, overcoming singularity and minimizing crisis phenomena [7, 8].

2.1.1. Some Innovative Disciplines of Transdisciplinary Nature

In the context of permanent change the management of complex, nonlinear, emergent, self-organizing systems is the most important condition for dynamic economic growth, social sustainability and national security.

To ensure this, it is necessary to change the existing paradigm of education based on a linear approach and replace it with a system of knowledge based on Universal principles that are transdisciplinary, with the transfer of this knowledge in the process of education in secondary and higher education.

A combination of current specialized disciplines of transdisciplinary context for students of various specialties, for example, such as:

1. Econophysics (EPH)
2. Mathematic of Harmony
3. Synergetic management *(positions 1-3 were taught to undergraduate and graduate students of Odesa Mechnikov's National University).
4. System synthesis
5. Tribo-fatigue (theory of systems deterioration)
6. Mixology (characters of food security system) [11].
7. Theory and methodology of design of stable systems that self-organize
8. Theory of stability
9. Nature-like Management, etc. [6-8, 10].

2.1.2. Comparative Example: Mainstream (Economics) and Econophysics

It most clearly represents the possibilities of a transdisciplinary approach, as well as the dialectical reality of physics and economics and the corresponding relevance of the courses "Economics" or "Mainstream", which is practical for all specialties in the management and economic profile [3, 8].

Let's consider a comparative example of the currently widespread concept of Mainstream and the relatively new (1996) concept of EPH. The advantages of EPH, common sense and relevance to the requirements of the modern situation are obvious even within the framework of such a minimized example. The shortcomings of Economics or Mainstream are also obvious, which is proven by existing economic practice and the lack of a crisis-free model for economic development. The need to study EPH as a modern transdisciplinary direction of economic theory becomes a priority in the context of singularity.

2.2. Equations and Algorithm

The constant of the Phidias figures and its mathematical derivatives refer to structural invariants, attractors, which should be focused on when designing artificial super systems and their components. The stages of the design methodology proposed by the author are as follows:

1. Assessment of the status of the system (for example - the system of economic security of the state).
2. Evaluation of the time interval between the occurrence and satisfaction of the need (in a specific system).
3. Assessment of the structural and functional state of the

system.

4. Assessment of the level of vertical integration of business in terms of industries and sectors of the economy and the share of added value in General Domestic Product (GDP);
5. Comparison of evaluation results with attractors representing a recurrent series of golden ratios: 0.500...; 0.618...; 0.682...; 0.725.
6. Control of reliability and viability of the system (estimation of deviations).
7. System entropy testing (relative information entropy calculation). Entropy becomes an expression of the amount of information related in the distribution of system components. Normalized to unity, that is, taken to its maximum value, it can be calculated as:

$$\overline{H} = -\frac{1}{\log n}\sum_{i=1}^{n} p_i \log p_i \qquad (1)$$

where n is the number of system components.

8. Formulation of the system restructuring (reengineering) project
9. Implementation of the project and assessment of compliance of the designed system for structural and functional compliance with the constant of the golden section and its derivatives [8, 11].

2.3. Figures

Complex dynamic systems are divided into dissipative and conservative systems and systems with mixed dynamics. A dissipative system is characterized by the existence in it of a strange attractor that gravitates to a closed invariant set that lies and absorbs it in the phase space of the system within the region that includes all trajectories that cross its boundaries. The basis of the functioning of a dynamic system is feedback and multiple repeatability. The result of the functioning of a dynamic system is a fractal. In 1963, E. Lorentz discovered an attractor, later named after him, which can be an example of a model of dynamic chaos. It is called the strange Lorentz attractor. Any complex economic system, including a hierarchical system of economic security, crisis etc., is open and moves towards an increase in entropy or an increase in the degree of chaos. If the functioning of the system becomes unmanageable, the conditions for the emergence of crisis situations are formed. Knowing the system parameters and managing them, you can take measures to return the system to normal mode. Attractor is also understood as the aspiration of the system to a relatively stable state in the phase space. The model is described by a system of three differential equations. Graphically, the display has the shape of a butterfly.

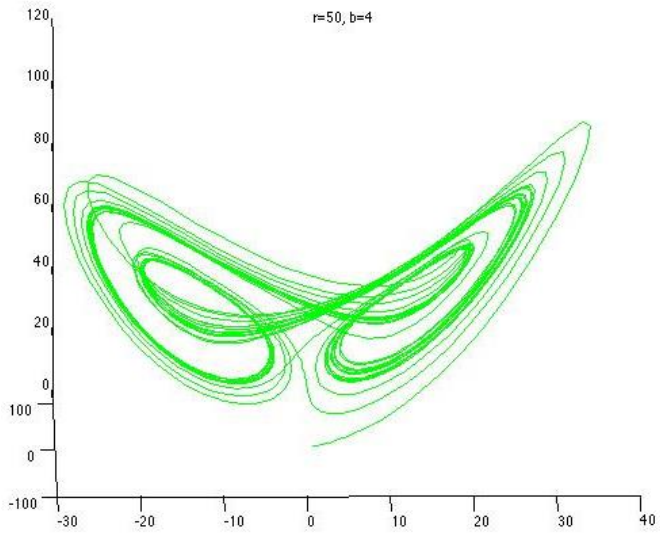

Figure 1. *Lorenz Attractor. [21].*

Lorenz attractor indicates a stable structural and functional state of the system. At the same time, the entire set of trajectories of the developing system will tend to this steady state, or structure. "Strange attractor" - the Lorentz attractor is most characteristic of self-organizing systems [1, 6, 20, 21]. Such attractors have a prognostic horizon or a corridor with a period of prediction of system behavior. The space of the strange attractor has a fractal structure and this also extends the possibilities of prediction. Strange attractors are described by irrational numbers, or Fibonacci numbers, which is a manifestation of the Phidias figures and its derivatives [3-5]. Without understanding the mathematical basis of this phenomenon, which should be provided by modern transdisciplinary education, one can assert a lack of understanding of the development of pro-

cesses in any complex systems. And, exclude the possibility of adoption of incorrect management decisions.

2.4. Table: Mainstream and Econophysics

Table 1. Mainstream (economics) and econophysics: conceptual characteristics.

Mainstream (economics)	Econophysics
Macroeconomic agents act rationally	Economy is a system that develops and is subject to regulation and within the framework of theories of systems that are developing.
People are set up like this: consumers - to maximize output, producers - to maximize profit.	However, when moving towards the goal, nonlinear connections may undergo unstable and chaotic stages. This may lead to deterioration of various market equilibrium processes.
The movement towards the goal is a process of reasoning, unambiguously predictive and universal (it is the same in all countries). The result of the process is an equilibrium market and this is also unambiguous.	Current science can assess the validity of the various options and can give an unambiguous answer that is their proper place. Therefore, EPH appears as an unambiguous transfer of the future and thus rises above the mainstream
The movement towards such an important market equilibrium appears random and sovereign control is not needed	To indicate the obvious - the problem of choice is becoming more acute for many equal countries. This problem cannot be solved spontaneously. It can arise as a force, based on the characteristics and national interests of the region (for example, the vector of integration, the introduction of a new common currency for the region, etc.).

3. Hypothesis and Methods

The hypothesis regarding the possibility of designing a stable system is based on primary design, or on bringing into an artificial system for the purpose of re-designing the set of mathematical constants of living nature.

A comprehensive study of the phenomenon of self-organization of economic system is an actual direction of modern theoretical research and has significant applied significance, especially in pre-crisis situation [6, 9, 13].

The constant of the Phidias or golden ratio and its mathematical derivatives refer to structural invariants, attractors, which should be focused on when designing artificial super systems and their components. This is the mathematical basis of transdisciplinary given by Nature itself and the stimulus for initiating corresponding changes in the system of modern education and science.

4. Results

Each complex open system, schematically, or enlarged, has three basic components: input - circuit of operational closure - output. The most detailed and obvious presence of this property can be observed in nonlinear or non-Gaussian systems with the properties of self-organization and self-harmonization.

The property of operational closure is the most important and interacts with the properties of self-organization and self-harmonization. Together, these three properties ensure the stability of the system and its viability to changes and various kinds of bifurcations for the period between these bifurcations and changes in the state of the system and its transition to a new level. In such periods, there is a need to measure and evaluate the state of the system, which is practically impossible to do with the help of ordinary indicators and indicators. According to K. Shannon, the assessment of the state of the system with self-subordination properties can be determined by calculating the relative information entropy - an integral indicator, which mathematically correspond to the generalized golden sections or fractals or invariant of Phidias figure [2-5, 9, 16, 17].

5. Discussion

Nodes measure the recurrent series of Phidias figure (golden sections) are: 0.5000...; 0.6180...; 0.6823...; 0.7245..., are attractors for integral indicators of systems, in particular - for relative information entropy as a measure of the state of any structurally complex system. These values are the basic characteristics of non-equilibrium stable, stationary states, self-organizing and evolving complex systems beyond the equilibrium of the latter, where this indicator, the relative entropy, is equal to 1. [2, 8, 11, 14, 15].

Understanding the topic of sustainability, self-organization, self-harmonization and the invariant-variant approach is possible only on the basis of studying

the transdisciplinary approach and the concept of measure, which are based on the universal mathematical constants of the Universe.

6. Conclusions

In modern economics, the importance of integrating unevenly important processes and positive feedback is growing. There may be a change in views on the nature of the stable and unstable, on the basis of order and chaos, on the behavior of agents in the market, which forms new goals and objectives for the theory and practice of economic science. The course of each of transdisciplinary disciplines examines the concepts of chaos, uneven transitions, turbulence, bifurcation, fractals and fractality and its economic forms manifest. The concept of complex systems and their characteristics, the theory of channels and jokers, and the phenomena of self-organization of such systems are examined. The basic provisions of the theory of harmony of systems, the systems of invariants and variations of the harmonious economic system from the point of view of the mathematical foundations of harmony are outlined

Abbreviations

EPH	Econophysics
GDP	General Domestic Product

Author Contributions

Tatiana Yehorova-Hudkova is the sole author. The author read and approved the final manuscript.

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Conflicts of Interest

The author declares no conflicts of interest.

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Biography

Tatiana Yegorova-Hudkova, is Docent of Chair Management and Innovation of Economic Low Department of Odessa National Mechnikov's University, Ukraine.

Research Field

Tatiana Yehorova-Hudkova: Theory and Methodology of Transdisciplinary based on Phidias number and its derivatives: - Design of sustainable economic systems and it's self-organization properties based on structuring the system into invariants and variations; - Mixology - study of the sustainability of food product formulations and design of new formulations based on the above proportions; - Crisis Management, study of the stability of systems based on their invariant-variant structure and forecasting possible crisis deviations using of above mathematical constants. Logical–structure approach of Project Management as a working methodology for any research. (Certified Project Manager of International Project Management Association, Swiss)