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## THE REGULATORY FUNCTIONS OF EDUCATION IN BEHAVIORAL MODELS

**Purpose.** To use the behavioral approach to distinguish and consider the main functions of education, which are used to manage and identify neurobiological and social systems.

**Methodology.** The authors used an interdisciplinary approach, in particular, the neurobiological, social and psychological, natural science and sociological concepts. The interdisciplinarity of the methodology allowed the authors to identify and reveal the regulatory functions of education on the basis of the behavioral approach. Developments in the field of neurophilosophy and neurosociology were of great methodological importance. In the work the authors used the methods of historicism, comparativism, analysis, synthesis, and others.

**Findings.** The choice of a behavioral approach for the disclosure of the regulatory functions of education is explained by its mathematical and physical capabilities to model a wide range of neurobiological and social systems. In the problematic field of neurosociology, the authors examined the behavioral models that allowed them to identify and consider three key functions of education that, as external stimuli, affected the transitive core of neurobiological and social systems:

1. A form-building function, which is fully disclosed in the behavioral model of the neurobiological and social system, in which the transitive core is the essence of arete. Arete, as a transitive core, consists of three existentials: mind or noos (νοῦς – “intellect”); knowledge or episteme (ἐπιστήμη); technē (τέχνη).
2. A developing function, which regulates orientation of human self-realization. The developing function of education regulates features of manifestation of a transitive core, or establishes a certain vector of execution of the behavioral model of the neurobiological and social system.
3. A stabilizing function, which brings neurobiological and social systems into a state of “global sustainability”.

The regulatory functions of education have the formation of a stable model of the individual behavior as their ultimate goal. Initially acting as an external stimulus, the regulatory functions of education over time are evolving into a new qualitative state – the functions of self-regulation. Neurobiological and social systems are trained self-control skills. They learn to manage their own external activities and self-development.

**Originality.** The authors used a behavioral approach to study the functions of education. The authors have established and considered three key functions of education that, in the role of external stimuli, affect the transitive core of the neurobiological and social systems: a) formative; b) developing; c) stabilizing.

**Practical value.** The behavioral approach allows modeling a wide spectrum of behavior of neurobiological and social systems: family, groups, cities, civilization and culture. Behavioral modeling of the social processes and behavioral acts in neurosociology improves the quality of management of neurobiological and social systems. Education in behavioral modeling is considered as an important regulator of the behavior of neurobiological and social systems, which improves the quality of management of interconnected systems.

**Keywords:** *behavioral approach, behavior, social learning theory, management, Behavioral models, neurosociology*

**Introduction.** In the theory of systems and control theory, the behavioral approach occupies an important place. In the late 1970s, Jan Willems proposed a behavioral approach as an alternative to classical approaches based on state space, transfer function and convolution representations. The main object of study of the behavioral approach is behavior, as a general basis for system analysis and management. Thanks to the behavioral approach, new results on controllability for nD systems, system identification, control via interconnection were obtained, etc.

In the article, the authors use the behavioral approach to achieve the main goal of the study: to identify and consider the main regulatory functions of education. Achieving this goal will improve the management and identification of neurobiological systems.

**Results.** The behavioral approach before being of interest to mathematicians and physicists has already been widely used in psychology and sociology. In the early twentieth century, representatives of the Chicago school of sociologists used widely the behavioral approach in political science and sociology. In the early twentieth century sociologists Ch. Merriam, H. Laswell, and others formulated a fundamental methodology of the behavioral approach: to bring the structure of power relations out of human nature, which is available for research by scientific methods.

The methodology proposed by the representatives of the Chicago school was based on two key principles:

1. The principle of verification that means that only those facts, which are obtained and verified by observation and quantitative measurement, have scientific value.

2. The principle of operationalism that represents knowledge as a set of specific operations: processing, obtaining and measuring data.

The development of a behavioral approach in the 20<sup>th</sup> century made it possible to model a wide range of behaviors in biological, neurobiological, social, and other systems, as well as continuously improve the quality of control in them.

The behavioral approach aroused great interest in mathematicians and physicists in the second half of the 20<sup>th</sup> century. Having become an object of research of mathematicians and physicists, behavior as a phenomenon, began to be considered as the balanced interaction between specific physical parameters and the general mathematical ideas. Consideration of any dynamic system as behavior, and interrelation of a system as variable sharing became possible. The tearing, zooming, and linking methodology, which was used in the behavioral modeling, brought the modeling of the behavior of interconnected systems to a new qualitative level. The possibility of a mathematical and physical study of neurobiology and sociology, i.e. relationships between people, was opened.

In modern science, the behavioral approach underlies the Social Learning Theory and plays an important role in the development of modern management. It is based on the cognitive-affective personality system, proposed by W. Mischel and Yu. Shoda in 1995. The behavioral approach to modeling of social systems and behavioral acts formed the subject field of a new scientific discipline – neurosociology.

In the neurosociology, the behavioral approach reveals the meanings of the actions that the neurobiological systems carry out. We are talking about social processes and behavioral acts that are associated with the creation and functioning of social systems: families, groups, cities, civilization and culture. One of the most recent reviews in neurosociology is D. Franks' book "Neurosociology: Fundamentals and Current Findings" [1].

Using the behavioral approach in neurosociology, researchers build various behavior models of neurobiological and social systems, or otherwise, models of dynamic behavior of a system during its execution. As a rule, in behavioral modeling scientists distinguish: a) modeling; b) role playing; c) feedback; d) execution. The behavioral models reveal what occurs or how the system reacts under the influence of stimulus from the external environment. Moreover, two types of incentives are considered:

1. Data, i.e. some data obtained from the external environment which have to be processed by a system.

2. Events, i.e. the taking place event that triggers system.

Behavioral models include latent variables in addition to the manifest variables the manifest variables to which the model aspires.

Thus, the use of the behavioral approach in neurosociology opens up the possibility to model the individual behavior of a person, as well as their behavior in society, and in various situations, under the influence of internal and external stimuli. The construction of behavioral models in sociology, on the one hand, allowed involving the methodological possibilities of mathematics and physics in the sociological research, and, on the other hand, created conditions for the integration of neurobiology and sociology into neurosociology. Despite the fact that neurobiology and sociology are very different in terms of methods, theory, tradition and practice, the behavioral approach reunites the evolution of the brain and its social nature into a new scientific discipline – neurosociology. It allows you to build specific behavioral models in which the main functions of education are revealed.

Examples of behavioral models which are created and investigated in neurosociology are:

1. Models of Individual Health Behavior. In the last review on this subject "Health Behavior: Theory, Research and Practice" the main behavior models concerning health behavior are collected and considered. Models consider individual, interpersonal, group and social behavior. They allow us to consider the features of human care about health, quality and life expectancy, and others [2]. It models both individual health and the health of the nation, as well as the correlation between individual and public health care.

2. Numerous individual and group models of behavior in the economics, which reveal the behavior of investors, buyers, retailers, and others, for example [3]. There is a whole area of research in economics – Behavioral economics, which studies the influence of cognitive, emotional, social and other factors on the economic decision-making of individuals and various social associations. Behavioral models in Economics are based on knowledge

of neuroscience, psychology and microeconomic theory.

3. Behavioral models associated with the formation of stereotypes of aggression and peacefulness, on the basis of which, for example, state and regional security strategies are formed [4], or, for example, manifestations of cyber-aggression are modeled [5].

4. Behavioral models of the states in geopolitics, for example [6]. The main purpose of modeling of geopolitical processes is to identify threats to the sustainable development of mankind. The most famous examples of modeling in geopolitics are the reports of the Club of Rome, founded in April 1968 in Rome by the Italian entrepreneur Aurelio Peccei. There should be noted one of the latest projects of the Club of Rome called "Reclaim Economics". This is the youth project aimed at teaching Economics as a practical discipline, but not the mathematical pseudo-science.

However, an important, perhaps, key place in neurosociology is occupied by the construction and study of behavioral models that reveal the modern possibilities of education.

Still Plato wrote about education as about "a form-building matrix" [7]. However, the behavioral approach made it possible to involve methods of mathematical and physical analysis in the study of education. Accuracy in data collection and analysis methods, modeling quality, etc., has increased. The use of the behavioral approach in the study of education has led to transition from the standard educational theories to the empirical educational theories. It became possible to objectify the meanings of education as a "form-building matrix" and establish key regulatory functions of education.

The basis of any behavioral model is formed by a transitive core. The article "The transitive core: Inference of welfare from nontransitive preference relations" discusses the value of the transitive core for different models of nontransitive preference relations [8]. N. Nishimura reveals the meanings of the functions mapping complete binary relations into transitive and reflexive binary relations [8]. H. Nishimura's research expands our understanding of neurobiological and social systems. It allows us to use a transitive core as a phenomenon and a basis of a behavioral model, and functions of a transitive core to consider as the decision maker's true preference. Based on Nishimura's understanding of the transitive core and its functions, we can identify three key functions of education, which in the role of the external stimuli affect the transitive core of the neurobiological and social systems:

1. Form-building function.
2. Developing function.
3. Stabilizing function.

Let us consider the listed functions in more detail.

**1. Form-building function of education.** The first attempt to reveal the sense of a form-building function of education in the neurobiological and social behavioral models was made by N. May in the book "Aristotle's Ethics: Moral Development and Human Nature" [9]. The book provoked a mixed reaction in the scientific community. On the one hand, May, based on the key theories of modern psychology, reinterpreted Aristotle's ideas. She proposed the models of behavior in which the large-scale

Aristotelian meanings revealed the existing psychological theories. For the first time in the scientific literature, the philosophical categories became the object of behavioral modeling, and according to psychologists, a quite successful one. However, on the other hand, as critics of May proved, the modern psychological theories and behavioral models constructed on their basis are not able to explain behavior of a person comprehensively. Therefore, the behavioral models constructed by May do not transfer the scale and perfection inherent in Aristotle's ideas.

The second attempt to reveal a form-building function of education in behavioral models belongs to O. Bazaluk. In the article "The Revival of the Notion of Arete in Contemporary Philosophy" Bazaluk tried to revive the key ancient Greek term "arête" (ἀρετή) through the meanings of the modern research in cognitive psychology and neurobiology [10]. Despite the fact that the term "arête" is actually out of use in modern scientific literature, in fact, all modern sciences of human beings are focused on research of Man. The fact is that in Ancient Greece, especially in the works by Plato and Aristotle, the term "arête" was used to denote the basis of human existence, or the border of "human" in Man. "Arête" in the ancient sense is not just "virtue", as this term is translated in modern literature. It means something close to "unconscious" as at Freud, to "Dasein as at Heidegger, to "existence" as at Sartre, etc., i. e. it is a key concept that reveals the basis of Man, his essence. Therefore, if N. May restricted herself in creation of behavioral models of the neurobiological and social systems by exclusively existing psychological theories, then Bazaluk builds the behavioral models on the basis of the methodology of neurosciences, fundamental ontology, and philosophy of space. In the transitive core of his behavioral models the ontology of Man is presented much broader than the neurobiological and psychological processes. The behavioral modeling Bazaluk allows us to consider the neurobiological and social systems in a wider range of performance than in the behavioral models proposed by May. Bazaluk states that arete is the transitive core of any neurobiological system. Following Aristotle, he singles out the "arete existentials" [10]:

1. Mind or noos (νοῦς), just modern architectonics of the human brain, with its set of functions.

2. Knowledge or episteme (ἐπιστήμη), which are considered as the possibility of expanding the boundaries of individual life to the boundaries of life in the interests of the society, the planet, the cosmos.

3. Techne (τέχνη) is ability to convert knowledge into technologies, peculiar to human beings only. Techne is the care of man about himself and society, which is achieved by the creation of the technosphere, totality of artificial products of labor that segregates human life.

Exploring arete existentials through methods of neuroscience, fundamental ontology, and the philosophy of space, Bazaluk reveals the scale of Plato's understanding of education as a "form-building matrix". In fact, he offers the behavioral model of the neurobiological and social system in which the form-building function of education is completely disclosed. Forming of arete is the essence of execution of the system, giving it certain functions, orien-

tation of self-realization. Influencing the form-building of arete existentials, education regulates the self-realization of man. The form-building of arete, as the form-building of functions of the transitive core of the behavioral model of the neurobiological and social system, reveals completely the formative function of education in action, as the dynamic behavior of the system during its execution.

**2. Developing function of education.** The developing function of education perhaps is presented most fully in the behavioral models of neurosociology. For example, R. Naumenko considered the developing function of education as development of criteria for evaluation of qualities, effectiveness and efficiency of personnel management in the civil service in Ukraine [11]. Based on the behavioral model of a civil servant, Naumenko revealed the impact of education on the development of the key criteria of behavior of a civil servant: special knowledge, skills, moral qualities, and value orientations. On the basis of the results obtained, Naumenko came to the conclusion that the developing function of education actually sets a particular vector of execution of the behavioral model of the dynamic [11].

The developing function of education was studied in the article by O. Fatkhutdinova [12]. Fatkhutdinova considered the developing function of education on the model of Legal Education. Fatkhutdinova showed how effective and versatile the developing function of education can be as well as the behavior of a dynamic system regulated by it, respectively. Fatkhutdinova came to the conclusion that education does not only determine the development of the neurobiological system, but also forms the criteria of legal consciousness, that is, the neurobiological system develops in accordance with additional variables that are controlled by the system itself.

In general, the developing function of education is a source and means of development of neurobiological and social systems. Historically, the developing function of education is considered in the behavioral models as:

1. The function that defines the transitive core and its existentials (Vygotsky-Leontiev's school of psychologists).
2. The function which is caused by self-development of the transitive core (J. Piaget's school).

The degree of influence of the developing function on the transitive core had a direct impact on the choice of existing educational systems. In different periods of the history of civilization and in different cultures if the point of view dominates that the developing function of education forms a transitive core, then in educational theories the role of the external social environment is considered as dominant in the formation of a personality. If the viewpoint prevails that the developing function of education is caused by the self-development of the transitive core, and that the guiding power of the transitive core dominates the developing function, then the individual approach dominates in the educational theories and, accordingly, educational systems. Education adheres to the principle "Do no harm!"

**3. Stabilizing function of education.** The stabilizing function of education now appears to be not only the most recognized but also the most used in practice on a planetary scale. It is actively investigated and used not only in

individual and group behavioral models, but also in behavioral models of a planetary scale, which are created under the auspices of UNESCO. One of the latest examples of the study and use of the stabilizing function of education in the behavioral model of the planetary scale is the Global Action Programme (GAP). The preliminary report was presented in the "Global Action Programme on Education for Sustainable Development" [13].

Global Action Programme (GAP) in fact is a bright example of a behavioral model in which under the influence of education, as an external stimulus, a certain set of behavioral acts is formed. This set of actions, or orientation of execution of a system, is formulated by a phrase "Learn to live in a sustainable way". Five directions of execution of a system or, as they are called "the Partner Networks", are presented in the model *Global Action Programme* (GAP). The Partner networks express a definite direction of individual, group and public self-realization. In the real world, these are global communities of practitioners that form the stabilizing function of education with five directions of the Global Action Programme on Education for Sustainable Development [13]:

1. Advancing policy.
2. Transforming learning and training environments.
3. Building capacities of educators and trainers.
4. Empowering and mobilizing youth.
5. Accelerating sustainable solutions at the local level.

The effectiveness of a behavioral model of the Global Action Programme (GAP) is determined by the magnitude of the vector of the execution of the neurobiological and social systems. According to the Preliminary report, the total execution in all five areas forms an impressive power of the stabilizing function of education. Global Action Programme on Education for Sustainable Development has influenced the behavior of millions of people in different parts of the world. Performing the function of "the global sustainability" education stabilizes the manifestations of the transitive core and leads the dynamic system to a regulatory compromise.

A. Ursul and T. Ursul's research studies are devoted to the disclosure of stabilizing functions of education in the behavioral models of the neurobiological and social systems. The authors identify and consider the stabilizing function of education in the models of the social sustainable development, the economic sustainable development, the demographic sustainable development, and the environmental sustainable development [14, 15]. A. Ursul and T. Ursul prove that despite the difference of the behavioral models, in each of them education provides a specific vector of execution – the stabilizing function.

**Conclusions.** In the article, the authors reviewed briefly the history of the formation of the behavioral approach in science, as well as its ability to model a wide range of behavior in neurobiological and social systems. The analysis of the behavioral models of neurosociology has allowed the authors to identify and consider three key regulatory functions of education, with the help of which the management and identification of neurobiological and social systems are carried out:

1. A form-building function, which is fully disclosed in the behavioral model of the neurobiological and so-

cial system, in which the transitive core is the essence of arete. Arete, as a transitive core, consists of three existentials: mind or noos (νοῦς – “intellect”); knowledge or episteme (ἐπιστήμη); and techne (τέχνη) [Bazaluk].

2. A developing function, which regulates orientation of human self-realization. The developing function of education regulates features of manifestation of a transitive core, or establishes a certain vector of execution of the behavioral model of a neurobiological and social system.

3. A stabilizing function, which brings neurobiological and social systems into a state of “global sustainability”.

The regulatory functions of education have the formation of a stable model of the individual behavior as their ultimate goal. Initially, acting as an external stimulus, the regulatory functions of education over time are evolving into a new qualitative state – the functions of self-regulation. Neurobiological and social systems are trained in self-control skills. They learn to manage their own external activities and self-development.

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### Регуляторні функції освіти в поведінкових моделях

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**Мета.** Полягає у використанні поведінкового підходу для виділення й розгляду основних функцій освіти, за допомогою яких здійснюється управління та ідентифікація нейробіологічних і соціальних систем.

**Методика.** Автори використали міждисциплінарний підхід, зокрема, нейробіологічні, соціально-психологічні, природничо-наукові й соціологічні концепції. Міждисциплінарність методології дозволила авторам на основі поведінкового підходу виділити й розкрити регуляторні функції освіти. Важливе методологічне значення мали розробки в галузі нейрофілософії та нейросоціології. У роботі автори використали методи історизму, компоративізму, аналізу, синтезу та ін.

**Результати.** Вибір поведінкового підходу для розкриття регуляторних функцій освіти пояснюється його математичними й фізичними можливостями моделювати широкий спектр поведінки нейробіологічних і соціальних систем. У проблемному полі нейросоціології автори розглянули поведінкові моделі, що дозволили виділити й розглянути три ключові функції освіти, які в ролі зовнішніх стимулів впливають на Транзитивне ядро нейробіологічних і соціальних систем:

1. Формоутворюючу функцію, що в повній мірі розкривається в поведінковій моделі нейробіологічної та соціальної системи, в яких Транзитивне ядро є сутью арете. Арете, як транзитивне ядро, складається із трьох екзистенціалів: розуму або нусу (νοῦς); знань або епістеми (ἐπιστήμη); техне (τέχνη).

2. Розвиваючу функцію, що регулює спрямованість самореалізації людини. Розвиваюча функція освіти регулює особливості прояву транзитивного ядра або встановлює певний вектор виконання поведінкової моделі нейробіологічної й соціальної системи.

3. Стабілізуючу функцію, що призводить нейробіологічні й соціальні системи до стану „глобальної стабільності“.

Регуляторні функції освіти своєю кінцевою метою мають формування стійкої моделі індивідуальної поведінки. Спочатку, виступаючи як зовнішній стимул, регуляторні функції освіти з часом трансформуються в новий якісний стан – функції саморегуляції. Нейробиологічні й соціальні системи навчаються навичкам самоконтролю. Вони навчаються самостійно управляти зовнішньою діяльністю та своїм саморозвитком.

**Наукова новизна.** Автори використовували поведінковий підхід для дослідження функцій освіти. Автори встановили й розглянули три ключові функції освіти, що в ролі зовнішніх стимулів впливають на транзитивне ядро нейробиологічних і соціальних систем: а) формоутворювальну; б) розвиваючу; в) стабілізуючу.

**Практична значимість.** Поведінковий підхід дозволяє моделювати широкий спектр поведінки нейробиологічних і соціальних систем: сім'ї, колективів, міст, цивілізації та культури. Поведінкове моделювання соціальних процесів і поведінкових актів у нейросоціології підвищує якість управління нейробиологічних і соціальних систем. Освіта в поведінковому моделюванні розглядається як важливий регулятор поведінки нейробиологічних і соціальних систем, що підвищує якість управління взаємопов'язаними системами.

**Ключові слова:** поведінковий підхід, поведінка, теорія соціального навчання, менеджмент, поведінкові моделі, нейросоціологія

## Регуляторные функции образования в поведенческих моделях

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**Цель.** Заключается в использовании поведенческого подхода для выделения и рассмотрения основных функций образования, с помощью которых осуществляется управление и идентификация нейробиологических и социальных систем.

**Методика.** Авторы использовали междисциплинарный подход, в частности, нейробиологические, социально-психологические, естественно-научные и социологические концепции. Междисциплинарность методологии позволила авторам на основе поведенческого подхода выделить и раскрыть регуляторные функции образования. Важное методологическое значение имели разработки в области нейрофилософии и нейросоциологии. В работе авторы использовали методы историзма, компоративизма, анализа, синтеза и др.

**Результаты.** Выбор поведенческого подхода для раскрытия регуляторных функций образования

объясняется его математическими и физическими возможностями моделировать широкий спектр поведения нейробиологических и социальных систем. В проблемном поле нейросоциологии авторы рассмотрели поведенческие модели, которые позволили выделить и рассмотреть три ключевые функции образования, которые в роли внешних стимулов воздействуют на транзитивное ядро нейробиологических и социальных систем:

1. Формообразующую функцию, которая в полной мере раскрывается в поведенческой модели нейробиологической и социальной системы, в которых транзитивное ядро есть суть арете. Арете, как транзитивное ядро, состоит из трех экзистенциалов: ума или нуса (νοῦς); знаний или эпистемы (ἐπιστήμη); техне (τέχνη).

2. Развивающую функцию, которая регулирует направленность самореализации человека. Развивающая функция образования регулирует особенности проявления транзитивного ядра или устанавливает определенный вектор исполнения поведенческой модели нейробиологической и социальной системы.

3. Стабилизирующую функцию, которая приводит нейробиологические и социальные системы в состояние „глобальной устойчивости“ (“global sustainability”).

Регуляторные функции образования своей конечной целью имеют формирование устойчивой модели индивидуального поведения. Изначально выступая как внешний стимул, регуляторные функции образования со временем трансформируются в новое качественное состояние – функции саморегуляции. Нейробиологические и социальные системы обучаются навыкам самоконтроля. Они обучаются самостоятельно управлять внешней деятельностью и своим саморазвитием.

**Научная новизна.** Авторы использовали поведенческий подход для исследования функций образования. Авторы установили и рассмотрели три ключевые функции образования, которые в роли внешних стимулов воздействуют на транзитивное ядро нейробиологических и социальных систем: а) формообразующую; б) развивающую; в) стабилизирующую.

**Практическая значимость.** Поведенческий подход позволяет моделировать широкий спектр поведения нейробиологических и социальных систем: семьи, коллективов, городов, цивилизации и культуры. Поведенческое моделирование социальных процессов и поведенческих актов в нейросоциологии повышает качество управления нейробиологическими и социальными системами. Образование в поведенческом моделировании рассматривается как важный регулятор поведения нейробиологических и социальных систем, который повышает качество управления взаимосвязанными системами.

**Ключевые слова:** поведенческий подход, поведение, теория социального обучения, менеджмент, поведенческие модели, нейросоциология

Рекомендовано до публікації докт. філос. наук  
О. Бродецьким. Дата надходження рукопису 25.02.18.