

NDM-PHILOSOPHY OF EDUCATION IN THE 21ST CENTURY

¹⁾Marga Georgieva, ²⁾Sava Grozdev

¹⁾University of Veliko Tarnovo

²⁾University of Finance, Business and Entrepreneurship – Sofia

Abstract. The article is an attempt to demonstrate the universality of the so-called NDM-philosophy of education in the 21st century. A concept has been presented through various conceptual models targeted at optimization of the intellectual development of lifelong learners within the triad “formal – non-formal – informal” education. All this is realized through a proposed technological model based on an introduced NDM-approach in the context of morphodynamics as a science with interdisciplinary direction in the presence of the “I-concept” of mathematical modeling. The mathematical modeling is visualizing the harnessing the power of human thought in the present technological society, but having justified claims about what is happening in this context and in the future technological society.

Keywords: NDM-philosophy, NDM-paradigm, NDM-environment, NDM-approach

The new dynamic modification – NDM is a tool for adequate changes in different scientific fields, a source of evolution with new options for the optimal development of all processes related to human perception of the world and especially in this respect in the educational system. This is because in the present 21st century more new models related to the ‘I-concept’ of mathematical modeling and rapid development of the information technologies are being imposed.

In our research, we are trying to present auto-didactical technology in the educational system which allows the current scientific knowledge to be used to maximize the development of cognitive abilities in learners. Thereby we are striving to overcome the contradiction between the ever-increasing amount of information and the opportunities of its consumption by learners.

This makes us build this technology in two directions – invariance and variance, i.e. on the one hand, these directions are connected with reproductive capabilities of knowledge itself and on the other hand, with reaching the desired creativity in the optimal development of the intellect in its core activities.

This leads to the following requirement: to search for a new approach (Georgieva & Grozdev, 2016 c), which provokes the emergence of a number of topical issues in the dynamic changes of the social development, within this century being caused by the specifics of the contemporary realities related to the so-called developing training, which answers are not yet clearly defined (Georgieva, 2001a).

Similar conclusions (Georgieva, 2001 b) outline trends with direct projections toward the way of thinking in didactic discourse and provoke discussions that are held in psychological-pedagogical and philosophical literature in the last 20 years.

In such a situation, we are seeking an answer to the question: can we rely on traditional models, but with a new interpretation which in some degree is referring to some of the achievements of innovative models and concepts of training or to look for a completely new approach.

In this article, we talk about a new approach connected to the so-called by us NDM-paradigm which we will be discussing in more detail.

Considering that in the 21st century, the world is again on the verge of fundamental changes linked to the strategy for building a more effective common space for higher education, we will focus on the claim that both in the present and in the future of this century the emphasis is on lifelong learning. In this regard, the article dwells on the triad “formal – non-formal - informal education.” And this requires clarification of what is characteristic about this triad and attention to some definitions of these concepts:

1. Formal education – received by institutionally constructed schools. It is organized, structured and leads to obtaining officially recognized documents.

2. Non-formal education – it is not regulated by laws. It is implemented by institutionalized schools as well as by external ones. Obtaining of the document depends on the willingness of the employer.

3. Informal education – unorganized, unstructured and unclassified accumulation of knowledge, skills and habits/experience. Generally, focused on receiving life experience.

Why is there a need for the above statement?

The scientific literature ((UNESCO, 1997), Notes¹, Notes², (Jeffs & Smith 2008), Notes³, (Swachuk, 2008)) has already concluded for a long time that all three types of learning: formal, non-formal and informal, must go hand in hand and informal learning already has legal framework in Bulgaria (as of August 2016).

Why is this happening?

Because in learners' lives these forms are in constant synthesis and sometimes, of course, one is dominating the others at different periods of training.

Let us now take a look at the NDM-paradigm (respectively the NDM-approach) as an interdisciplinary field in the educational system of 21st century.

What is the nature of this paradigm?

This is a new dynamic modification, i.e. a new complex concept as it covers 10 concepts: eidetics, reflection, synectics, synergetics, enigmatics, akmeology. All of these concepts in synchronization with creativity, cognition, emotion and motivation are able to solve the problems of optimal development of the intellect.

The outlining of this road is related to the introduction of 10 learning environments listed in the abbreviation (see Georgieva & Grozdev, 2016a, p. 6).

The complex environment covering these concepts is called NDM-environment, as it is a foundation in the development of morphodynamics. The morphodynamics itself leads to the defining of the necessary and sufficient conditions in order to enrich itself as an interdisciplinary field for harnessing the power of thought (Georgieva & Grozdev, 2016 a). It is implemented through the mental environment covering two varieties – environment for developing thought and harnessing thought (Georgieva & Grozdev, 2016a).

In this context, the morphodynamics also has 2 varieties – external and internal. The external morphodynamics (Lalov, 2003) is crucial for the generation of options for the development of its modeling features. This means increasing the power of the internal morphodynamics, which is related to the ideal internal processing of external information (from external morphodynamics). And this comes from the fact that the person develops their intellectual potential (Lalov, 2003) during the period of thinking, when they use the incoming information from the outside and process the priorly accumulated information internally. This means that within the NDM-paradigm the relational links between the concepts mentioned above are clarified in the mental environment – in the context of morphodynamics.

Based on that, we believe that in this way we will get faster to the optimization in the development of intellect in the current and future technological society having in mind the ever more increasingly complex integration in various scientific fields. Such statements require continuous changes in numerous educational paradigms with an emphasis, above all, not on the evidence, rather than on the cognitive side of science, with the aim of reaching to the optimal development of the intellect of trainees of this age (Georgieva & Grozdev, 2016b).

However, it here is appropriate to look at the ‘I-concept’ of mathematical modeling, which is responsible for the optimization in the reconstruction of the system ‘trainer-trainee’ through the didactic knowledge (Georgieva, 1987) and we should not forget that it is a binding link between theoretical and empirical methods of research.

In fact, in the monograph (Georgieva & Grozdev, 2016a) we have provided didactic models (6 structural, 5 conceptual, 1 technological model) and 8 mathematical models that outline in detail the optimal path of the development of the noosphere intellect, focusing on models related to the question: What new and why under the new contemporary realities it should be introduced?

The answer to these questions can be found through the proposed conceptual models and is realized through the implementation of the technological model of the NDM-approach. In (Stoyanova, 2017) 'Education' magazine, issue 4 from 2017 (in print), the author very well outlines the contribution of NDM-paradigm in this direction. Conclusions have been made about what makes mathematical models so helpful to the future specialist. The author correctly states that the problems of the education system are systematized in the monograph. These problems of the education system are related to its rapidly changing dynamics needs that require reconstruction in all its levels with a high degree of flexibility and adaptability, especially regarding the role of trainers – a consequence of the new amendments in the innovational situations of modern information society.

Yet why is this conclusion correct?

The proof is related to the fact that the proposed models, indeed, outline the steps of achieving specific educational objectives, i.e. as we have indicated in the monograph ((Georgieva & Grozdev, 2016 a), p. 47): 'The rationale of the conceptual ideas and their process verification, occurring in the system 'trainer-trainee', is allowing the essence of these concepts and mechanisms of optimizing their interdependencies to be completely revealed, which is realized through the dynamics of the proposed mathematical models.

Which are these models – see (Georgieva & Grozdev, 2016a) p. 49 ÷ 59.

At their core, we can find the non-linearity of the processes in the education system and as a consequence of that we can also find the use of partial differential equations of the following type:

$$F_1 \frac{\partial u}{\partial x_1} + F_2 \frac{\partial u}{\partial x_2} + \dots + F_n \frac{\partial u}{\partial x_n} = R, F_i(x_i, u), i = \overline{1, n},$$

$$\sum_{i=1}^n F_i^2 \neq 0, R(x_i, u) \neq 0, i = \overline{1, n},$$

F_i and R are functions of both the independent variables $x_i, i = \overline{1, n}$ as well

as of the unknown function $u(x_i), i = \overline{1, n}$.

The independent variables can represent knowledge, skills, habits/experience, abilities, intuition, insight/revelation, etc. The function $u(x_i)$ can be any of the: abilities, intuition, insight, etc. depending on numerous independent variables x_i . The selection depends on the notion used in the experimental study.

While finding the solutions of these equations or systems of differential equations, attractors spectrum is obtained from which information about the examined problem can be found. For example, when the learner is solving a particular test, they are also track the development of their intellectual potential (see details in Georgieva & Grozdev, 2016a).

The symbiosis of the three types of arts: visual, performing and mathematical (within the mathematical modeling) also represent and interest in terms of the NDM-approach in the monograph (Georgieva & Grozdev, 2016 a). This need is imposed by the presence of the triad ‘cognitions – emotions – motivation’ and its requirements which in some degree are related to the learners’ mood, which influences their memory.

It could even be argued (see Georgieva & Grozdev, 2016a) that the concepts in the triad are driving the creative activity since they incite the subject to fulfill their unconventional ideas as a dynamic factor of the personality.

The entertaining shades of basic chaos theory tools are of interest in the NDM-paradigm and are also attracting learners.

If you call the mathematical models a dynamic art, then the triad ‘performing – visual – mathematical art’ leads not only to the emotional suggestion but also to the entire spectrum of the spiritual nature of the human individual (respectively learners). The full synchronization between them is needed for the triad ‘enigmatics – creativity – akmeology’ which is the way to the peak in the intellectual development of the lifelong learner.

In the 21st century an increasing attention is paid to this triad of arts and based on that there are opportunities for the emergence of a fundamentally new direction in the scientific knowledge due to the so-called computer mathematical modeling, especially in the field of fractal geometry, which contains means for adequate reflection of natural phenomena. The fractal goes as an ‘amazing’ concept, i.e. a revolution in human perception of the world. Rightfully so in science there is the claim for a need of a new paradigm with a new methodology (see (Georgieva & Grozdev, 2016a), p. 60 – 78), that is related to the forming of a universal way toward the study of natural and social phenomena (respectively to what was mentioned above in various scientific fields).

At the risk of repeating ourselves, we will say that everything being referred to so far leads us to the conclusion that in today’s technological society integration is a foundation in the development of science, so in the monograph ‘Morphodynamics for the development of noosphere intelligence’ the main focus is on the information resources of the so-called ‘NDM-approach’ (Georgieva & Grozdev, 2016c).

At the basis of this approach, we postulate that the mathematical art associated primarily with the information technologies that are based on the mathematical knowledge are “alive” because of the practice. The 21st century brought unprecedented progress in all areas of the public practice.

Organically in the integration “Mathematical informational technology” there are a number of components like the nature of the interaction of mathematics and informatics and their projections into practice.

In this regard, here are some general patterns that are at the basis of NDM-philosophy in the educational system which is maintained by the practice (Georgieva, 2001c):

the mathematical knowledge is changing qualitatively in its development, i.e. in its field it includes ever new areas that are climbing to new steps of abstraction and simultaneously are deepening the analysis of its foundations;

the mathematical knowledge is developing namely in the core application of practice, including through information technology.

The mathematical models are those which in many cases may suggest ideas, but the mind is not able to see through them quickly (see the importance of fractals in various scientific fields (Georgieva & Grozdev, 2016a).

The deterministic role of practice in the development of mathematical knowledge and information technology lies in the fact that it constantly poses new problems stimulating their development in some direction.

The fundamental pattern in the development of any science is that it serves to the practice.

All this leads to the dyad 'Mathematical Modeling – information technologies'.

For example, in the NDM-paradigm the interest is rightly directed toward the so-called Grid and Cloud-technologies, at the basis of which information is sought to enrich the optimal development of the intellect. It is only natural to turn our attention to the structures both in the present and in the future toward the information technologies, toward the so-called service-oriented architecture related to the availability of various components serving the triad: начин 'Grid-computing-Cloud-computing-X-computing (using future versions of the software) and to seek ideas for optimizing the development of the intellect.

This, too, prompted us to offer new concepts in the monograph that are served by a new conceptual model of the NDM-philosophy of modern education system (see Georgieva & Grozdev, 2016a, p. 202, fig. 4).

From our long-term research, we rely on the synergistic links between these technologies to enrich the scientific knowledge in this direction, to lead to the realization of the proposed objectives of the conceptual models. We also hope that their components with multiple appropriate characteristics serving the positive evolutionary development will lead in some degree to the realization of the necessary and sufficient conditions for the optimal development of the intellect on a global level.

In the 21st century the need to pay greater attention to heuristic activity in education is even more vital. To this end, in our research we offer conceptual model of the heuristic activity (see Georgieva & Grozdev, 2016a, p. 223, fig. 1), in which we emphasize on the emotional modulation, providing a sense of self-referentiality with personal meaning as well as in the formal, non-formal and informal learning.

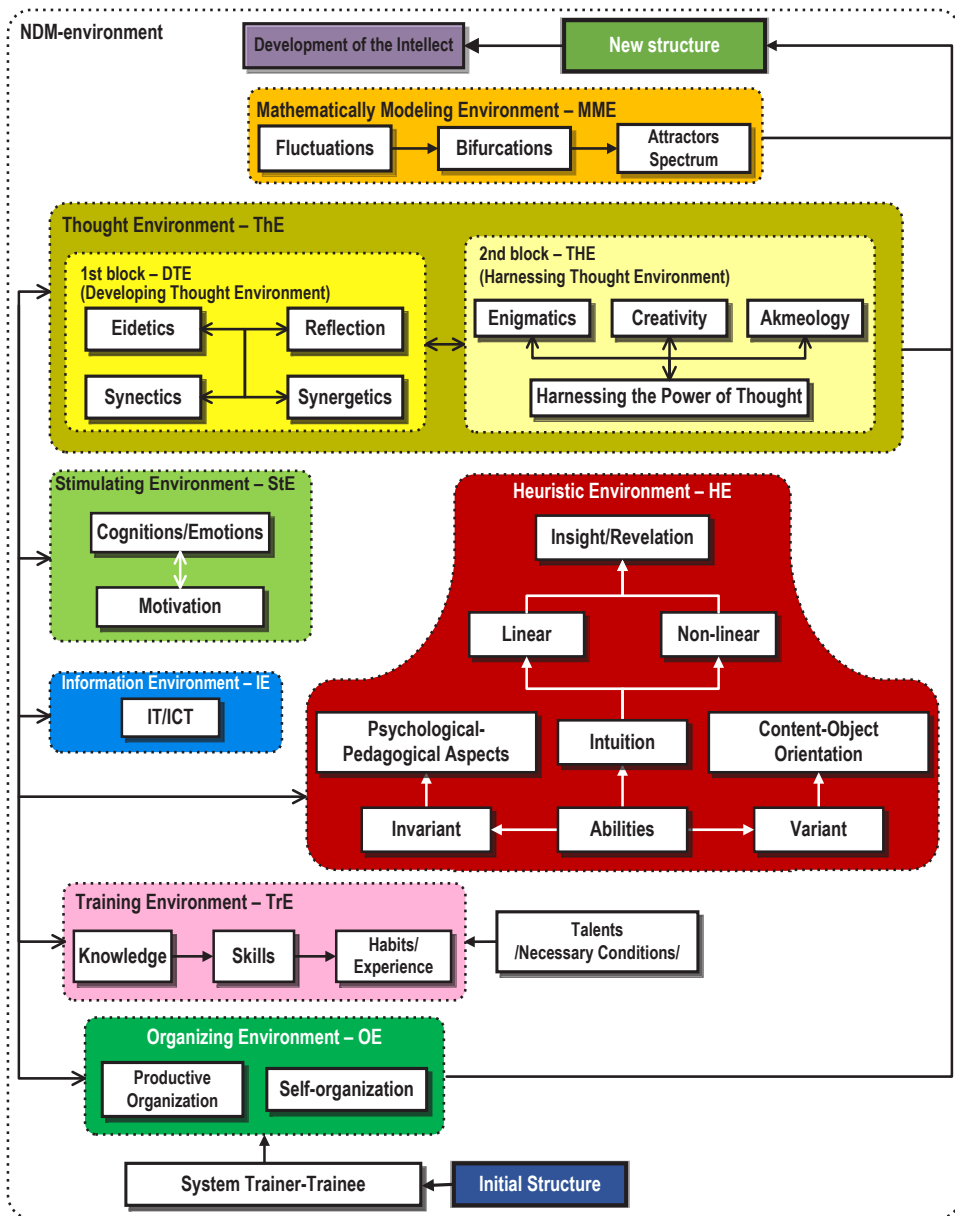


Fig. 1. Conceptual model of lifelong learning within the NDM-philosophy in the presence of the triad ‘formal – non-formal – informal learning’ in the context of ‘I-concept’ of mathematical modeling

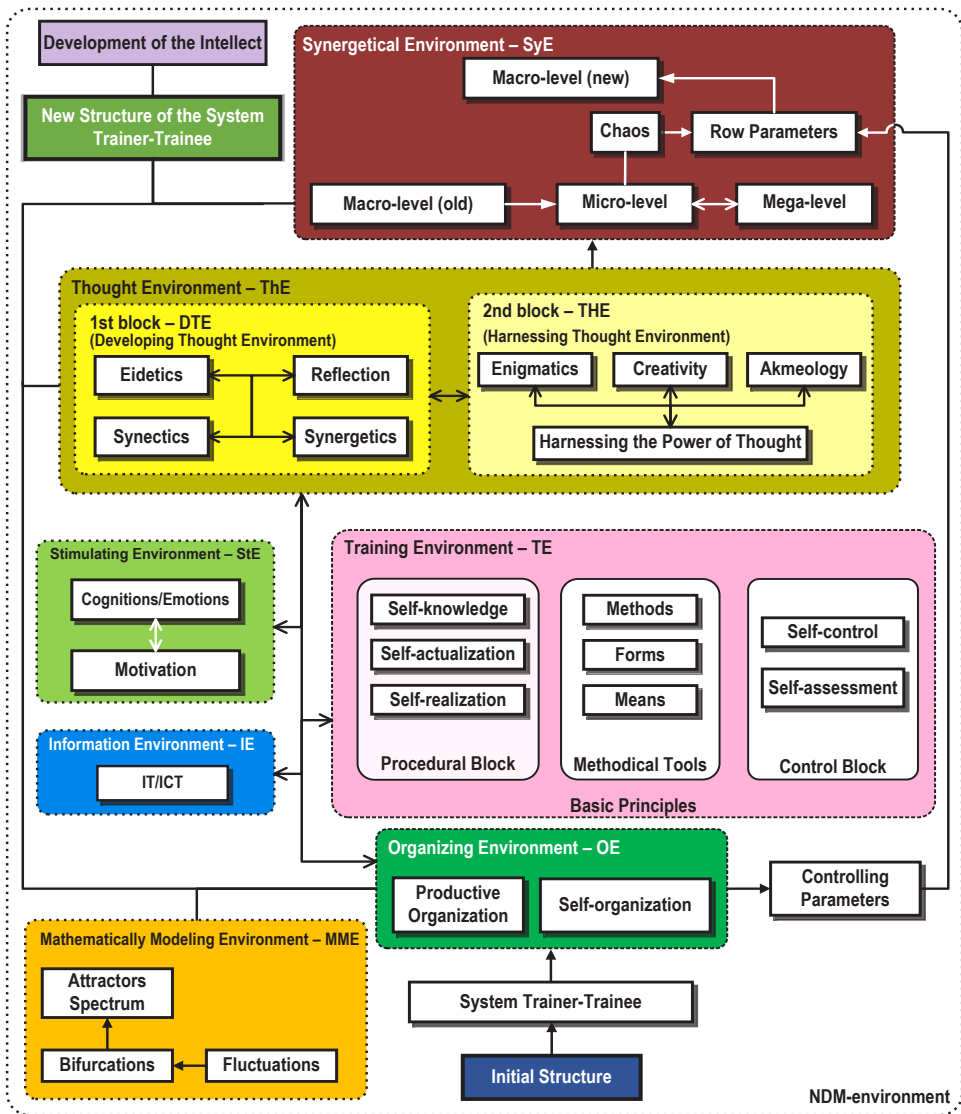


Fig. 2. Technological model of lifelong learning within the NDM-philosophy in the presence of the triad ‘formal – non-formal – informal learning’

We pay attention to the internal motivation because of its effectiveness on creativity which is the basis of heuristic activity that serves the mastering of

thought that is associated with the triad ‘enigmatics – creativity – akmeology’. Details on this issue can be found in (Georgieva & Grozdev, 2016a), § 4.2., p. 220 ÷ 287.

As we have mentioned at the beginning, the NDM-philosophy of education, respectively the NDM-paradigm focuses on lifelong learning (LL) and therefore the proposed conceptual model for lifelong learning also represents an interest. Of course, we must emphasize that the difference between the conceptual models in the various forms of training is essential (see (Georgieva & Grozdev, 2016a), fig. 2, p. 295). This is proved in detail in (Georgieva & Grozdev, 2016a), § 4.3., p. 288 ÷ 304. That is very important because these conceptual models receive information about the speed of change in knowledge, skills, habits/experiences, abilities, intuition, insight/revelation which above all, we will confirm again, are necessary and sufficient conditions for the optimal growth of the learners’ intellect especially in the so-called informal learning from early age (childhood) to the aged adult learner who is seeking opportunities for growing from their individuality to a person (see Grozdev & Georgieva, 2016), as required for scientific knowledge (see fig. 1 and fig. 2 p. 11, p. 12 of this article).

Given the title of the article we will note that the NDM-philosophy of education of the 21st century is an innovative interdisciplinary field, but it must obey to the principle of continuity in science.

On that basis, we take everything positive from the many existing approaches and introduce, because of the constant changes occurring in education of the 21st century in science that is dissolving the issues in the development of the world in which we live - the last word of the present philosophy. We hope that everything mentioned here, will find its positive direction in the future.

Why is this so?

Here is the answer that we offer:

Education cannot be developed (see Merdzhanova, 2015) fully without rethinking of its philosophical foundations.

As some authors rightly claim (Merdzhanova, 2015) in the educational system of 21st century an “open educational environment” must be implemented, respectively “open learning environment” and it should apply fully to the triad ‘formal – non-formal – informal learning’ because as the author of (Merdzhanova, 2015) claims, education itself is a ‘pragmatic means’ for achieving the predetermined objectives. This, on the other hand, leads to a redefinition of certain concepts that are a stable entrance into the thought space in the NDM-philosophy as an integral educational environment that is an original trend of real opening of the education system in 21st century.

Which, however, are the main instruments of this NDM-philosophy of education?

Here is our opinion:

1. Raising the training to a technology in order to increase its effectiveness.
2. The training of technology must be characterized by a description of the procedures for the organization of its operations.
3. The enrichment of the intellectual development of learners should go through the outlined shape of technology.

This particularly means:

1. We depart from the eidetic knowledge to provide a learning environment leading to increased effectiveness of learning activities. In those activities variations of patterns are used and conditions are created in order for learners to analyze the different ratios and to reach understanding and use of the theory.
2. Planning of training as a self-studying in an appropriate learning environment.
3. Conversion of the existing mechanisms into internal support and activation of the innovation processes connected with thinking and teaching activities.
4. Optimizing the ratio of 'rational-emotional' in any activity since the synectical heuristic method stimulates activity.
5. Self-organization of the system 'trainer-trainee' following by a disturbance of the balance and reaching the deterministic chaos, according to the leading goals-attractors.
6. Harnessing the power of thought in the movement of knowledge, skills, habits/experiences, development of capabilities with a focus toward intuition and insight/revelation in order to reach the confirmation of the subject as unique by its daily presence in the triad 'enigmatics – creativity – akmeology'.

We believe that the NDM-philosophy of education in the 21st century within the developed NDM-paradigm is able to solve the paradoxes of the present education, in a way that achieves the pre-planned and expected results.

Moreover, (Georgieva & Grozdev 2016 a), p. 307) in the present technological society the information technologies are allowing different ideas to be precisely model and thus many of the challenges that learners face, in formal, non-formal as well as in informal training to be solve.

NOTES

1. Jeffs, T.& Smith, M. (1990), Educating informal educators. <http://infed.org/archives/usinginformaleducation/jeffsandsmith2.htm>.
2. Jeffs, T.& Smith, M. (1990), Using informal education. <http://infed.org/archives/usinginformaleducation/jeffsandsmith1.htm>.
3. Smith, M. (1999). Informal learning. <http://www.in-fed.org/biblio/inf-irn.htm>.

REFERENCES

- Georgieva, M. & S. Grozdev (2016 a). *Morphodynamics for the Development of the Noospheric Intellect*, 4th revised edition. Sofia: East-West.
- Georgieva, M. & S. Grozdev (2016 b). The NDM-relation 'Morphodynamics- Noosphere Intellect', *Strategies of Educational and Scientific Policy*, 4.
- Georgieva, M. & S. Grozdev (2016 c). NDM-Approach – An Interdisciplinary Approach in the Educational System of the 21st Century, *Education Forum* (e-magazine), Stara Zagora: Thrace University, 4.
- Georgieva, M. (2001 a). *Reflection in the Mathematical Education*. V. Tarnovo: Faber.
- Georgieva, M. (2001 b). On a Rational Technology of Mathematical Training in University, *Mathematics and Informatics*, 2.
- Georgieva, M. (2001 c). Mathematical Knowledge – Practice – New Information Technologies, *Pedagogy*, 2.
- Georgieva, M. (1987). Mathematical Modeling in the Teaching Practice – Relevance, Necessity, Essence, Characteristics and Importance, *Methodology, Modeling, Computing*, Veliko Tarnovo.
- Grozdev, S. & M. Georgieva (2016). NDM-taxonomy Serving the Dyad 'Individuality – Personality', *Pedagogy*, 6.
- UNESCO (1997). *Report of the International Commission on Education of the 21st century before*. UNESCO.
- Zhelyazkova, T. (2010). Informal Education as an Important Element of the Educational Triad, *Strategies of Educational and Scientific Policy*, 2.
- Lalov, B. (2003). *Extrapolation Theory of Learning*, Sofia.
- Stoyanova, V. (2017). The Dyad "Scientific Forum – Scientific Life Serving the Present and Future Scientific Knowledge", *Education*, 4 (in print).
- Merdzhanova, Y. (2015). Synergetic Education – Philosophy, Pedagogical Concept. *Practice*, 2.
- Jeffs, T. & M. Smith (2008). *The process of informal education*. Luxemburg: Office for official publication of the European Communities.
- Swachuk, P. (2008). Theories and methods for research on informal learning and work: tavadscros-fertilization. *Studies in continuing Education*, 30 (1).

NDM – ФИЛОСОФИЯТА НА ОБРАЗОВАНИЕТО В XXI ВЕК

Резюме. Статията е опит да се демонстрира универсалността на т. нар. NDM философия на образованието в XXI век. Представена е концепция чрез различни концептуални модели с насоченост оптимизация на интелектуалното развитие на учещите се през целия им живот в границите на триадата „формално – неформално – информално“ образование. И всичко това се реализира чрез предложен технологичен модел на базата на въведения NDM подход в контекста на морфодинамиката като наука с интердисциплинарно направление в присъствието на „Аз-концепцията“ на математическото моделиране, визуализираща овладяване силата на мисълта на човешкия индивид в настоящото технологично общество, но с обосновани претенции за случващото се в този контекст и в бъдещото технологично общество.

✉ **Prof. Dr. Marga Georgieva**
University of Veliko Tarnovo
2, T. Tarnovski St.
5003 Veliko Tarnovo, Bulgaria
E-mail: margi.georg@gmail.com

✉ **Prof. Sava Grozdev, DSc**
University of Finance, Business and Entrepreneurship
1, Gusla St.
1618 Sofia, Bulgaria
E-mail: sava.grozdev@gmail.com