

Environmental Education and Sustainability in the Greek curriculum: citizenship education and active citizenship¹

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Abstract

The inclusion of Environmental Studies as a curriculum in the Greek Elementary School Curriculum, from the outset, was not limited to an "addition" to existing educational and pedagogical structures, but brought about changes in the epistemology of educational thinking and practice, with a view to educating active citizens and advocates of sustainable development (Sterling, 2004: 49-50). These changes have also contributed to the utilization of ideas and tools of systematic thinking (Sterling, 2004: 49-50), since they are the foundation of the educational and pedagogical approach of this subject. This presentation is a systematic approach to the educational and philosophical background of Environmental Studies (a Greek elementary school lesson) in order to show whether the way human beings and their environmental impacts meet systemic perception criteria. In particular, an exploration of the relevant debate that the scientific community has developed about the transition from objectivism to critical subjectivity, from reductionism to holism and from relativism to the relational mode of environmental study (Sterling, 2004: 51), will be studied and presented in order to show the extent of its impact on the respective Greek Curriculum and the formation of a critically thinking and active citizen. The research method used is the historical review of the relevant literature.

Keywords

Systemic Thinking, Teaching Transformation, Environmental Studies, Sustainable Development

Introduction

The need for a better understanding of the environmental issues (a knowledge that is still under construction) makes it necessary to refer to developmental views, highlighting the diversity and necessity of constructing concepts related to individual nature and the relationships that develops global and local

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environmental risks and interactions between development and the environment. In this context, Environmental Education (E.E.) stresses the need to formulate pedagogical proposals with particular emphasis on changing attitudes, raising awareness and transforming social practices, developing knowledge, involving learners and ability of evaluation.

Conceptual Clarification of Environmental Education and Sustainable Development Education as a teaching subject in the Greek Curriculum

In Greece, the term of "Environmental Education" (henceforth, EE) has been used since 1976. Since 1990, when E.E. has been recognized as a part of the secondary school curricula to this day, a broad institutional framework has laid the groundwork not only at the school but also on a local and central level. According to the current institutional framework, until the school year 2004-2005, the contribution of the PE is being supported as a teaching object to help students acquire a cognitive background and value orientation. They needed to have positive attitudes and participatory behaviors to protect ecological balance, sustainability, growth and quality of life (C7 / 98498/179; 2004). Although there were clear references to environmental objectives between the circulars up to (and including) the school year 2004-2005, the goals were slightly different the following year. According to the Government Gazette (C7 / 105087 / 5-10-2005), the development of E.E. and the development of corresponding action plans for the decade 2005-2014 tend to *"cultivate attitudes that characterize the active citizen and at the same time promote our students the opening of the school to society through the joint implementation of actions with social actors."*

The transformation of E.E. to Education for Sustainable Development was considered by many to be a step that would contribute to promoting an innovative approach to environmental problems and their pedagogical processes (UNESCO, 1996). The concept of Sustainable Development Education (S.D.E.) in its predominant version as S.D.E. is usually based on two definitions. The first and most common reference is the definition set out in the report of "Our Common Future of the World Commission on Environment and Development" (WCED), also known as the Brundtland Report: *"Development is sustainable when it meets modern needs, without reducing the potential of future generations to meet their own needs"* (WCED 1987, 43). The second definition comes from IUCN, UNEP and WWF (1991) "Caring for the Earth: A Strategy for Sustainability" where the previous definition was considered ambiguous (Hesselink, Kempen, & Wals, 2000) and a new one was adopted. According to these organizations, sustainable development means *"improving the quality of human life within the bearing capacity of the ecosystems that support it"* (IUCN et al. 1991, 10). This definition is complemented by the adoption of principles on ecological sustainability,

interdependence with nature, biodiversity, living on Earth without major impacts on nature, species justice and social justice.

The E.E. and S.D.E. is a continuous, future-oriented education process (Daskolia, 2004 as cited in Trikolos, 2015). Its important aims are to realize that the environment is a unified whole, either locally or globally, on the part of individuals or social groups of which man is a part, as well as the formation of attitudes, the development of skills, the acquisition of knowledge and the development of participatory perceptions of individuals or groups to solve various environmental problems (Trikolos, 2015).

Citizenship in the context of Environmental Education and Sustainable Development Education

Whenever we refer to E.E., we classify it in a broader context (i.e., citizenship education). From this perspective, the E.E. aims to empower students as key factors in causing social transformations in individual environmental problems (Paraskevopoulos & Korfiatis, 2003). Political literacy makes students well-informed and refine their critical-thinking skills which in turn will enable them to actively participate (Crick & Porter, 1978) in solving environmental and development problems (Fien, 1993b cited in Paraskevopoulos & Korfiatis, 2003).

Thus, E.E. becomes a means to an end for each student (Kilvington 2010 cited in Jacobi, Toledo & Grandisoli, 2016). This end is seen as a sustainable future (Keen et al., 2005 cited in Jacobi, Toledo & Grandisoli, 2016). It enables them to face complex problems that are resilient to the solution that require multiple disciplines and perspectives and a fundamental shift in social and institutional barriers (Jacobi, Toledo & Grandisoli, 2016). In Keen et al. (2005, p. 262), it is argued that social learning in environmental management is essentially about managing change (Jacobi, Toledo, & Grandisoli, 2016). It is about processes that allow us to share our perceptions and better negotiate social change, so that different views are taken into account (Jacobi, Toledo, & Grandisoli, 2016). That is, the more we build our knowledge grid through the exchange of understanding, the more knowledge we gain. Collective understanding is improving and, in this regard, the RP is an excellent field of knowledge for expanding the growing capacity of social entities to cover common tasks related to sustainable initiatives, as it relates to both the learning process and the learning process.

Thus, when designing education, moving away from the traditional linear path can leave room for new innovations. Sustainable education focuses on these complex interconnected relationships, examining ecosystems, economic systems, and social constructs in order to understand how the system works to effectively solve problems and develop more robust systems (Walker & Salt, 2006, p. 2).

The systemic approach to citizenship in the context of Environmental Education and Sustainable Development Education

What does it mean to teach the systemic way of thinking? In fact, there is no one who teaches a person how to think. It is possible, however, for people to be taught tools and techniques that focus on thought processes and specific processes of the mind. However, it is necessary to differentiate systemic from systematic approach. A systematic approach is defined as something well organized and structured, based on a set of plans or as a grouping into systems. While the systemic approach recognizes that something can affect the whole system. It describes, that is, something that can either affect the whole body or system, belong to it or work with it.

Due to the interdependence of the parts, changes cannot occur individually. In fact, feedback loops can cause unpredictable consequences that do not follow a simple linear lesson and often cause time delays. Senge (1990) summarized that *"today's problems stem from yesterday's solutions"* (p. 57). Richmond, B. (2001) states that systemic thinking requires decision makers to consider the role that the system structure plays (i.e., performance measures, reward systems, and information flows) in shaping behavior. It also examines the system's interactions with external forces. It is characterized as synthetic thinking since it involves studying the role and purpose of a system and its parts with the ultimate aim of understanding the reasons why these parts behave in a certain way. Systemic thinking, in addition, is characterized as dynamic thinking because it examines how the system and its parts behave over time.

Since the concept of systemic thinking is not specific, the cognitive processes required to think systemically are not fully described. Forrester (1971) identified various features of complex systems that make it difficult for people to understand and work with them. These characteristics are as follows: a) cause and effect are often separated both in time and in the interval between them, b) preventing short-term problems often creates bigger problems in the long run, and c) actions that make things worse in the short term often have long-term positive effects. As a consequence of the first two traits, people often fail to learn from their mistakes. Sometimes long delays often result in one person creating a cause and another experiencing the effect. Due to differences in the short- and long-term effects, what a person perceives from the short-term effect of a decision may be different from the actual long-term effect. The subsystems and parts of a system interact with each other using multiple, non-linear feedback loops. This complex flow of interactions often creates unpredictable behavior. Consequently, what seems to be the obvious "right" decision is actually often a bad choice!

Without a clear understanding of the 'big picture' of a situation or an environmental issue, stakeholders focus primarily on behaviors and events that relate to the issues that are dealt with each time rather than on the systems and structures that caused them (Choi, 2011). As a result, the stakeholder cannot "see the forest for the trees" and works harder but not smarter (Choi, 2011). Consequently, learning to apply a systemic approach can help people who desire it to gradually become global citizens through their behavioral adjustment and adaptability to many different factors (Blackmore & Smyth, 2002). Systemic thinking contributes to active citizen participation in collective and transformational practices; thereby helping to move from a language of criticism to a language of opportunity (Paraskevopoulos & Korfiatis, 2003).

Norman Uphoff, an academic and graduate of Cornell University, was among those who emphasized the need to look at open and closed systems, especially to identify "win-win" rather than "win-lose" or zero negative cumulative ("loss-loss") dynamics (Uphoff 1995, 1996 cited in Blackmore & Smyth, 2002). Systems can be considered open or closed in terms of matter, energy, or information (Boulding 1971, cited in Ref. in Blackmore & Smyth, 2002). A closed system is one that remains closed to inputs and outputs in its environment (Blackmore & Smyth, 2002).

Finally, in line with the basic principles of systemic thinking, it is important to consider another dimension of the process of globalization: the "internal" rather than the "external" dimension. The external dimension is the process of building the evolutionary system geared towards a socio-economic and ecological system of global scope and interdependence (Blackmore & Smyth, 2002). The internal dimension, on the other hand, consists of the way people perceive the process of globalization and how societies integrate culture (Blackmore & Smyth, 2002). The inner dimension decides whether the outer dimension is oriented to move along human and sustainable paths or whether it leads to increasing crises and ultimately to disaster (Blackmore & Smyth, 2002). This transit puts changes in social relations at the heart of social innovation and examines the processes through which initiatives attempt to bring about these changes.

The educational and philosophical background of Environmental Education and Sustainable Development Education

The educational background of Environmental Education consists of various educational streams, as reported by Gavrilakis, K. and Sofoulis, K. (2005, p. 54), among which are not those that are ecological in nature but mainly those which are distinguished for their educational and social character. Each, however, is part of the more general pedagogical method of New Education (Gavrilakis & Sofoulis,

2005, p. 54). In Greece, E.E. was developed mainly for the purposes of harmonization with the declarations and activities of international organizations. Specifically, the Ministry of Education moved towards the Declaration of the World Conference held in Stockholm in 1972, which provided for the development of an International Development Program of the E.E. under the auspices of UNESCO-UNEP (Sakoveli & Papasotiropoulou, 2005). The Stockholm International Conference was organized in 1972, under the auspices of the UN, on "Human Environment". Its contribution has been crucial since it has recognized the global dimension of environmental issues and the irreplaceable role of the «E.E.» in addressing them on an institutional level (Gavrilakis & Sofoulis, 2005, p. 58; Flogite, 1998, pp. 121-125). Work has been done and placements have been made, with the consequent enlargement of the subject matter of E.E., since a less physio centric and more anthropocentric approach has been formulated (Gavrilakis & Sofoulis, 2005, p. 1998; Flogi, 1998, p. 58, pp. 121-125). On the other hand, the necessity of including the socio-cultural dimension of environmental issues in the themes of the IP and the inadequacy of its unilateral, physio centric approach was highlighted (Gavrilakis & Sofoulis, 2005, p. 58, pp. 121-125). At the same time, of course, as Gavrilakis, K. and Sofoulis, K. (2005, p. 58) point out, the degradation of nature was just as remarkable, since it was treated as a 'medium' of utility value to man without intrinsic value.

Subsequently, at a Conference in Britain in 1974 entitled 'Project of Environment', School Councils formulated the dimensions of E.E according to the study of Watts (1969) and Lucas (1972- through his doctoral dissertation), as three different approaches to the environment, which defined three different educational and, consequently, didactic approaches to the environment (Papadimitriou, 1998, p. 45, 59 cf. Ref. , Gavrilakis & Sofoulis, 2005, p. 59). These dimensions were about the environment, inside the environment and for the environment. These were (Sterling & Cooper, 1992):

1. Education through the environment. The environment will be used as a familiar field of knowledge and skills. Significance will be given to developing emotions, expressing interest and cultivating respect for it.
2. Education for the environment. It contains the transmission of knowledge about the functions of the environment as well as other aspects of life - economic, cultural, social - that influenced whatever decisions they had to make with the environment.
3. Education for the sake of the environment. The main objective is to cultivate attitudes and to adopt values related to the environment, which have helped shape responsible environmental behavior. Of course, "for the sake of the environment" has given the leading role in meeting human needs.

At the same time, its goals relating to the cultivation of attitudes and behaviors, as well as the ethical and evaluative nature of E.E. were not neglected (Gavrilakis

& Sofoulis, 2005, p. 59). Therefore, its targeting framework and its practical approach were based on the triptych of knowledge, the development of appropriate behaviors and the cultivation of values that would ensure the protection of the environment and human contact with it (Gavrilakis & Sofoulis, 2005, p. 59). However, each aspect had ambiguities, since it was not clear what attitudes and behaviors would be taught, what constituted an environment, and what was defined as a third dimension of the environment (Gavrilakis & Sofoulis, 2005, p. 59). The third dimension was construed as a 'favor' of the environment with the uncertainty of its correct translation (Gavrilakis & Sofoulis, 2005, p. 59).

Subsequently, the Charter of Belgrade was signed at an International Conference on E.E. held in Belgrade in 1975 (Tsaliki & Georgopoulos, 2002, pp. 13-15). According to the Belgrade Charter, in addition to the ecological awareness of the pupil, the aim of E.E. was to ensure the active social participation of tomorrow's citizen, with the aim of resolving environmental problems (Tsaliki & Georgopoulos, 2002, pp. 13-15). Her texts were characterized by an idealistic tone and expressed trends of eccentric content (Flogaitis, 1998, pp. 132-138). The holistic and interdisciplinary nature of its field was established, since the need to treat the environment in its entirety as a natural, anthropogenic, political, ecological, social, technological, economic, cultural, aesthetic and legal environment was required (Tsaliki & Georgopoulos, 2002, pp. 13-15).

The drafting, however, of a clear and substantiated theoretical framework of E.E. was sought at the first World Intergovernmental Conference on E.E. in Tbilisi in 1977, with a view to defining its purpose, purpose and the formulation of a series of proposals that would address its integration into education systems and the best possible cooperation between the States involved (Tsaliki & Georgopoulos, 2002, pp.13-15).

According to this Conference, therefore, the active involvement of people in dealing with environmental problems has been the aim of E.E. (Chawla & Cushing, 2007, p. 441). The specific objectives were human consciousness, environmental interest, knowledge and competence (Chawla & Cushing, 2007, p. 441). In fact, the notion that the transmission of required environmental knowledge would ensure the social mobilization required for the pursuit of a better future prevailed (Chawla & Cushing, 2007: 441). Emphasis was placed on the fundamental importance of ecological knowledge and the approach of the environment as a systemic reality that would evolve over time and, therefore, require a systemic and interdisciplinary approach to environmental problems. Indeed, it has been suggested to employ methods that would promote participatory and direct experience (Flogaitis, 1998, pp. 138-14). The fruit of this Conference's work was the "Declaration on the E.E." in combination with 41 new proposals that constituted the most important text of a theoretical framework of the IP for all subsequent work (Flogaitis, 1998, pp. 138- 144). In other words, the Tbilisi

Declaration has been the cornerstone of every strategy and program at national and international level for years to come, without implying that its content was complete (Gavrilakis & Sofoulis, 2005), p. 61). This did not allow teachers to be adequately oriented (Gavrilakis & Sofoulis, 2005, p. 61). The concept of the environment was difficult to define, as was the difficulty with the proposed teaching methodology due to the ambiguities of the text in its corresponding points (Gavrilakis & Sofoulis, 2005, p. 61). The texts as a whole, then, had no educational outlook, as conditions were prevailing in the technological and political sector (Gavrilakis & Sofoulis, 2005, p. 61).

A world conference on "Environmental Education and Training" (Gavrilakis & Sofoulis, 2005, p. 62) was held at the Tbilisi Conference in Moscow in 1987. This has contributed to the development of a common strategy for the establishment of E.E. in the education and training of stakeholders worldwide (Gavrilakis, K. and Sofoulis, K., 2005, p. 62). Sustainable development has gradually emerged as a key word in trying to bridge the gap between the environment and development as well as resolving individual environmental issues (Gavrilakis & Sofoulis, 2005, p. 63).

The next important meeting for the promotion of E.E. in all disciplines and levels of Education as well as for the training of the teachers involved was the Meeting of the European Ministers of Education within the Council of Europe (Georgopoulos & Tsaliki, 1993, p. 22 pp. Gavrilakis & Sofoulis, 2005, p. 63). In this context, its gradual and progressive consolidation of a clear, integrated and substantiated theoretical framework of E.E. with its parallel scientific foundation was confirmed, while at the same time seeking to secure this subject as a process of political and social education, such as reports Tanner (1980). They conclude that a central place in the educational model of E.E. should have been the up-to-date social action of the citizens provided they possessed the required knowledge, relevant competence and appropriate skills.

The 1990s then began with the Rio Intergovernmental Conference in Brazil (1992) on 'Environment and Development' (Liaraku & Flogaitis, 2007, pp. 34-37) whose contribution has been of paramount importance since marked the entrance of E.E. into the Age of Sustainable Development (Gavrilakis & Sofoulis, 2005, p. 64). Particular importance was given to reducing the pollution of the planet to enhance sustainability (Gavrilakis & Sofoulis, 2005, p. 64). Elemental economic development, environmental protection and social justice are the keys to social cohesion and progress, as the rules of sustainability dictate (Gavrilakis & Sofoulis, 2005, p. 64).

The World Conference on Education and Communication on Environment and Development, held in Toronto in 1992 by UNEP, UNESCO and ICC, dealt with the educational part of the Rio Recommendations (Liaraku & Flogitis, 2007, pp. 34-37). It was recognized as a key tool for promoting sustainability while the International Conference "Environment and Society: Education and Awareness

Raising Citizens", organized in Thessaloniki in 1977, identified Education as one of the key pillars of sustainability (Liaraku & Flogaitis, 2007, pp. 34-37). As a consequence, E.E. was now defined by the term 'Education and Sustainability' including nutrition, population, poverty, human rights and democracy in the sense of sustainability (Liarakou & Flogaitis, 2007, pp. 34 - 37).

In the early 1990s, Toronto, Canada, attempted, through research and meetings, one of the first attempts to redesign the curriculum of all levels of compulsory education with a view to sustainable development. Some countries renew their curricula by incorporating sustainability, while others, including Greece, do so at a glance. So after the Thessaloniki Conference, the circulars addressed sustainable development. The direction is for teachers to link their action to sustainability, issues that deal with local environmental issues and work with local bodies (Government Gazette C2 / 4881 / 11.9.1998, C2 / 4255 / 22.9.1999).

Sustainable Development is included in 2003 in the IFRIC (210721 / C2, March 23, 2003, Government Gazette Issue 2, Issue No. 303) (Liarakou & Flogitis 2007). The decade 2005-2014 was designated as the Decade of the S.D.E. and was officially launched in March 2005 by UNESCO. The concept of sustainability is at the heart of international action to eradicate poverty and protect the environment, and sustainable development is a prime objective for the coming years, while focusing, at the same time, on the relationship between poverty, the environment and the use of natural resources.

As already stated at the Rio Conference in 2012, the need to incorporate the concepts of sustainability in the Curriculum was recognized. The value of solidarity is an integral part of education, with the aim of safeguarding freedom, equality and ecological sustainability. Floggett (2006) mentions the attempt to create citizens who will strive for social emancipation through a democratic educational process that is consistent with sustainable development practices.

In Greece, E.E. has been linked to the Environmental Study teaching course, which is taught in the first grades of elementary school. There is a connection between their disciplines and therefore the latter could be a means of disseminating its principles and philosophy into a clear, comprehensive and substantiated theoretical framework of E.E.. As stated in the Department of Education (GG 303 / 13-3-2003), the educational process is aimed at re-educating the student about the needs of the social environment and the gradual action. Specifically, the focus of educational planning is to make the student aware (GG 303 / 13-3-2003: 3734): *"of the necessity of protecting the natural environment and adopting similar behavioral patterns"*, since the educational process is inextricably linked to the social status of the student. The need to enhance the sustainability of the planet through the protection of natural resources is being identified, and the concept of intergenerational solidarity is being diffused. There is also reference to sustainability, which is recognized as a

prerequisite for human (and not only) well-being and the need to redefine human needs (Government Gazette 303 / 13-3-2003: 37353736).

The course is taught in the first four grades of elementary school and includes elements from Physical and Social Sciences, Religious and History, Environmental Education, Consumer Education, Traffic Education, Health Education, Mass Media Education, as well as Mass Media Contemporary Technology (Government Gazette 303 / 13-3-2003: 4044). The above are not an integral lesson and are approached through an interdisciplinary framework with thematic extensions. The Environmental Study is included in the schedule of the 1st and 2nd grade (4 hours per week) while in the 3rd and 4th grades the classes are held 2 hours per week (Φ13 / 1655/197708 / D1, 2016).

The student seeks to develop appropriate attitudes and behaviors for effective integration into their physical, social and cultural environment, with general goals often referring to the need to develop environmentally-friendly behavior and awareness of their relationship to the natural and social environment (GG 303 / (Government Gazette 303 / 13-3-2003: 4047) (Government Gazette 303 / 13-32003: 4050). Its holistic dimension (i.e., natural, artificial, social, economic and historical) accounts for the environment.

GG 304 (13/3/2003: 4361) does not omit the prevention and resolution of environmental problems, the involvement of students in the decision-making process, the sustainable management and development of the environment, the examination of its present and future state of environment. It aims at original action on a local level with the ultimate aim of acting nationally and globally in the rational use of natural resources and technology within an educational context of equal opportunities for learning and knowledge in co-operation and development of environmental behavior and school connection with social happenings.

In order to achieve sustainable goals, we propose a holistic system of values based on active learning by the learner himself. It is very important to analyze the student's social and personal experiences. According to the *Guide to the Development of Inter-thematic Activities of the RU* (YPEP, III, 2009), E.E.: "*aims at creating active citizens through the cultivation of an understanding of environmental problems, decisions and action in relation to them, including the study of interdependent parameters such as democracy, peace, human rights, poverty and the provision of food and a decent standard of living, equality, multiculturalism, etc.*" (p. 13).

Conclusions

The promotion of a clear, integrated and substantiated theoretical framework of E.E. requires the application of systemic thinking as a way of constructing the world which

Flood (1999) calls “a holistic view of social settings” (Abdyvor et al., 2016). This means that events and organizations will not be static but dynamic (Abdyvor et al., 2016). It is necessary for the student to understand the interactions and systemic effects of different modes of action between them (Blackmore, & Smyth, 2000). Systemic thinking allows one to think, to view, evaluate, and gradually acquire the ability to predict the interactions between living and non-living things and sometimes predict the results of relations established between them (Senge et al., 2000).

It is clear from the historical overview of the debate that has taken place on the foundations of the contents and purposes of the curriculum. The present study points out that educational institutions have been progressively and gradually scaling up since the accession of S.D.E. in the Environmental Education course and then seek to impart a systemic approach to the world to primary education students. This is the case when individual conferences are recognized as promoting E.E. requiring the application of systemic thinking to shape tomorrow's environmental ethics, behavior and perception. The present study points out that education policymakers have laid the foundations, at the level of purpose of E.E., for establishing systemic thinking as a way of resolving environmental and, consequently, complex problems. It is briefly stated that it was pursued at the first World Intergovernmental Conference held in Tbilisi in 1977, to approach the environment as a systemic reality that would evolve over time and therefore systemically needed and the interdisciplinary approach of environmental problems. At the 1987 Tbilisi Conference in Moscow, sustainable development has gradually emerged as a key word in trying to bridge the gap between the environment and development as well as resolving individual environmental issues (Gavrilakis & Sofoulis, 2005, p. 63). The meeting of the European Ministers of Education within the Council of Europe also highlighted that a central place in the E.E. model of education should have been the up-to-date social action of citizens subject to the required knowledge including their respective and appropriate skills. The Rio Intergovernmental Conference in Brazil (1992) on "Environment and Development" marked the entry of E.E. into the Age of Sustainable Development. The International Conference on Environment and Society: Education and Awareness of Citizens for Sustainability," organized in Thessaloniki in 1977, recognized Education as one of the key pillars of sustainability while E.E. was now defined by the term of "Education and Sustainability" including nutrition, population, poverty, human rights and democracy in the sense of sustainability.

In the context of environmental and sustainable education, it now becomes clear that people live in a rich and complex environment in which some of its elements are natural and some are of its own production (Pushkar & Potrashkova, 2008). Systemic thinking recalls that everything that is observed is caused by comprehensible relationships between the individual elements (Pushkar & Potrashkova, 2008). It is necessary to appreciate a particular phenomenon from

a larger number of perspectives and perspectives and, of course, one's ability to see oneself as part of large processes and events (Abdyvor et al., 2016). Donella Meadows (1999) interprets systems that “think” as a new means of describing and discovering the surrounding world, meaning that “everything is related to everything,” that interactions can be non-linear and form circles. It remains to be seen, however, whether more has been done on the level of textbooks to convey the interdependence of parts of a system and the environment with the system itself to pupils, so that this principle inspires its practical application.

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