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**CONSTRUCTING INTERDISCIPLINARY EDUCATIONAL
REALITY INTO INFORMATION AGE**

Natalia N. Naydenova (a)*, Anna A. Mamchenko (b), Tatiana D. Shaposhnikova (c), Igor G. Sukhin (d), Oxana I. Dolgaya (e), Vladimir A. Myasnikov (f)

*Corresponding author

(a) PhD (Education), Deputy Head, Centre for Comparative Education, Institute for the Education Development Strategy of Russian Education Academy, 5/16 Str. Makarenko, Moscow 105062, Russian Federation; naydenova@my.com*; +7 926 2128867

(b) PhD (Philosophy), Deputy Head, Laboratory of General Learning Theories, Institute for the Education Development Strategy of Russian Education Academy, 5/16 Str. Makarenko, Moscow 105062, Russian Federation; anna-priv@yandex.ru

(c) PhD (Education), Senior Researcher, Centre for Comparative Education, Institute for the Education Development Strategy of Russian Education Academy, 5/16 Str. Makarenko, Moscow 105062, Russian Federation; tatianashap@inbox.ru

(d) PhD (Education) Senior Researcher, Centre for Comparative Education, Institute for the Education Development Strategy of Russian Education Academy, 5/16 Str. Makarenko, Moscow 105062, Russian Federation; suhin_i@mail.ru

(e) PhD (Education) Senior Researcher, Centre for Comparative Education, Institute for the Education Development Strategy of Russian Education Academy, 5/16 Str. Makarenko, Moscow 105062, Russian Federation; o-dolgaya@yandex.ru

(f) Dr.Sc. (Education), Academician, Professor, Chief Researcher, Centre for Comparative Education, Institute for the Education Development Strategy of Russian Education Academy, 5/16 Str. Makarenko, Moscow 105062, Russian Federation; mjasnikov@inbox.ru

Abstract

The theoretical basis of designing interdisciplinary educational reality is built on the basis of approaches of constructivism. Twenty methods have been identified that can be used to conduct interdisciplinary research in the field of education on a different constructs and for the formation of a constructed reality by different subjects of the educational process. Among the interdisciplinary constructs, the following are considered: 1) the theoretical positions of constructivism, which are the basis for interdisciplinary understanding of the constructed educational reality; 2) interdisciplinary approaches of the constructivism methodology; 3) constructive pedagogy in the post-Soviet space; 4) verification methods used in interpreting the results of interdisciplinary research in the field of education. Each subject constructs his own reality according to the level of his information literacy and goes beyond formal education. In particular, we give a brief overview of the research conducted among mathematics teachers from Latvia, Russia and Estonia on the use of constructivism methods in their practice. The theoretical basis of the constructed educational reality is considered in the article; interdisciplinary approaches within the framework of the constructivism methodology; the principles of designing interdisciplinary educational reality are given; there are described the development of the ideas of



constructivism in education, primarily in the post-Soviet space; methods of verification of scientific research results are given: quantitative and qualitative comparative analysis on the basis of statistical processing of results by mathematical and software tools.

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Keywords: Interdisciplinarity, reality, design, methodology, verification.

Reality is a cipher with many solutions, all of them right ones.

I. Murdoch

1. Introduction

In today's rapidly changing world, the interpretation of reality is changing. Educational reality is designed much broader than the framework of formal education. Actually, educational reality is constructed by the subject of education itself - a learning person (Lukackij, 2016). Moreover, each educational institution has its own constructed interdisciplinary educational environment (Klimenko & Elkina, 2015; OECD, 2009). All subject teaching in the school is permeated with Interdisciplinary learning, since the student learns not only on the subject teaching, but also in the family, at the tutor, comrades in school, friends in the yard, on the basis of the mass media. And in the information age, each student is bound by close ties with the gadget and the Internet. That is, the student creates an educational reality independently, attracting various training aids and various assistants for own training (Fuchs, 2008b).

2. Problem Statement

It is enough to pass the observation tube (kaleidoscope) to other person, so the picture of reality changes instantly. Moreover, if you are twisting a kaleidoscope in own hands, then the picture even for you will change. Therefore educational reality is not a frozen learning space so it is instantly changed (Ivanova, 2017). In addition, here and now, this changing environment becomes a constructed educational reality outside the subject teaching (Fuchs, 2008a). That is, the educational reality is constructed by each subject and at each moment of time, or else it exists in the mind of a person.

Without pretending to fully consider and understand this problem, for starters it is worth considering an interdisciplinary reality formed within the framework of formal education in the context of the ideas of constructivism. However, let us remember (see the epigraph), reality is a cipher with many decisions, and there are many ways to solve it (Murdoch, 2003). Therefore, the views of constructivists on the formation of the constructed reality should be carefully analyzed here and now.

3. Research Questions

First, we need to consider the basics of constructivism, since to explore educational reality as a constructed one follows in this perspective. Then we reveal the principles of development of educational reality in the information age. The result of the study is the methods of the verifying results in

interdisciplinary studies. Therefore, after studying the possibility of applying the constructivism methodology to education.

4. Purpose of the Study

Therefore, the aim of the study was to examine the constructed educational reality from the standpoint of constructivism and on the basis of common approaches to solving this problem in different sciences. As a result, it is necessary to break common approaches of constructivism to education and to write methods of verification. That is, the study has two goals: the construction of educational reality and the primary description of methods for verifying the results of interdisciplinary research.

5. Research Methods

Therefore, to solve these goals, a hybrid methodology was used: interdisciplinary analysis and interpretation analysis of the application of the allocated approaches to education. Methods of analyzing literature from related sciences were used, approaches that could be used in constructing educational reality were singled out, principles for the development of reality were formulated, examples of solutions in the post-Soviet space were given as an empirical representation, and then primary methods of verification were described. The methods of conducting this research in a logically sequenced order for solving the stated goals in three conceptual frameworks are presented below.

5.1. The theoretical basis of the constructed reality.

The theoretical basis of construction could not be outside the framework of constructivism. At the heart of constructivism lies the thesis that in the process of cognition, a person creates (constructs) his own reality. Constructivism is a direction based on the idea of the activity of the cognizing subject in constructing ideas about oneself, the world and their interaction. According to I.T. Kasavin it is “an approach according to which, any cognitive activity is construction” (Kasavin, 2009).

“The constructivist approach to cognition presupposes that the subject does not simply use the products that have developed as mechanisms in his brain or in the cognitive system, but builds up the notion of the environment in which he is to act directly in the course of solving the facing him tasks” (Falikman, 2016).

At the present time, constructivism is an interdisciplinary general methodological concept that studies and models the constructive activity of human consciousness in a wide range of studies: from neuroscience and biology to theories of cognition and new human philosophy, from semiotics to enactivism, from I-concepts to network forms of mind and artificial intelligence. Today hopes for significant breakthroughs in the understanding of human and social nature and the reorganization of the most important social practices, including the sphere of education, are connected with constructivism.

5.2. Designing educational reality.

The basic question of philosophy is connected with the concept of reality: what is primarily matter or consciousness (objective or subjective reality); and is man able to know reality at all? According to

constructivism, reality can only be a subjective, subject is constructing it. The reality can only belong for the subject.

By subjective reality is usually understood the content of consciousness, a set of sensations, representations, images, theories, beliefs, as well as the perception by man of the world as a whole and of itself in this world. Constructivism explores a reality taken together with the tools of its construction by the person herewith a man is enactive with respect to himself.

For the pedagogical science, constructivism is a natural paradigm for many years. The traditions of constructivism in domestic pedagogy and psychology have long been deeply rooted. However, the possibilities of using constructivism in pedagogy are limited by the general level of scientific development of both educators and practitioners of education. This level of development basically corresponds to the classical type of rationality and the world view of modernity with its conviction of materiality and absolute cognizance of the world. Constructivist representations and theories, both substantive and operational, challenge these provisions and are based on non-classic and post-non-classic types of the rationality.

When you are constructing an interdisciplinary educational reality, its design is conducted through constructs. Some researchers restrict this concept, others understand by constructs any ideas, theories, concepts, images, representations - in a word, everything that can serve to receive and structure life experience. Communication and the joint embodiment of social constructs is a source of social reality.

Among the principles of constructing an interdisciplinary educational reality on the basis of constructivism, the following should be distinguished: a) limited diversity; b) integrity; c) simultaneous multi-vector development; d) disciplinary framework; e) subjective selectivity in decision-making; e) multiple alternatives (Hanna Dumont, 2010).

5.3. Methodology of constructivism: general approaches. To constructive approaches as a set of methods by which it is possible to confirm the reliability of the results and the validity of the final conclusions in interdisciplinary scientific research can be attributed the following:

1) autopoiesis (property of the system to make self construction without a violations in its internal organization) (Maturana, Varela, 2001; Maturana, 1981; Allen, Friston, 2016);

2) bio-semiotics (use of sign systems and languages in living systems) (Nevalainen & Raumolin-Brunberg, 2016);

3) bio-cognitive (considers cognition as a biological function and / or process in living system) (Maturana, 1970; Tardiff et al., 2017);

4) evolutionary-epistemological (provides an evolutionary explanation for cognitive phenomena and processes on the basis of universal evolutionism, in particular using the modern theory of complexity) (Onuf, 2016; Sanjeev & Boaz, 2009);

5) constructive-realistic (recognizes the existence of objective reality, but defends the interpretative nature of cognition) (De Gruyter, 2018);

6) embodied (postulates that we get to know not only through the brain, but by our whole being) (Abrahamson, Lindgren, 2014);

7) activate (consciousness is represented as immanent activity) (Knyazeva, 2014; Varela, Thompson, Rosch, 1971; Reid, Mgombelo, 2015);

8) personal (there is no objective knowledge, any knowledge belongs to the subject) (Roth, 2012; Dennett, 2005);

9) interactive (social interaction as interpersonal symbolic communication, that is, a person's ability to "take the role of another" and construct his own reality) (Hałas, 2008);

10) neuro-phenomenological (based on self-observation and analysis of subjective experience) (Thompson, 2006);

11) neuro-constructive (mental development is understood as the construction into the brain of neural systems that ensure the active interaction of the subject with the environment) (Mareschal et al., 2007; Trautmann, 2014);

12) non-dual (denial of the dualism of consciousness and peace, promotion of convergence theories of the physical and mental) (Riegler, Weber, 2013);

13) personality-constructive (it is believed that the constructs are invented by the person himself for the organization of subjective experience) (Kelly, 1955);

14) radical- constructive (objective reality is impossible, man as a cognizing being is infinitely lonely) (Glazersfeld, 2001);

15) social-constructive (studies the processes of socio-psychological construction of social reality in human activity) (Berger & Lukman, 1995; Matuszek, 2014);

16) constructional (considers the formation of social constructs in collective and group social processes) (Gergen, 2003; Pinch & Wiebe, 1984);

17) interpretative (understanding is based on interpretation, man is an interpreting being) (Lenk, 1993);

18) cybernetic-reference (independent observing systems) (Riegler, Müller & Umpleby, 2017; Heinz, 1974; Umpleby, 2014);

19) cybernetic-measuring (control of measuring systems related to poly-subject environments and man) (Calhoun & Hayward, 2018).

20) method- constructive or thought-activity (reality is built by a person on the proto-language as a way of working with symbols and defining meanings; on the basis of the original language, other languages arose, including the scientific one) (Shchedrovickij, 1997; Pulgram, 1995).

So, the theoretical basis of constructivism after considering common interdisciplinary approaches is as follows:

It is useless to assert that knowledge corresponds to reality - reality itself depends on the subject, is inseparable from it and is brought to them.

An object could not be without a thought subject, that is, the focus of research is shifted from the question "what exists?" To the question "what is being done?"

Constructivists assert that all human knowledge is experiential, hypothetical, incomplete, subjective knowledge.

Constructivists insist that man in the scientific world is an observer, social agent, cognitive subject, carrier of activity, consciousness and communication.

Constructivism prefers constructing operational theories instead of substantive theories, relying on constructs.

Subjects of cognition are considered as self-referential organizationally closed systems.

Social constructionism recognizes the intersubjectiveness of social reality.

Rejection of the indisputability of the truth of scientific knowledge and recognition of the proto-language of constructs equates "in rights" all kinds of knowledge, opening the way for the consolidation of knowledge built on various grounds and progressing to noospheric thinking in accordance with the ideas of V.I. Vernadsky and N.N. Moiseyev (Moiseev, 1998; Behrends, 2005).

Thus, the constructivist approaches and methods that represent these approaches are interdisciplinary and transdisciplinary, as they are usually used in studies united by common ideas building their metalanguage and successfully overcoming the traditionally rigid boundaries of scientific disciplines (Slavík, Janík, Najvar, Knecht, 2017). The foundations of these approaches are essentially non-classic and post-non-classic, gravitating towards post-non-classic rationality and convergence of scientific and extra-scientific knowledge.

6. Findings

The results obtained in the framework of the methodology described above are also presented in three perspectives: A) theoretical representation of constructivism in education; B) empirical – in the post-Soviet space; C) methods for verifying the results of interdisciplinary research (see below).

6.1. A. Constructivism in Education.

The problem of constructivism in modern education as a special educational model in the information age of the development of society, which meets the innovative challenges of education, is now being widely discussed in the scientific community. Among foreign researchers, caution is typical for the spread of constructivism in education. For example, according to M. Mathews, the appeal to constructive pedagogy is conditioned by the methodological crisis of all pedagogy (Mathews, 1992). J. Kanselaar believes that constructivism represents only a set of educational technologies (Kanselaar, 2002). Defenders of constructivist ideas in the educational sphere represent constructivism as the leading didactic theory of learning (Rowlands & Carson, 2001). The leading theses of constructivist theories for learning: a) learning as a constructed reality; b) appeal to the students' own experience; c) intersubject dialogue of pupils and teachers. Supporters of the position of constructivism as a pedagogical theory represent education as a continuous education.

Constructivists believe that knowledge is a socio-cultural process. Radical constructivists believe that with the coincidence of the opinions of individuals and society, interindividual constructs of the surrounding world appear, which only confirms the idea of a "socially constructed reality" (Cokolov, 2000; Wendt, 1996).

So, what do constructivism gives for education:

1. The object of the constructed reality, in order to take root in the worldview, must exist three times - as a description (in consciousness), as a relation (in communication) and as an action (in activity). Three interconnected projections generate something in the worldview than you can operate.

2. In classical didactics knowledge is "transplanted" knowledge into the student's head. Our ideas about the effectiveness of training should be radically revised - from direct evaluation of results to an indirect evaluation of learning processes and an assessment of what the student himself is.

3. A person constructs an integral worldview that is not divided into parts and could not be classified. The inner world of man is a rhizome-like network of interconnected processes of comprehension, connections and mental movements (Funes, 2015).

4. The learner, modeling himself as a subject, is aware of his own uniqueness. The individual way of knowing becomes more important than a uniform result.

5. Educational content is superfluous, diverse, focused on different types and levels of intelligence, temperament, health status, interests and abilities of students. At the same time, the existing linear discursiveness and the monologue content of education must be overcome.

6. No languages of science and culture are primary for consciousness, that is, they could not be constructs. Primary constructs represent complex network formations that are able to relate essentially non-random elements of experience. Such "constructs over constructs" are probably described in terms of self-organizing systems.

6.2. B. Constructive pedagogy in the post-Soviet space.

Russian researchers of pedagogical constructivist theories take for the basic thesis of constructive pedagogy such that the one who studies must create knowledge himself, which means that each concrete student individually (and socially) himself constructs the conceptual core of learning (Babich, 2013; Baskanskij, Kucher, 2005; Vinogradov, 2000; Gladilina, 2014; Pluzhnikova, 2008; Cokolov, 2001).

In the theories of pedagogical constructivism, every schoolchild or student, while learning, himself creates his own model of the world - and must be able to explain it, interpret it. The teacher only directs to such alignment (Kot, 2012).

The ideas of pedagogical constructivism in the modern information age have become widespread in the education of all countries of the world, including the formation of post-Soviet countries. Attitude to it as an innovative model of education, modern approaches to reforming education is typical for almost every former republic of the Soviet Union. In the Republic of Belarus, educational scientists see the possibility of actively using the ideas of constructivism in mastering and using modern technical means of instruction by teachers (media: Facebook, Twitter, Youtube, blogs, Wiki, podcasts, social bookmarks).

Belarusian scientists believe that with the use of computer technologies it is possible to implement an individual approach to teaching. For example, the use of interactive materials, consultations on the site, activities in a single educational network, etc. V.I. Kot, notes that the mathematical communities of children active in "Diarynik.ru" ("We give lessons in mathematics", "Ah, this mathematics!" and others), thanks to which it became possible for schoolchildren to take part in various competitions and projects of national and international significance (Kot, 2013). The experience of attracting information technologies and their discussion in the practice of teachers (Klimec, Ketko, 2015) are interesting, in which schoolchildren from Belarus, the Russian Federation, and Kazakhstan participated actively (Kot, 2012).

According to the well-known Ukrainian social philosopher S. Datsyuk, it is constructivism in education that belongs to the future, because the goal of education is to recreate the holistic ideas about

the reality that surrounds the growing man, where he lives now and where he will live in the future. Using constructive pedagogy, the future education is built, the purpose of which is to teach growing children to construct reality using different methods and ways of thinking (Dacyuk, 2010).

Constructivist ideas are the basis for the activity of "intellectual schools" in Kazakhstan, where innovative methods of constructing meanings, technology of problem-based learning, a communicative approach, the practical orientation of instruction, changing the requirements for a teacher acting as a mentor and moderator of the learning process are used for training (Abrahmatova, Orynbekova, 2014).

Curricular reforms in Moldova, Ukraine, Azerbaijan and other countries are also based on ideas of pedagogical constructivism. Today, the curriculum is a special document covering the thematic and activity content in education (Ukraine) (Galinen, 2007), that is, the curriculum is represented by "... a complex of didactic situations and teaching techniques, including ways of organizing educational activity" (Moldova) (Gucu, Krishan, 2007).

Actively applied and developed in the education systems of post-Soviet countries the ideas of the scientific school of A.V. Khutorsky (Russia), proclaiming the tasks of designing and implementing a human-like type of education that ensures the development of personal cultural and historical self-realization of man (Hutorskoj, 2012).

In 2012-2014 years Russian, Latvian and Estonian scientists carried out an international study of the beliefs of mathematics teachers and their relationship with constructivist orientations in education. The researchers noted that the main goal of education in Latvia today is to provide schoolchildren with the knowledge and skills that will be needed in everyday life (Sapkova, 2011). In Estonian education there is a predominance of exercises and tasks aimed at memorizing and training certain actions and algorithms (Lepik, Pipere, 2011).

Traditional beliefs include the understanding of the learning process as the transfer of knowledge, and the constructivist position presupposes a focus on the acquisition of knowledge by the schoolchildren themselves through a specially organized activity.

6.3. C. Methods of verification

Of great importance for interdisciplinary research is the verification of theoretical and empirical results at different stages: the organization, conduct and interpretation of the results obtained. Verification is a method of testing a hypothesis for truth, that is, its relevance to reality, the reliability of information that reflects its quality, completeness and accuracy. Of importance for the verification procedure is the form of providing the results of the study: it should be concise, simple (the principle of economy in William Ockham's intellectual creativity is Ockham's razor) (Sober, 2015).

The validity and reliability of the research results were ensured by the selection of complex methods adequate to the purpose and objectives of the study, systematic verification of the results of the study at different stages, processing results by mathematical statistics, and comparing the results. In order to verify the results of research on the quality of education in the context of economic, cultural, demographic and other indicators of education, the comparative scientists always conduct in-depth analysis of hypothetical positions and comparison of results. For example, the results of the project "In-depth analysis of the results of research on the quality of education in the context of the economic

indicators of education" carried out within the framework of the HSE's Basic Research Program in 2013 (Tyumeneva, Havenson, 2012).

Comparison of the results of the research allowed scientists to recognize that the mathematics teachers of the studied countries of the post-Soviet space differ not only in interdisciplinarity, but also have a different level of constructivism in teaching. Teaching math for them is a constructive process, preference is given to the development of mental activity of schoolchildren. 27% among Russian teachers are traditionalists, that is, teaching mathematics as a set of rules, formulas and procedures is still important for teaching mathematics in Russia. 20% of Russian teachers, 8% of Estonian and 11% of Latvian consider two approaches at the same time in teaching, that is, these teachers pay enough attention to the instrumental part in the mathematical preparation of schoolchildren (knowledge of facts and procedures). Estonian teachers are compromising on two approaches to learning: the beliefs of Estonian teachers indicate the possibility for them to consider learning math and how to build knowledge, and how to transfer them (Kardanova et al., 2014).

Thus, the hypothetical provisions of the study were confirmed by a set of verification methods, qualitative and quantitative analysis of information, their statistical verification and comparison.

7. Conclusion

Considering constructivism in modern education, or rather approaches and methods of constructivism, we recognize that the adoption of the methodology of constructivism is difficult to take root in a pedagogical environment. So, a number of scientists write both for and against constructivism in modern education. We propose to use the term "constructive pedagogy", since constructivist pedagogy reflects the belonging of this pedagogy to concrete constructivist scientists, and not belonging to the ideas of constructivism. In our opinion, there can not be a traditional educational reality in modern times, today it is designed by every teacher, parent, student and other subjects. Moreover, this construction acquires a largely digital form of education through modern technologies, that is, educational reality loses a rigid framework.

And all this requires further comprehension and development of methodological support not only for constructing an educational reality, but also for determining methods for verifying the results of interdisciplinary research at different stages of their conduct. In our opinion, today we touched this problem lightly, and the search for solutions is just beginning.

Thus, in conclusion we can draw the following conclusions:

1. Constructivism has long existed in the educational arena. Only now in the information age it penetrates deeper into the educational process, since the very educational reality itself has changed very significantly in the eyes of the modern learner. A new educational reality is emerging that goes beyond the educational organization. Information technologies have changed the style of learning for all subjects of the educational process. All this required a new look at educational reality.

2. On the basis of theoretical comprehension of approaches to constructivism, general methods and principles for constructing an interdisciplinary educational reality were revealed.

3. In the post-Soviet space, constructive pedagogy already exists. Studies are being conducted on the application of constructivism methods in educational practice.

4. Continuing education is faced with the problem of constructing an interdisciplinary educational reality much more often than traditional educational institutions. In the information age, all subjects of education are building their educational reality.

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