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INTERDISCIPLINARY RESEARCHES OF THE PROCESS OF TRAINING

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Abstract

The article considers the understanding of interdisciplinarity in the relation to Didactics, the science of the training process, shows the broadening of its research fields; identifies groups of interdisciplinary studies of learning and gives concrete examples of such studies. The authors show that one of the interdisciplinary forms in the research of training is loans by didactics of concepts, methods, and scientific results of Psychology, Physiology, Philosophy, Sociology, and other sciences. The authors distinguish the group of interdisciplinary studies conducted by a researcher specializing in a particular scientific field, but with an examination of an object from the position of different sciences. This requires a deep penetration of the researcher into areas adjacent to Didactics. A team of specialists can carry out an interdisciplinary research. Each of specialists studies a hybrid object, formed in the process of research, using the methods of his discipline. In such studies, there are difficulties in harmonizing both the conceptual apparatus of representatives of different sciences participating in a research and the scientific language describing the research in general. Another difficulty is the need to correct the interpretation of specific language results of multidisciplinary scientific discipline. Another difficulty is the need for correct interpretation of interdisciplinary results in the language of a concrete scientific discipline. The article shows that interdisciplinary researches of the process of training continue to develop, broadening the problem field of Didactics, doing its borders permeative. This is typical of post-non-classic science.

Keywords: Interdisciplinary research, Didactics, object of research, resource discipline.

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1. Introduction

Philosophy, Epistemology, Science of science are widely studying the problem of interdisciplinarity (poly-, multi-transdisciplinarity) now. There is no exact and full solution of this problem; some guidelines have been developed that can be relied upon (Azhimov, 2016; Latucca, 2001; Post, 2009; *Wellbery,* 2009). Increasingly, researchers discuss the concept of "interdisciplinarity", "polidisciplinarity"', "transdisciplinarity". So, Stepin writes that interdisciplinary studies are the sciences that apply conceptual means and methods developed from different disciplines and synthesized in a new science for the solution of its specific tasks. Transdisciplinarity is characteristic of one of the languages of the science. Mathematics is transdisciplinary (Stepin, 2007).

Knyazeva somewhat differently defines interdisciplinary as the cooperation of various scientific areas, circulation of general concepts to understand certain phenomena. The polidisciplinarity, in her opinion, is the characteristic of such a research when any phenomenon or an object (a planet, Earth, a person …) is investigated simultaneously from different directions by multiple scientific disciplines. The transdiscsiplinarity is inherent to researches which go "through" disciplinary borders (Knyazeva, 2007, page 373-374).

The philosophical encyclopedia considers the interdisciplinary researchers as the way of organizing research activity providing interaction in the studying of the same object by representatives of various disciplines (Novaya filosofskaya enciklopediya, 2001). We join this understanding.

Interdisciplinarity in the research of the learning process is realized through the consideration of the objects of the learning process as interdisciplinary and through the design of the learning process as interdisciplinary. It can manifest itself in various forms and in varying degrees: in the formulation of problems, goals, in the creation of new concepts, the formation of new disciplines. Tulchinskiy believes that it is possible to speak about the scale of interdisciplinarity: from an integrated mosaic of disciplined accurate descriptions and explanations to a new synthesis and the emergence of a new scientific discipline (Tul'chinskiy, 2000).

At the same time one of the disciplines can act as an initiator of the interdisciplinary interaction (in our case, Didactics), and the other as "a resource discipline" (material of the interdisciplinary interaction) (Kasavin, 2010).

The phenomenon of interdisciplinarity/transdisciplinarity in science is akin to the processes of globalization: here and there, borders that for a long time were considered inviolable and guarding the integrity of the cultural code and the existing order of things become permeative. Kiyashchenko points out: "It is important to emphasize that transdisciplinarity is one of the vectors of the multidimensional transgression of modern science beyond its classical self-identity" in his article" Philosophy of the transdisciplinarity: approaches to definition" ("Philosophiya transdisciplinarnosti: podkhody k opredeleniyu") (Kiyashchenko, 2015, p.111). The most important vector of transgression is the overcoming of boundaries and the unification of scientific knowledge and besides this movement refers both to the objects of research, and to the subjects of various disciplines, to the languages of science, approaches, methods and results obtained. Besides, the transformations concern also the organization of the science – scientific communications, an ideal of the scientist, openness of a scientific information, an ethos of science. On the other hand, it is the movement beyond the science limits – an exit in culture, the

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nature, society, technologies, and inclusion of the person in a scientific picture of the world. Moreover, this exit means not simply the use of research results, but the creation of symbiosis and meta-structures that allow the science to bring its results, methods, and ideas into significant areas of human activity.

Recently, the nature of the objects of scientific research has fundamentally changed: complex objects are in the focus of science's attention, the study of which, within the framework of individual disciplines, does not yield the planned results. To achieve them, either one has to "establish" new disciplines, or develop interdisciplinary and transdisciplinary research methods. Becomes obvious that multidimensional modern problems cannot be solved not only by forces of one discipline but also even by the simple cooperation of scientific areas.

However, despite the fact that the most of the significant scientific discoveries and developments of recent times have been made at the intersection of sciences, the universally recognized methodology of interdisciplinary research that could help researchers in the construction and implementation of specific research programs in the field of education has not yet developed.

It is important to note, it is no matter what scientific views on interdisciplinarity a researcher adheres to, it is necessary to answer at least three questions:

- the purpose and the subject of the study (the construction of a generalized subject of the interdisciplinary research) and the nature of its connection with the disciplinary subjects;
- the research methods - the construction of a methodology for studying a generalized subject and a program for interdisciplinary research;
- the nature and applicability of the results obtained in the educational theory and practice.

Consideration of classical studies in the field of Didactics allows us to conclude that interdisciplinarity is in one way or another inherent in didactics. It is known that the basic didactic principles, patterns, models are constructed taking into account theoretical constructions borrowed in Psychology, Physiology, Philosophy, and Sociology.

At the same time, it should be noted that at one time Kraevskiy, Skatkin, and Lerner (1995) made considerable efforts in order to define clear boundaries of Didactics, to prevent the understanding of Didactics as an applied Philosophy, and to show that Didactics and Psychology are different sciences having different subjects of study. In the 21st century, the reverse process occurs, the boundaries between sciences cease to be insurmountable, and accordingly, the interdisciplinarity of Didactics intensifies.

2. Research Questions

The above idea of the scale of interdisciplinarity makes it possible to identify in Didactics various forms of interdisciplinary researchers at different points of the scale:

1. Different kinds of borrowing in didactic concepts, research methods, research results other sciences.

2. Examination of the object from the position of Didactics and from the position of the other science in one study, for which the researcher need to deeply penetrate the adjacent science.

3. Organization of complex studies of one problem by different specialists, for which it is necessary to create interdisciplinary research teams of scientists - specialists in various fields of knowledge.

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Basing upon these points we put the research question: what is the potential of interdisciplinary approach in the joint research of the team of scientists?

Further, we give the examples of interdisciplinary researchers, conducted by the aforementioned groups.

3. Purpose of the Study

Studying of the change of the research field of process of training through cross-disciplinary researches is the main purpose of this article.

4. Research Methods

We use in our research the analysis and the comparison of cross-disciplinary researches in training and the primary systematisation.

5. Findings

Borrowing of concepts, methods, and results of researches of other sciences by Didactics does not fully reflect the specifics of interdisciplinary research, since it is carried out in the research field of Didactics when studying a didactic object. This form of interdisciplinarity can be considered as starting, initial, containing elements of an interdisciplinary research.

For example, Didactics now widely uses the term "convergence", which refers to the process of convergence, the emergence of similar traits in converging sides (there is the convergence between the General and supplementary education, the convergence of different teaching strategies). Traditionally this term is used in Biology, Geology, Physics, and later, in Economy. Now we see his penetration into Didactics. The same can be said about the terms "human capital", "foresight", "techno park", "method of frames", etc.

It should be noted that borrowing of terms from other sciences, especially natural ones, in didactic researchers often leads to the reduction of the scientific process, its vulgarization. As an example, the penetration of the terms "half-life of teachers' competencies", "entropic assessment of the content of educational material", "complex-wave lesson" into Didactics.

The enrichment of pedagogical tools assists the development of Didactics in the aspect of interdisciplinarity. Didactics begins to use the methods of humanitarian cognition: the interpretation of texts, the monographic study of pupils, the phenomenological description of typical or, on the contrary, nonstandard situations with their subsequent analysis, the use of narrative interviews. Sociological methods are used: the focus group method, the method of peer review.

Advances in neuroscience, cognitive science in general, make it possible to justify the construction of the learning process, the conditions for increasing its effectiveness from the natural sciences. For example, studies under the guidance of Bezrukikh quite definitely showed with reliance on conducted experiments, that the technique of continuous writing does not take into account the functional immaturity of the muscles of the first graders, the unfinished processes of forming the bones of the hand and phalanges of the fingers, the imperfection of the neuromuscular regulation of graphic movements. A

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student, trained with this method, makes considerably more stops than with conventional methods. "The result is not just bad handwriting, inefficient and lengthy development of writing skills, but excessive functional and emotional stress, resulting in complex school problems, increased anxiety, and often neurotic and neurotic disorders" (Bezrukikh, 2009).

An example of an interdisciplinary study on educational content, carried out by a specialist in didactics with immersion in research fields of other sciences, is the study of Krasnova, in which, the concept of "the triple image of scientific knowledge in the content of school education'', is constructed on an interdisciplinary basis (Krasnova, 2013; 2014).

Didactics in the study of Krasnova acts as a "goal-setting discipline", the initiator of interdisciplinary interaction with such "resource disciplines" as Philosophy, Psychology, Linguistics. Interdisciplinary interaction is carried out in the following formats: a) methodological: with each "resource" discipline a separate single object of research is formed; b) organizational: mediated interdisciplinary communication); c) informational: borrowing the results in other disciplinary areas and their synthesis.

As a result of the interdisciplinary interaction, an integrative object of research is constructed: the concept of "the image of scientific knowledge in the content of learning." The core of this concept is the "triple image of scientific knowledge" as an integral hybrid. It represents the unity of the authentic knowledge, hypothetically probable knowledge and potentially possible knowledge.

Based on the triple image of scientific knowledge, a new configurational model of the content of learning is projected, which reflects the reality of the known, unknown and unidentified. The model contains three training modules. The first module consists of a system of objective scientific knowledge of reality. The second module is scientific problems and hypotheses. The third module includes scientific versions and questions to which science has no answer.

The concept of "the triple image of scientific knowledge in the content of education" performs epistemological, methodological and gnoseological functions. It is created as part of an interdisciplinary research facility of such a complex design and object-defined study as scientific knowledge, serves as a tool of the study thought, as a means of cognition, as a way of thinking about the object of study, as a form of display object of study. In addition, the concept provides methodological guidance for the selection of the content of the training; a tool for designing a new configuration of the content of training, different strategies, models and learning technologies. And finally, with the introduction in the educational process it helps students understand how scientific knowledge is arranged, what its dynamics is, and also let you get a personal experience of interdisciplinarity, since the study of scientific problems, assumptions and versions would require searching and connecting knowledge from different disciplines.

In this study, the scientific problem is solved both from the standpoint of Didactics, and from the standpoint of Philosophy, Psychology, and linguistics. It was originally designed and implemented as interdisciplinary. These are not four studies that run parallel, each in their own logic, and use each other's results fragmentarily. This study of the image of scientific knowledge in the content of learning as a single object synthesized on the basis of knowledge obtained from various scientific disciplines.

We can attribute to this kind of research the study of problems of the influence of info-communication technologies on the educational space, in which the object is studied from the standpoint of Pedagogy, Psychology, Philosophy, Information theory by S.V. Ivanova (Ivanova, 2016); the study of

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the formation of the linguistic picture of the world in the framework of cognitive Linguistics, Linguistics and Didactics, conducted by Lukatsky (2016) and Kurovskaya (2015).

It is expedient to include the organization of complex studies of one problem in the field of training by different specialists to interdisciplinary researchers. For such research, it is necessary to create interdisciplinary research teams of scientists, which would include didacts, psychologists, physiologists, and specialists in the methodology of teaching individual subjects.

An important stage in the activity of such collectives is the coordination of concepts, which are called identical terms, but in different sciences they are filled with different content (for example, the concept of "development" in Philosophy, Physiology, Psychology, Pedagogy; “adaptation”, “disadaptation” and “desadaptation” in Psychophysiology, Pedagogy, Sociology). You can talk about the need to develop a common language, which will describe the research.

An example of such a study is a study conducted by the team of specialists led by Dzyatkovskaya (2015); Kolesnikova, Dzyatkovskaya, Rychkova (2015). The described longitudinal study (12 years), which united physiologists, physicians, psychologists, ergonomists, and teachers, was caused by a request from the side of the education system. School teachers noticed that one and the same schoolboy can easily master one content and experience difficulties with the other. After the transition from one teacher to another, the problems do not disappear, but after the transition from one methodical learning system to another, systematic (repetitive) difficulties may disappear or new ones may appear. Note that we are talking about intellectually safe children from well-to-do families, without neurological diagnoses. Often, educational difficulties led to a violation of school adaptation and the development of psychosomatic disorders. There was a question: is there an opportunity to increase the availability of educational material for all students?

6. Discussion

The problem of accessibility of mastering the curriculum is not only pedagogical; it can have a physiological, medical, psychological, linguistic, ergonomic "footprint." Therefore, interdisciplinary researchers were needed. It was necessary to enter the general subject of research. The problem had to be reformulated in a new subject field so that the general subject of research could be studied by the means of all participating sciences, and the results obtained in the course of research could solve the posed problem. But how to find it? In the framework of the listed special sciences, there is none. The output was found by accessing the categories of cybernetics. Researchers argued as follows: curricula, the content of the training are a way to manage the student's learning activity. But after all, educational activity is also managed by the involuntary regulation on the part of the child's body. How do they interact? Perhaps the problem of accessibility of educational material is connected with the peculiarities of the regulation of the educational and cognitive activity of schoolchildren, i.e. there is a conflict of management and regulation. Thus, the general subject of the research was determined - the peculiarity of the involuntary (without the participation of consciousness) regulation of the educational and cognitive activity of a schoolboy mastering this or that educational content. And cybernetics (more precisely, one of its sections - homeostatic) has provided researchers with criteria for optimality of regulation in self-organizing systems.

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Since the language in which the subject of the study was formulated was not understood by specialists involved in an interdisciplinary project, the task was to find empirical data, methods, theories, language tools, data processing methods in these sciences that somehow could characterize one of the Aspects of the general subject of the study. On this basis, specific indicators were selected from different sciences, which from different directions would study the regulation of the student's cognitive activity. Since the language in which the subject of the study was formulated was not understood by specialists involved in an interdisciplinary project, the task was to find empirical data, methods, theories, language tools, data processing methods in these sciences that somehow could characterize one of the Aspects of the general subject of the study. On this basis, specific indicators were selected from different sciences, which from different directions would study the regulation of the student's cognitive activity. Since such a regulation is a multi-level system, an integral model of its study has been drawn up so that the multifacetedness of the research would not leave "blank spots" in a holistic study. This was a difficult stage, requiring the participation of different specialists and mathematical modeling for the processing and comparison of results. Studies have shown that the reason for the decrease in the availability of educational material is associated with the immaturity of the various links of central regulatory systems or with features of their functional state. The change in the functional state of regulatory systems can be diagnosed by problems of interhemispheric transport, neuropsychological syndromes, "stuck" to the profiles of vegetative, cognitive and other regulations, for example, on the difficulties in switching from one method to another, processing, coding, and transforming information. The development of educational difficulties is facilitated by the blocking of compensating (stress-limiting) mechanisms of neuropsychic regulation on the part of the management of the student's learning and cognitive activity (blocking creativity, refusing to choose methods of performing assignments, the imposed pace of tasks, etc.). The emerging chronic information stress does not cause realization of the student's potential abilities, leads to his personal changes and problems of socialization, and forms a psychosomatic response status. In the presented research, the principles of constructing content, teaching methods and the educational environment were defined, which are a system-wide means of preventing and overcoming immaturity of regulation. They serve to increase the pedagogical accessibility of the instruction for all. A homeostatic model of the educational environment has been developed, warning the conflict of management and regulation. The studies laid the foundations of a new direction - adaptive pedagogy, developed a theory of the pathogenesis of psychosomatic disorders and gave the teachers a method for a comprehensive study of the state of regulation of the schoolchild's educational and cognitive activity for compiling individual trajectories of the development and self-development of the child. However, at this stage there were problems related to difficulties in translating the results into the language of Pedagogy, taking into account its multi-paradigm and conflict of interpretations within the framework of different theories.

7. Conclusion

Consideration of interdisciplinary studies of the learning process makes it possible to conclude that such research exists; this scientific direction is actively developing, separate interdisciplinary studies give rise to interdisciplinary fields that expand the research field of didactics.

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