Genesis and evolution of scientific and pedagogical knowledge

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Abstract. From the position of axiological and systemic approaches the paper attempted to reflect the phenomenon of scientific and pedagogical knowledge, which genesis, evolution and formation was carried out in the process of historical development of society, bifurcational socio-cultural changes, and intensive deployment of knowledge in technological paradigms. The consideration of the essence and stages of the formation of knowledge, the main trends in its production and formation through the prism of changing, expanding and improving the terminological apparatus reflects the meanings in the philosophical ego-text of scientists, the development of emerging educational practices, new didactic samples. The authors conducted a typological analysis of the concept of "knowledge", which makes it possible to state its indisputable philosophical significance, unconditional semantic content, undoubted phylogenetic essence, in accordance with which the paper appeals to cultural and historical paradigms; to education as the most important means of teaching and educating the subject; to the architectonics of the experience of becoming a subject in education by building knowledge potential and developing a thesaurus in a historical aspect, which contributed to the expansion of the sacred landscape of the individual by unfolding his practice of social design. Through the study of analytical differentiation and the identification of the orientation vector of scientific and pedagogical knowledge in the historical aspect, in the modeling of the cognitive picture of knowledge, the paper considers the development of the knowledge paradigm in technological paradigms through the problematic field of their main resource, basic factors, fundamental achievements and sources of narratives, which contributes to the establishment of the social nature of knowledge through the discovery of its main types, character, generation paths, markers of maturity.

Keywords: education, scientific and pedagogical knowledge, meanings, terminology, knowledge development factors

1 Introduction

The relevance of the study of the specified problem is caused by the increased attention of Russian society to education in the 21st century. The increasing role of education imposes new requirements on the modern person for his intellectual and social development, the level of realization of the potential of the individual, the degree of disclosure of the personal balance of the subject through the development of new cultural patterns, which requires the reflection of general lines in the development of knowledge, as well as the appeal to historical projections of the study of the genesis and evolution of the thesaurus, as an important tie of scientific and pedagogical knowledge.

Numerous scientific studies of the basic vocabulary in the works of Russian and foreign scientists and teachers testifies to the presence of pedagogical concepts that determine other projections of the development of education and, therefore, the thesaurus, which draws the attention of researchers to philosophical foundations and approaches that identify the paradox of modern education, the patterns of its formation, ethical regulations of the subject's activities, a new format for the development of professional educational programs [1].

2 Problem Statement

Scientific and pedagogical knowledge can be studied using a spectrum of techniques to reveal the methodological significance of the phenomenon. This requires the solution to the following problem: to consider the essence, stages and trends in the production and development of scientific and pedagogical knowledge through the prism of unfolding the basic vocabulary formed in technological paradigms.

Let us refer to the definition of the concepts introduced into the canvas of our study.

Knowledge (Wissen) in the philosophical dictionary is defined as "the possession of experience and understanding, which are correct both subjectively and objectively, and on the basis of which one can build judgments and conclusions that seem reliable enough to be considered as knowledge" [2].

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Knowledge may serve the following:

1) development of personality (educational knowledge);

2) development of the world (redemptive knowledge);

3) practical domination of the world and its transformation for human purposes (knowledge of positive sciences).

We define knowledge as a creative, dynamic dimension of consciousness, as a form of a subject's individual experience.

The phenomenon of "knowledge" has been of interest to scientists, philosophers, teachers, psychologists since ancient times. Table 1 shows the typology of the concept of "knowledge".

Table 1. Typology of the concept of "knowledge"

Person	Type of knowledge	Immanent essence	Form of knowledge
Platon	empirical	consistency of the elements of experience among themselves	justified conviction, discursive system
Aristotle	empirical	knowledge of craft, language, rite	scheme of activity and communication, function of human activity
I. Kant, K. Popper	empirical, theoretical	comparison of true assessment	affirmative statement with subject-predicate structure
M. Polanyi	empirical, theoretical	typology of knowledge coincides with the history of culture	practical knowledge is implicit, non-verbal; theoretical knowledge suggests an explicit textual-verbal form
M. Scheler	empirical, theoretical	expansion of personality, fixation of experience in social memory, understanding and transformation of experience	transformation of sign systems, consciousness, meaning and import

The table shows that knowledge is a kind of operative meaningful unit of information that

1) determines the adequate reflection of the external and internal world in the consciousness of a person in the form of ideas, concepts, judgments [3, 4];

2) provides the subject with information on the properties of objects, patterns of processes and phenomena [5, 6];

3) formulates the rules for using this information for decision-making using methodological markers: degree of systematization of the results of human cognitive activity; level of subjectivity of the image of objective reality; adequacy of the reflection of the external and internal world in the human mind [2, 7].

3 Research Questions

To reflect the phenomenon of genesis and the evolution of scientific and pedagogical knowledge, it is necessary to identify the factors influencing the transformation of knowledge. There are two such groups of factors:

1. Group of external factors for the development of knowledge: political, economic, socio-cultural;

2. Group of internal factors for the development of knowledge: a change in the types of scientific rationality, the development of a system of interdisciplinary interactions, the theoretical design and consolidation of new directions of sociocultural practice, a change in the methods of obtaining and translating knowledge.

Knowledge is a cellular structure in which a linguistic sign occupies an important place – a certain material formation representing a subject, property, or relation of reality. In their totality, language signs form a special kind of sign system – a language filled with various types of lexical units, among which terms stand out.

The term is the name of a certain concept in any special field of science, technology, art [8]. Language terms form terminology, i.e., a meta-language characterized by specific features: systemicity, presence of a definition, monosemy, lack of expression, stylistic neutrality.

Terminology is formed when science reaches a high degree of development, which is possible due to the formation of a technological paradigm – a set of technologies characteristic of a certain level of economic development. There are six technological paradigms in the historical section, which expansion is associated with the growth of new scientific and pedagogical knowledge.

4 Purpose of the Study

The purpose of the paper: reflection of knowledge based on the genesis and evolution of scientific and pedagogical terminology in the format of historical development of technological paradigms.

The historical background allows stating that the first technological paradigm began in England in the second half of the 18th century. The epistemological model of the evolutionary development of society was enriched with a number of new words and phrases. Some terms: water energy, industrial mechanization, increased labor productivity, etc., are firmly included in the scientific thesaurus. Pedagogical knowledge was also enriched due to the development of industry. This was caused by the fact that there was an urgent need for training personnel for industrial production, so textbooks, scientific methods, and forms of training appeared at schools. The vocabulary of the school was enriched by such neologisms as teaching and learning, teaching and learning aids, public lectures. New types of educational institutions appeared during this period: the school of mathematical sciences, artillery, engineering, surgical schools, the Academy of Sciences, the Institute of Noble Maidens, etc.

The Church Slavonic script during the reign of Peter I was replaced by the civil script for the more intensive development of education. During this period, the vocabulary of science and education included new words and phrases: learning, education, pedagogy, student magazine, etc. [9].

About 50 years later, innovative technological thought gave impetus to the development of the steam era and the railway construction. The scientific thesaurus included such terms as ferrous metallurgy, steam engine, locomobile, etc. Such words and expressions as education, identity, reading, patriotism consolidated in the field of science and education, and the pedagogical thesaurus included such terms as female education, general education, education in native language, as well as psychological terms: natural inclinations, individual traits, imagination, susceptibility, nature of children, innate abilities, etc. [10].

The second half of the 19th century is marked by the appearance of such terms as education and re-education, home nursing, female education, patriarchal education in the scientific and pedagogical thesaurus.

Considering the following technological paradigm and the development of scientific and pedagogical knowledge, it should be noted that the 20th century is represented by the most striking technologies: the era of oil began in the world at the beginning of the century. The scientific thesaurus included the following terms: oil raw materials, hydrocarbons, fraction, benzene, components of high-octane gasoline, etc. The pedagogical thesaurus was replenished with such concepts as development, instruction, recovery, social environment, influence of social ties; pedagogy of the new person, etc.

The fifth technological order opened the era of computer technology and telecommunications for humanity in the second half of the 20th century. The pedagogical thesaurus was supplemented with such terms as computer class, cloud technologies, electronic journal, interactive board, computer technologies, etc. [11].

The 21st century is the sixth technological paradigm characterized by the development of nanotechnology. The pedagogical thesaurus includes such terms as composite knowledge, educational cluster, pedagogical agglomeration, robotics, quantorium, nanoink, etc. [12].

5 Research Methods

The paper uses a set of methods to reflect scientific and pedagogical knowledge and thesaurus: general scientific methods (analysis and synthesis of concepts), inductive, deductive, holographic approaches, sociological method. The main method of studying the phenomenon is the affirmation of the development of knowledge, the emergence and expansion of a scientific and pedagogical thesaurus, ontological modeling, reconstruction of the basic patterns of scientific and pedagogical thought.

6 Findings

The study of the genesis and evolution of scientific and pedagogical knowledge through the prism of technological paradigms is caused by the fact that the development of industrial production was the driving force for the formation and improvement of knowledge, proving the humanitarian advantage of each next stage in the development of science and technology. Let us use an example from Table 2.

Table 2. Development of knowledge in technological paradigms

No.	Primary resource	Key industry	Key factor	Result of a paradigm	Result in humanities
1	water energy	textile industry	machines	mechanization of factory production	increase in labor productivity
2	steam energy, coal	transport, ferrous metallurgy	steam engine	production growth, transport development	relief of hard manual labor
3	electric power	heavy engineering, electrical industry	electric motor	concentration of capital, radio communication, telegraph	improvement of the quality of life of the subject
4	hydrocarbon energy, nuclear power	non-ferrous metallurgy, polymer materials, automotive industry	internal combustion engine	large-scale and mass production	development of communication means, growth of production of consumer products
5	nuclear power	microelectronics, information technology, genetic engineering, software, space exploration	microelectronic components	individualization of production and consumption	globalization, speed of communication and movement
6	nanoenergetics	nano- and biotechnology	cellular, molecular, nuclear technologies	stem cell use, living tissue engineering	apparent increase in human life expectancy

The table shows that the sources of narratives were developed in each technological paradigm of the industry, therefore, such words as microelectronics, software, nanoenergy, nuclear energy, cellular technology, etc. entered the scientific circulation [20]. The development of science, technology, economics testified to the growing trend of amplification in education:

1) planning in education, as evidenced by a significant number of applicants who decided to get (higher) education [13];

2) mastering the general and special principles of training of the subject;

3) development of educational book publishing;

4) implementation of the subject's strategic thinking;

5) mastering new cognitive practices;

6) transformation of education and learning functions under the influence of analytical differentiation of cognition orientation;

7) expansion of the sacred landscape of an individual by unfolding the practice of social design of the subject;

8) development of convergent technologies in education;

9) design of pedagogical education models;

10) formation of digital skills in a digital society;

11) desire for technologization of knowledge, leveling the tendency to self-isolation of sciences, etc.

The transformation from one paradigm to another implies certain gaps in science that should be filled and problems that need to be solved. As for pedagogical knowledge, the existence and development of which is the phylogenetic code of our time, we state the unconditional dependence of pedagogical education on events in the country: in the field of politics and economics, in the socio-cultural situation, in mass education.

Let us talk about the last thesis in more detail. According to Russian and foreign scientists (N.M. Borytko, L.V. Mardakhaev, V.S. Bezrukova, M.-L. Lange, K. Behring, A. Dreyer), modern pedagogy cannot be perceived in isolation from institutional pragmatism:

- contradiction between time and administrative logic [14];
- teaching scene is a network of obligations of two parties: teacher and student [15];
- presence of transgressive force of teaching (introduction of mediation, hybrid forms of teacher training into education, variability of profession tracks, use of the applied science model in non-core universities to train teachers, etc. [16];
- transformation of educational space into structurally incomplete practice of thinking [17];
- presence of institutional pragmatism [18].

Let us give an example of a classical university, which goal is to form pedagogical humanism in the context of digital education of the 21st century. The mission is to develop a different role for the profession, and the main model for training a teacher is a model for training a researcher.

It is important for a modern researcher to have extensive knowledge. The following are the indicators of knowledge formation:

1) mental activity;

2) process cognition;

3) adaptability;

4) ability to set and address tasks;

5) activity (unlike "data", "knowledge" can become a source of change in decision-making) [19].

Let us consider the nature of knowledge acquisition, its fundamental basis, markers of formation using the example of two types of knowledge presented in Table 3.

Table 3. Types of knowledge

Name	Nature of knowledge acquisition	Semantic content of the concept	Fundamental basis of knowledge	Markers of knowledge formation
Scientific knowledge	rational: understanding reality in its past, present and future	reliable generalization of facts, foresight of various phenomena	reality in the form of abstract concepts and categories, general principles and laws	formalization of data, formatting of thinking, abstraction
Pedagogical knowledge	direct demonstration of samples of activity and its products	own experience depending on the abilities of the subject, his intellectual activity	actions to transform the world, statements, experiences, value orientations, intuition	knowledge that turns into skills and abilities, perception schemes, practical skills; operation of symbolic systems; intellectual structures, formation of social intelligence

The table shows that the types of knowledge of the subject appear as an option for social, scientific, economic reality. The main criteria for the development of knowledge are: objectivity, validity, evidence, verification, and the presence of a variety of thought forms – the markers of formation.

7 Conclusion

In conclusion it should be noted that the problem of genesis and evolution of scientific and pedagogical knowledge in the format of technological paradigms and space-time continuum allows the following:

1) understand the dialogue space of the national history of science and education on the basis of an appeal to philosophy, the main conceptual ideas of leading scientists, which allow using a range of approaches to study the phenomenon of "knowledge", its genesis and evolution;

2) state that the evolution of knowledge is carried out under the influence of economic, political, social conditions, cultural changes that determine the state of the scientific and pedagogical thesaurus at various historical stages of the development of society and technological paradigms;

3) find pedagogical meanings in the philosophical ego-text of scientists, teachers, thinkers of different centuries, which provides the possibility of revealing the mechanisms of scientific knowledge;

4) identify indicators of the formation of knowledge, which make it possible to reveal the main patterns of the appearance of a scientific and pedagogical thesaurus in a historical context when changing technological paradigms:

a) rapid development of cognitive practices and innovative technologies;

b) expansion of the forms of world perception, when subjectivity becomes congruence of creativity;

c) introduction of a participatory approach in education and social practice;

5) explain the desire of scientists to create a new conceptual apparatus necessary for further development of meanings, tactical and strategic thinking, diversification of education practice, maintenance of knowledge-intensive industries;

6) reveal the evolution of scientific and pedagogical knowledge by considering the features of the formation of ethics of the values of each technological paradigm, which made it possible to eliminate the deficiency of student's level of education;

7) realize that knowledge is an information router that determines the vector of advancement of the subject into scientific and educational future zone.

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