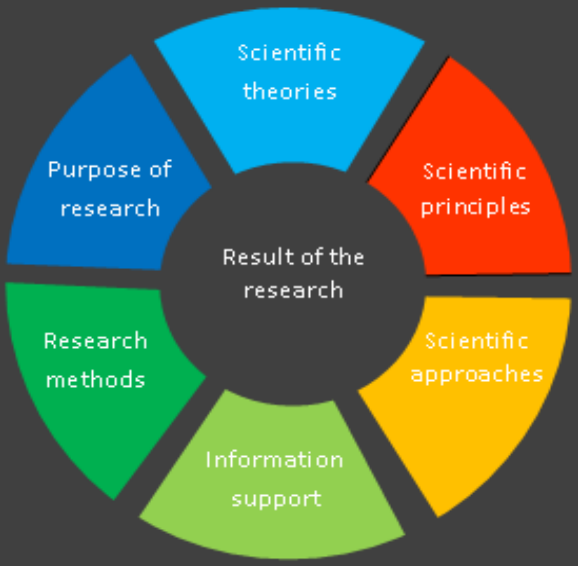
Moroz V., Buka S., Moroz S., Trush O., Moroz O.

METHODOLOGY OF ORGANIZATION OF SCIENTIFIC RESEARCH

Part 1

Theoretical and methodological basics of scientific research organization



MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

NATIONAL TECHNICAL UNIVERSITY
“KHARKIV POLYTECHNIC INSTITUTE”

Moroz V., Buka S., Moroz S., Trush O., Moroz O.

METHODOLOGY OF ORGANIZATION OF SCIENTIFIC RESEARCH

Manual for higher education applicants in specialties 054 – Sociology, 281 – Public Administration and Governance

In two parts

Part 1
THEORETICAL AND METHODOLOGICAL BASICS OF SCIENTIFIC RESEARCH ORGANIZATION

Kharkiv 2024

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The manual offers an exhaustive in its content and logical in the sequence of presentation model of mastering the problematics of theoretical and methodological basics of development and holding a research. The manual conceptualizes the views of domestic and foreign scientists on the theory and practice of the researcher's use of scientific approaches, principles and methods in the system of methodological support of scientific-research work. In addition, the manual highlights the problematics of the place and role of science in assuring the mankind's socio-political and socio-economic development, as well as the issues of formulating the content of the basic categories of the methodology for organizing scientific researches.

The manual will be useful for the higher education applicants at the second (master's) and third (educational and scientific) levels of its acquisition in the specialties 054 "Sociology" and 281 "Public Administration and Governance", as well as for higher education applicants in other specialties.

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TOPIC 1. INTRODUCTION TO THE DISCIPLINE “METHODOLOGY OF SCIENTIFIC RESEARCH ORGANIZATION”

Goal: to form among applicants of higher education an idea of the science's place and role in assuring the development of an individual, the state and society, as well as to achieve their understanding of the categorical content of the definition of “science”

1.1. The place and role of science in assuring the mankind's socio-political and socio-economic development

Content: the place and role of science in determining each of the industrial revolutions; the influence of the results of scientific activity on the development of the society's main areas; the place and role of science in ensuring the state's competitiveness; views of outstanding scientists on the role of education and science in assuring human development

1.2. Scientific inventions that have changed the world

Content: general characteristics of those of scientific inventions that most significantly influenced the mankind's development; general characteristics of the most famous inventions of Ukrainian scientists; inventions discovery of which was accidental

1.3. Approaches to the interpretation of the categorical content of the definition of “science”

Content: actualization of the category of “science” through the prism of the general philosophical worldview; comparison of famous scientists' views regarding the categorical content of the definition of “science”

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1.1. The place and role of science in assuring the mankind's socio-political and socio-economic development

Basing on the results of the analysis of the civilizational development's content and dynamics, we can claim that science is the basis and the main determinant of socio-economic, socio-political and general humanitarian development. The results of mankind's scientific activity became the cause of occurrence and development of the so-called scientific-technical and industrial revolutions. It is thanks to science that qualitative radical changes occur, both in the means and technologies of production, and in the labour activity itself (content, direction, efficiency, etc.). It is traditionally believed that development of science contributed to the actualization of each of the four industrial revolutions, namely:

– the First Industrial Revolution (the Industrial Revolution) took place at the end of the 18^{th} century and was determined by the need to mechanize manufactory production. The fundamental change in the means of production was based on innovations in heat engineering, mining and metallurgical industry, transport, engineering, etc. The invention of the steam engine caused a radical change in the means of production. It should be reminded that the first steam engine (1698) created by the English inventor Thomas Savery was based on the research of the French physicist Denis Papin, who not only proved the possibility of using the energy potential of water vapor, but also proposed a schematic design for inventing a steam boiler with a safety valve. The invention and usage of the steam engine changed not only the technology of goods production, but also actualized the problematics of need for intellectual development of

productive forces. Such development, in its turn, led to an increase in the level of population's political and social activity (transformational changes in society), as well as an increase in its general cultural level;

– the Second Industrial Revolution (the Technological Revolution) took place at late 19th - early 20th century and was determined by a change in production technologies due to the introduction of innovations related to the use of electricity potential. The invention of electric motor changed the technology of goods production. It should be reminded that the first scientist who managed to use the electromagnetic field to convert electrical energy into mechanical one (1821) was a British physicist Michael Faraday. In 1834, the scientist Moritz von Jacobi made the first suitable for practical use direct current motor, and in 1888 a Serbian inventor Nikola Tesla proved a principle of making a two-phase alternating current motor. In 1889, electrical engineer Mikhail Dolivo-Dobrovolsky, a graduate of the Odessa real college, developed the world's first three-phase induction electric motor, that has become the most common electric machine. The use of electric motors significantly increased the production's efficiency (the coefficient of performance of electric motors with a capacity of up to 1 kW is 65-80%, and for high-power machines is 95-99%, which significantly exceeds the corresponding indicators of steam engines (2-25%) and internal combustion engines (25-35%)), and as a result – had a positive impact on the dynamics and content of the development of society's socio-economic subsystem;

– the Third Industrial Revolution (the Digital Revolution) took place in the period from the second half of the 20th up to the beginning of the 21st century. This revolution was determined by the invention, and over time, the mass introduction of information technologies (systems) into production, as well as the need to find an alternative to traditional development potentials (information and knowledge as a resource; renewable energy sources, etc.). The foundation for creation and development of information technologies (systems) was based on development of mathematical theories, cybernetics and the invention of programmable computers. It should be reminded that speaking about the scientific theories that significantly influenced the inception of information technology are commonly referred to as a mathematical theory of communication; algorithmic information theory; the uncertainty principle; mathematical methods of decision making, etc.

– the Fourth Industrial Revolution (Industry 4.0) began in the first decade of the 21st century and was determined by the need to solve the consequences of the global financial crisis (2008) by using the potentials of cyber-physical systems (combining of artificial intelligence and physical objects to form a fundamentally new system, for example smart energy systems; autonomous transportation systems; automated decision-making systems; robotic systems, etc.). The development of Industry 4.0 was based on the results of scientific researches in bio-medicine, artificial intelligence, aerospace industry, automotive industry, etc.

No matter what kind of revolution we consider, the fact that remains unchanged is that innovations (derivative of results of scientific activities) play a significant role in the socio-economic, socio-political and general humanitarian development of the state. We agree with the opinion of Natalia Fedorova and Hanna Pylypenko that society's progressive development (usually the phenomenon of progressive development is considered through the prism of change in quality from a lower level to a higher level. The source of such a change is the introduction of scientific results to the traditional for the corresponding system of organization of socio-labour and socio-political relations) determines the improvement of the quality of the following main areas:

– economic (development of productive forces; production efficiency improvement, including by increase in labour productivity; optimization of the economic structure; optimization of the structure of production cost; improvement of macroeconomic performance indicators of the national economy; quality of life improvement etc.);

– social (increasing the level of human potential development, qualitative characteristics of labour potential, personality, meeting public needs and requests, etc.);

– scientific and informational (increase of the level of techniques and technologies development, scientific capability of social production, share of high-tech industries in GDP and exports, amount of enterprises carrying out innovations, amount of scientific institutions and scientific and science-pedagogical workers, ICT development, etc.);

– infrastructure (increasing the level and quality of market infrastructure development, as well as various communications, including information, etc.);

– political (increasing the level of democratization of society, as well

as the effectiveness of implementation of economic policy; increase in the quality of civil society, etc.), legal (degree of protection of the rights and economic freedoms of citizens, etc.) and institutional (development and effective functioning of democratic institutions – competition, private property, civil society system, etc.);

– environmental (the level of greening of production, its being waste-free; the state of the biosphere; a share of renewable natural resources in the total amount or the value of used resources);

– cultural and spiritual (increasing the level of public consciousness; the level of public morality development; degree of humanization of public life, etc.) [22].

The connection between science and the results of socio-economic, socio-political and general humanitarian development was pointed out at the All-Ukrainian Forum “Ukraine 30. Education and Science: science popularization as the basis for society's development” (31.05–02.06.2021, Kyiv). The participants of the event drew attention to the fact that “knowledge society is a society where the creation, spreading and use of knowledge is a key element for its development, construction and assuring the well-being of citizens and economic development” [48].

According to the results of the held parliamentary hearings "Balanced development of human capital in Ukraine: the tasks of education and science," recommendations were approved concerning the directions of solving the problems identified in the field of education and science, as well as mechanisms for ensuring the balanced development of human capital in Ukraine by the state. In addition to the content of these recommendations, the signatories of the final document drew attention to the fact that the source of economic growth of most of the countries of the world (64% of those countries that are included in the World Bank report) is human capital. Only 20% of the world's countries ensure their economic growth with the help of natural resources, and 16% – due to production potential. According to experts of the World Economic Forum, the share of human capital in the structure of national wealth of the most developed countries of the world is estimated at the level of 2/3 to 3/4 of the total value of the corresponding indicator [22].

Such famous scientists and philosophers as Karl Marx, William Petty, David Ricardo, Adam Smith and others drew attention to the importance of science in the system of assuring the socio-economic and

socio-political development of the state and society. The views of the above-mentioned scientists regarding the place and role of science in assuring social development are presented in Table 1.1.

Table 1.1. – The views of famous scientists on the role of education and science [49]

№	Scientist	The views on the role of education and science
1	Daniel Bell	He considered science and knowledge to be the main institutional value of society
2	Karl Marx	He stated that the set of needs, abilities, creative talents and the level of people's skills are the true wealth of society
3	Alfred Marshall	He believed that increasing the level of education of an employee leads to an increase in their labour productivity, as well as to an increase in the labour productivity of those who work next to him/her. He emphasized on the state's active and determining role in development of education
4	Michael Porter	He considered education to be a very important tool of the state in increasing the international competitiveness of the country. In order for education to become a real competitive advantage, the following is needed: high educational standards, combination of theoretical knowledge with practical training, existence of various educational institutions in the country, close cooperation of educational institutions with enterprises, companies' significant contributions to the professional training of their employees
5	William Petty	He considered knowledge and skills to be part of the wealth of man and society. Considered the possibility of a value assessment of a person taking into account their useful properties
6	David Ricardo	He attributed education costs to labour reproduction costs. He believed that salary depends on the level of spending on education and training, on the level of abilities of workers and employees
7	Adam Smith	He states that capital invested in development of knowledge and skills should ensure profit
8	Robert Solow	He proved, that more than 80% increase in production is ensured through scientific and technological progress
9	Alvin Toffler	He proved that for economic development, the most important resource is knowledge and it is inexhaustible. With the increasing amount of people who appeal to knowledge, the amount of available knowledge also increases

Exploring the issue of the phenomenon of capital, A. Marshall drew attention to the existence of sources of its formation outside the so-called physical assets. According to the scientist, a significant part of capital is formed in the plane of the organization itself and the knowledge that is

available for materialization within it. According to A. Marshall, knowledge is the most powerful catalyst for increasing the amount and quality of material production [28], and "the economic benefit from using one sufficiently significant industrial discovery is quite sufficient to compensate for the costs of education of the inhabitants of a large city, so just one such an idea, as, for example, the main invention of Bessemer, provides the same increase in production capacity as the work of 100 thousand people" [28].

According to A. Smith, a worker's skills and abilities are as important factor in increasing the level of labour productivity as improving the machines and tools involved in the production of the final product. According to the scientist, person's award for their professional activity will definitely refund all those costs that were spent in order to gain profession. D. Ricardo, at the time, drew attention to the existence of a direct proportion dependence between the level of the population's education and the growth rate of national wealth. The problems of dependence of the well-being of a social object on the quality of education found their indirect reflection in the system of scientific views of materialistic dialectics. According to K. Marx, the worker, with their physical and spiritual abilities, is a component of capital of the economic activity subject.

The idea substantiated at one time by A. Marshall concerning the possibility of perceiving education at the level of "national investment" acquired its further conceptualization within the neoclassical theory of human capital by Theodore Schultz and Gary Becker. According to the research of the author of the theory of human capital T. Schultz, the economic value of education is revealed through the prism of a consistent dialectical transformation of financial resources (studying costs) into knowledge (the result of human development) with its further transformation into goods (well-being), both for the person himself and for society. The scientist proved the fact that investing in education is not only justified and appropriate, given the development of man and society, but also is an effective investment of capital [41]. T. Schultz put the results of the scientific research by Edward Fulton Denison on the sources and causes of the US economic growth into the basis of the human capital theory. Using statistical analysis methods, E. Denison found out the fact that the usage of new technologies and modern equipment by management subjects in the production of goods and services, at the time, provided the USA with no more than half of the share of gross national product increased in the 20th

century. The other half of the corresponding shares, according to the scientist, was provided due to such factors as: improving the quality of the production's organization and management; intensification of labour; increasing efficiency of economic policy, etc. [9]. Studying these so-called non-productive factors, T. Schulz proposed to include education. In the work :Capital Formation by Education", T. Schulz suggested to consider the cost of labour through the prism of the unity of value of the person's labour itself and the cost they spent on education [40]. Given the subject of scientific research, we chose (the dependence of the individual's and the state's well-being on the higher education quality), the greatest value of the scientific views of T. Schulz is revealed through the content of his definition of human capital. By human capital, the scientist understood everything which is a source of future enjoyment or (and) future incomes, that is, everything, regardless of whether it is a material or human asset that can generate future incomes. In other words, T. Schulz formulated a direct reference to the education's ability to provide income to its carrier (owner) in the future [30].

Exploring the theory of human capital, Mark Blaug drew attention to the fact that a person's expenses (in our case, as of a social object) on education should be considered at the level of investment not only to meet their current needs, but also for future monetary and non-monetary income. People can "invest in their health; may voluntarily purchase additional education; can buy information about vacancies; ... . All these phenomena – health, education, job search, obtaining information, migration and learning at work – can be viewed through the prism of investment rather than consumption".

1.2. Scientific inventions that have changed the world

According to the results of analysing popular science literature, a list was compiled of those inventions that the most significantly influenced the mankind's development.

1. A light bulb. An invention that allows humanity to work equally effectively not only during the day, but also at night is a light bulb. Thomas Edison is considered to be the inventor of this revolutionary invention, as he created a fully functional lighting system, including a generator and wiring, as well as a filament lamp in 1879. Innovation not only stimulated the houses' electrification, but also changed the mankind's sleeping schedule.

Now there was no need to go to bed after dark, as a safe light source appeared.

2. The Internet. The history of development of a global system of interconnected computer networks began in the 1960s, when a group of scientists working for the Defense Advanced Research Projects Agency of the United States Department of Defense built a communications network to connect agency computers. It was their development that became the predecessor of the Internet. The basis for building of the network was the data transfer method developed by Lawrence Roberts called "packet-switching." After 1989, the Internet continued its development due to the invention of the World Wide Web by Tim Berners-Lee while working at The European Organization for Nuclear Research. The main goal of the development was to combine computer technologies, data networks and hypertext into a powerful and easy-to-use global information system.

3. An internal combustion engine. The first patent for a four-stroke internal combustion engine was received back in 1862 by Alphonse Beau de Rochas. However, German engineer Nicolaus Otto, who in 1862 began the production and sale of two-stroke engines, is often called the inventor of the internal combustion engine. In 1876, N. Otto designed a four-stroke engine. In 1877, he received a patent for a gas engine. This patent was revoked in 1886 in favor of a patent granted to Alphonse Beau de Rochas for his four-stroke engine design. The first two-stroke gasoline engine was designed by Karl Benz (the first patent was received in 1879). Rudolf Diesel in 1897 designed the first diesel engine on coal dust with a high coefficient of performance, and a kerosene engine for which he received a patent in 1898.

4. Printing press. German inventor Johannes Gutenberg invented the printing press sometime between 1440 and 1450. The key to its development was manual form – a new molding technique that made it possible to quickly create a large amount of metal fonts. Although similar inventions were in China and Korea – they developed a movable font made of metal, J. Gutenberg was the first to create a mechanized process that transferred ink (which he made from linseed oil and soot) from movable type to paper. Due to the process of movable font, printing presses greatly increased the speed at which it was possible to make copies of books, and thus for the first time in history they led to the rapid and wide distribution of knowledge. Among other things, the printing press allowed increase access to the Bible, which in turn led to alternative interpretations, including

Martin Luther, whose “The 95 Theses”, a document printed in hundreds of thousands of copies, led the Protestant Reformation. Printing became a real revolution in the field of knowledge spreading: only in 50 years, by 1500, about 40 thousand publications with a total circulation of 20 million volumes were printed in Western Europe.

5. The first compass was created in China during the Han Dynasty between the 2nd and 1st centuries BC. This compass was created from magnetite – naturally magnetized iron ore. Its amazing properties had been studied by ancient scientists for centuries. But for the first time, the compass was used directly for navigation during the Song Dynasty between the 11th and 12th centuries. A little later, technology came to the West, where it allowed sailors to freely depart far from land, opening new shores and paving new trade routes.

6. Gravity. It is known that the most important discovery of Issac Newton was gravity. The discovery of gravity was used to explain and study a variety of physical phenomena: from the flight path of a baseball to the Earth's orbit around the Sun. In 1687 Issac Newton published his famous book “Mathematical Principles of Natural Philosophy”. In it, the physicist formulated the law of gravity and the three laws of motion. This work became the basis of the modern physics

7. Electronic money. Credit cards that made cashless payments possible appeared back in the 1950s in the USA. The first electronic payment systems that allowed sending funds and paying for purchases online – in the 1990s. In particular, in 1998, the well-known PayPal system was first launched.

8. A plane. In 1903, the American inventors brothers Orville and Wilbur Wright successfully launched their aircraft “The Wright Flyer” (also known as the Flyer 1) into the air. And although it only lasted above the ground for a few seconds, this significant event is considered to be the beginning of the aviation birth era. The brothers-inventors are considered to be the first pilots in the history of mankind. In 1905, the brothers designed the machines' third version, that already could be in the air for almost half an hour. In 1907, the inventors signed a contract with the American army, and later with the French one. At that time an idea appeared to carry passengers on the plane, and Orville and Wilbur Wright improved their model, equipping it with additional seats. Also, scientists equipped the aircraft with a more powerful engine.

9. The television. One of the most important discoveries of the 20th century was the invention of the television. The first device was patented by Boris Rosing in 1907. In his model he used a cathode-ray tube, and to convert signals he used a photocell. In 1931, it became possible to transmit information using a color picture. In 1939, the first television channel was opened. Television gave a huge impetus to change the people's worldview and ways of communication.

10. A battery. The first step to create batteries was made by Alessandro Volta, but he did not realize how to make the galvanic cell, he received, rechargeable. Another German scientist Wilhelm Sinsteden observed the effect of obtaining direct current when immersing lead plates into sulfuric acid, but did not draw from it conclusions that can be applied in practice. However, in 1859 the French scientist Gaston Planté created a lead-acid battery, which, unlike the galvanic cell, could be recharged.

The world famous inventions of Ukrainian scientists. According to the results of the analysis of popular science literature, a list was compiled of the most famous inventions by domestic scientists.

1. A helicopter. The world's first helicopter was constructed by Kyiv aircraft designer Igor Sikorsky. In 1931, I. Sikorsky patented the design of the machine (the machine looked like a steel pipe with an open cockpit for the pilot) with two propellers – horizontal on the roof and vertical on the tail. The first VS-300 helicopter took to the skies in 1939.

2. A tram. The world's first electric tram was created by Fyodor Pirotsky, who was born in Poltava, based on the results of the implementation of the developed by him technology of combining electricity transmission through an iron wire with the operation of an electric motor installed on a movable structure. In 1880, F. Pirotsky presented to the public a two-tier horse railway car converted to electric traction. A year later, in Berlin, Siemens company launched the world's first electric tram.

3. A rocket engine. A native of Zhytomyr, Sergei Korolev is a constructor of rocket and space technologies and the founder of cosmonautics. Under his leadership and direct participation, the first liquid-propellant cruise and long-range ballistic missiles, aircraft missiles for firing at air and ground targets, as well as anti-aircraft solid-fuel missiles were created. In 1936, the first tests of cruise missiles were held – anti-aircraft with a powder rocket engine and long-range with a liquid rocket engine. In

1957, S. Korolev launched the first artificial Earth satellite into Earth orbit, and in 1961 he carried out the world's first human flight into space.

4. X-ray. A Ukrainian physicist Ivan Puluj in 1886 discovered X-rays, known more as roentgen radiation (this happened 14 years before the discovery of rays by Wilhelm Röntgen). Ivan Puluj designed a tube (cathode ray tube or Puluj lamp), which became the prototype of modern X-ray machines. It is known for certain that I. Puluj more thoroughly than W. Röntgen analyzed the nature and mechanisms of the appearance of rays, and also demonstrated their essence using examples. It was Ivan Puluj who was the first in the world to take an X-ray of a human skeleton.

5. Hard drive. Ukrainian scientist Lubomyr Romankiw in 1962 invented magnetic-resistance microheads for recording information that revolutionized the computer industry. The invention based on the fact that a method to record information on a magnetic head was found. It was the microheads of Romankiw that paved the way for the appearance of hard drives. The first who appreciated the invention of the Ukrainian scientist was Steve Wozniak – a co-founder of Apple. The first hard drive had as small volume as of 5 MB, and weighed 900 kg.

Accidental inventions

The vast majority of inventions are the result of planned and purposeful scientific work. However, some of the known discoveries were made by researchers by accident or in parallel to the main focus of attention. Below are some of these inventions.

1. The microwave oven was designed by Percy LeBaron Spencer in 1945 while working on projects of making radar equipment. The author of the invention noticed that an ultra-high-frequency radiation (electromagnetic waves) can heat objects. According to one version, such a property of this radiation (electromagnetic waves) was discovered after P. L. Spencer started to work with a magnetron without taking a chocolate bar out of his lab coat. A few minutes later he found a "melted" bar in his pocket. The first microwave oven was intended exclusively for defrosting products and weighed 340 kg. For his invention, P. L. Spencer got a small cash prize, and all the rights to produce microwave ovens were received by "Raytheon", where inventor was working at that time.

2. X-ray radiation was discovered by Wilhelm Röntgen in 1895 during his work with the cathode ray tube. During the experiments, W. Röntgen noticed that the cardboard covered with platinum-bearing barium,

which was next to the tube, despite the presence of a protective screen around the tube, began to glow in the dark. W. Röntgen tried to block the rays, but everything that he placed in front of the tube also began to glow. The scientist placed his hand in front of the tube and saw that it is “translucent” and is projecting on a special screen. During further experiments, the researcher replaced the tube with a photographic plate and obtained the world's first radiograph. Over time, the technology of using “Roentgen rays” (X-rays) was adapted for use by medical institutions.

3. Penicillin was discovered by Alexander Fleming in 1928 when he returned to his laboratory after a vacation. Returning to laboratory research after a long break, A. Fleming noticed that in one of the Perth cups (laboratory dishes in the form of a shallow cylindrical vessel) grew mold funfus that destroyed those staphylococcus colonies that had been sown in the cup. The surprise of the scientist was that other sown colonies remained unharmed. A. Fleming presented his discovery to the scientific community in the British Journal of Experimental Pathology, but it was left without readers' sufficient attention. A. Fleming wasn't a chemist, and therefore he couldn't find a technology for the rapid and economically proved isolation of penicillin for industrial use. Penicillin for human treatment was first used by Howard Florey and Ernst Chain only in 1941.

4. In 1903 Edouard Benedictus discovered impact-resistant glass. During the laboratory work, the scientist accidentally pulled back a glass flask that fell to the floor without breaking. Trying to understand the reason for the strength of the glass flask, the scientist found out that a collodion solution was stored in the flask for a long time, as a result of which the walls of the flask were covered with its a thin layer. It was this layer that added strength to the glass. Later, this invention found its use in the automotive industry.

5. Charles Goodyear invented vulcanized rubber during his attempts to create an elastic material resistant to low and high temperatures. The researcher treated the rubber resin with acid, boiled it in magnesia, added various substances, but all the actions were useless – the product turned into a sticky unusable mass. Working in 1839 at the Massachusetts Rubber Factory, Ch. Goodyear accidentally dropped a sulfur-treated rubber piece on a hot plate. To the surprise of the researcher, the rubber mass didn't melt like ordinary rubber under the influence of high temperatures, but only charred. According to results of additional experiments, Ch. Goodyear

found that rubber acquires the desired quality of resistance to low and high temperatures only after adding sulfur and lead to it. After numerous tests, Ch. Goodyear found the optimal vulcanization mode.

The mentioned above list of so-called accidental inventions is not exhaustive and can be continued, for example, with the discoveries of insulin, teflon, vaseline, etc. Despite the fact that discovery (invention) of that or another phenomenon (property) was accidental, one should pay attention to the fact that each of such discoveries was preceded by laborious scientific and (or) research work.

1.3. Approaches to the interpretation of the categorical content of the definition of "science"

Within the framework of scientific discourse, there are many approaches to the interpretation of the phenomenon of "science" (more than a hundred interpretations of the categorical content of the definition of "science" are known). Each of these definitions, depending on the author's ideological position, has its own accents regarding the categorical content of its definition. Some of the authors interpret the categorical content of the definition of "science" through the sphere of "human activity aimed at acquiring (development and systematization in the form of theories, hypotheses and laws of nature or society, etc.) new knowledge about the world" (here we have the concept of "science as an activity with a goal to get new knowledge". This concept of the mentioned above definition is not perfect, as its content can be used as to interpret the phenomenon of "education"); others through the "system of concepts about reality that is aimed to study development of nature, society and thinking, to predict and transform reality in the interests of society and man, basing on certain methods of cognition of the objective laws. Science is both a system of knowledge, its spiritual production, and practical activity on its basis" (here we have the concept of "science as a system of concepts and knowledge". This concept is also imperfect as its content does not appeal to human activity).

The definition of "science" is of Latin origin and in so-called literal translation is can be translated as "knowledge". Previously, instead of the definition of "science" people used the definition of "philosophy". That is, all the knowledge acquired by mankind was called "philosophy". Part of this knowledge concerning the learning of nature was called natural

philosophy for a long time, and the rest of the knowledge was called moral philosophy. In the process of differentiation of science, and its further integration, separate natural, humanitarian and technical sciences were formed, the subject of philosophy itself was also determined more accurately. There are definitions of philosophy as of a science within Marxism and positivism. But philosophy is not only science. It is rather a worldview, a theoretical reflection of the most general relations in the "man – world" system [1]. According to the results of the research of Arutyunov V. Kh., approaches to the interpretation of the categorical content of the definition of "science" can be classified into the following main groups: science – as a system of knowledge; science – as a kind or form of human activity; science – as a form of social consciousness; science – as a comprehensive spiritual experience of mankind; science – as the art of prediction; science – as work that scientists do; science – as a direct productive force. The most successful in its content definitions of science are presented in Table 1.2.

Table 1.2. – Approaches to the interpretation of the categorical content of the definition of "science"

№	Scientist	Definition
1	2	3
1	G. Birta, Y. Burg	science is an essence of human knowledge. It is a set of knowledge arranged according to certain principles, real connection of judgments, predictions and reality problems and its individual areas or aspects. [2]
2	M.Bukach, T. Popova, N.Klymenyuk	science is a special kind of cognitive and creative activity aimed at developing of objective, systemically organized knowledge about nature and society. The purpose of science is to identify laws through which it is possible to transform various objects during the process of human activity . Such objects can be natural subsystems of social groups, human consciousness, etc.[4]
3	O.Gutorov	science – is a special form of human activity that has developed historically, and its results consist of purposefully selected facts, hypotheses, theories, laws and methods of research. It should be noted, that scientific thinking is essentially a denial of a fact that at first glance seems obvious. Any research, theories, hypotheses that involve verification should be considered scientific [19]
4	O.Krushelnytska	science is a sphere of continuous development of human activity, the main feature and main function of which is the discovery, studying and theoretical systematization of objective laws on objective reality with the purpose of their practical implementation [24]

End of table 1.2

1	2	3
5	A. Konverskyi	science is a special form of human activity that has developed historically, and its results consist of purposefully selected facts, hypotheses, theories, laws and methods of research. It should be noted, that scientific thinking is essentially a denial of a fact that at first glance seems obvious. Any research, theories, hypotheses that involve verification should be considered scientific[21]
6	L. Lipych, S.Bortnik, I. Volynets	science is a set of theoretical and practical knowledge that are interrelated according to certain laws and principles. Accumulation of knowledge as the main goal of education no longer meets the current requirements and requires a swithcing to searching, ability to effectively operate with scientific achievements[27]
7	V. Medvid, Y. Danko, I. Koblianska	Science is the sphere of human activity which is aimed at developing new knowledge about nature, society and thinking. Science is a result of the social division of labour, the separation of mental labour from physical, transformation of cognitive activity into a special branch of activities of a certain group of people[29]
8	F. Chmylenko, L. Zhuk	science as a set of theoretical knowledge about the surrounding world is the result of learning carried out in a special, specific sphere of social activity. This is a special kind of spiritual activity – creation of objective-true systematic knowledge. Science is not only its own knowledge, which is the social value of mankind and is preserved by society, but also the hard creative work of researchers of scientific societies and teams, that is aimed at achieving new levels of knowledge every time [7]

Test questions for self-checking on topic 1

1. Determine the place and role of science in assuring the mankind's socio-political and socio-economic development in the framework of the first (industrial) and the second (technological) industrial revolutions.

2. Determine the place and role of science in assuring the mankind's socio-political and socio-economic development in the framework of the third (digital) and the forth (industry 4.0) industrial revolutions.

3. Provides examples of the impact of the scientific activity results on the main areas of society (for example: economic, social, political, infrastructural, cultural and spiritual, etc.).

4. Summarize the content of scientists' views regarding the place and role of science in assuring development of the individual, the state and society

5. Give examples of those scientific inventions that significantly influenced development of society and its main subsystems.

6. Expand the content of the category “science”.

TOPIC 2. THE BASIC CATEGORIES OF METHODOLOGY OF SCIENTIFIC RESEARCH ORGANIZATION: GENERAL CHARACTERISTICS OF THE CONTENT AND FEATURES OF ITS MANIFESTATION

Goal*:* to form a meaningful categorical basis for further consideration of the problematics in the methodology of scientific research organization, namely, to find out the content and determine the characteristics of its main categories

2.1. Approaches to the interpretation of the categorical content of "methodology". The subject of methodology studies

Content: a comparative analysis of the interpretations of the categorical content of the definition "methodology" available in the scientific and educational literature; actualization of the content of the phenomenon "methodology" through the prism of individual branches of knowledge; dialectics of relationships between methodology and methods of scientific knowledge; subject of the methodology of social sciences

2.2. The system, levels and classification groups of methodology. Methodology's functions in science

Content: composition of the methodology system; levels of methodology actualization and their general characteristics; functions of methodology in science

2.3. Approaches to the interpretation of the category "scientific research"

Content: the main categories of the Law of Ukraine "On scientific and scientific-technological activities" and characteristics of their content; comparative analysis of available interpretations of the categorical content of the definition "scientific research" in scientific and methodological literature

Recommended literature

1. Birta H.O., Burhu Yu.H. (2014) *Metodolohiia i orhanizatsiia naukovykh doslidzhen: navch. posib. [Methodology and organization of scientific research: teaching. manual]*. Kyiv : «Tsentr uchbovoi literatury».

2. Hutorov O.I. (2017). *Metodolohiia ta orhanizatsiia naukovykh doslidzhen: navch. posibnyk.[Methodology and organization of scientific research: teaching. manual.]* Kharkiv: KhNAU.

3. Dobronravova I.S., Rudenko O.V., Sydorenko L.I. (Eds.) (2018). *Metodolohiia ta orhanizatsiia naukovykh doslidzhen : navch. Posib [Methodology and organization of scientific research: teaching. manual]*. Kyiv : VPTs "Kyivskyi universytet"..

4. Otych O.M. (2016). «Try kyty» nauky: naukove piznannia – naukove doslidzhennia – naukove znannia ["Three whales" of science: scientific knowledge - scientific research - scientific knowledge]. *Pisliadyplomna osvita v Ukraini.* 2. 3–10ю

5. *Pro naukovu i naukovo-tekhnichnu diialnist : Zakon Ukrainy vid 26.11.2015 r. № 848-VIII. [On scientific and scientific and technical activity: Law of Ukraine dated November 26, 2015 No. 848-VIII]*. Vidomosti Verkhovnoi Rady. 2016. № 3. St. 25

2.1. Approaches to the interpretation of the categorical content of "methodology". The subject of methodology studies

Methodology is considered as a teaching about scientific method of cognition or as a system of scientific principles on the basis of which the research is based and selection of a set of cognitive means, methods, research techniques is made, and their specific sequence of use for obtaining the most objective accurate information concerning processes and phenomena [3].

Methodology is a set of methods, techniques and algorithms, using of which can provide an understanding of modern society as a whole and (or) processes and phenomena inherent to it. In its most simplified form, methodology can be considered as a kind of mechanism for obtaining a scientific result. Provided that methodology is perceived at the level of the mechanism for ensuring a scientific result, one should understand such its main components as: purpose, structure, tasks, principles of scientific knowledge organization, as well as hypotheses and results of scientific researches; environment within which scientific cognition is carried out; theory and practice of scientific cognition (direct activity of the subject of scientific cognition); traditions, norms and rules of scientific knowledge; subjects and objects of scientific knowledge; interests and targets, etc.

Methodology is the science about structure, logical organization, means and methods of activity in general. Usually, methodology is primarily understood as the methodology of scientific knowledge, which is a set of theoretical postulates on construction principles, forms and methods

of scientific and cognitive activity. So, methodology is a philosophical teaching of cognition methods and transformation of reality, usage of ideology principles in the process of cognition and practice [24, p. 64].

Methodology is a teaching on a system of scientific principles and methods of research activities. It includes fundamental, general scientific principles that form its basis, particular scientific principles underlying the theory of this or another discipline or scientific field, and a system of specific methods and techniques used to solve special research problems. The main goal of the methodology of science is a study and analysis of methods, means, and techniques by which new knowledge in science is obtained both at the empirical and theoretical levels of knowledge. Methodology is a scheme, a plan for solving the tasks of scientific research [24, p. 65].

Methodology (from Greek. “methodos” – method and “logos” – science, knowledge) is the doctrine about rules of thinking in the process of creating a scientific theory. In the domestic scientific tradition, methodology is considered as a doctrine of scientific methods of cognition or as a system of scientific principles on which research and the choice of a set of cognitive methods and techniques are based. Most often, methodology is considered: as a theory of research methods and the concepts' creation; a system of knowledge about the theory of science or about the system of research methods [7].

Method (Greek. – the way of learning) in its broadest sense of the word means “a path for something”, is a way of subject's activity in any of its forms. The concept of “methodology” has two main meanings: a system of certain methods and techniques used in a this or another field of activity (in science, politics, art, etc.); a teaching on this system, its general theory of the method, the theory in action. Methodology in a certain sense is "narrower" than the theory of learning, since the latter is not limited with reserching forms and methods of knowledge, and studies the problems of the nature of cognition, the relationship between knowledge and reality, the subject and the object of knowledge, possibilities and limits of knowledge, criteria of its truth, etc. On the other hand, methodology is "wider" than epistemology, as it is interested not only in the methods of knowledge, but also in all other forms of human activity [2].

Methodology is a type of rational-reflexive consciousness aimed at studying, improving and constructing methods. The concept of

"methodology" has two main meanings: firstly, it is a system of certain rules, principles and operations used in a particular field of activity (in science, politics, art, etc.); secondly, it is a teaching about this system, the general theory of the method [19].

Methodology is the teaching on rules of thinking while creating science, and implementation of scientific research. The methodology of science is mainly understood as the doctrine of the scientific method of cognition or a system of scientific principles on the foundation of which research is based and the choice of means, methods and modes of cognition is carried out. There exists another, narrower understanding of the methodology of science, when it is considered as the theoretical basis of some special, partial methods and means of scientific knowledge, for example, management methodology, pricing methodology, etc., but in this case it is more appropriate to talk about the methodology of knowledge and action. The main purpose of methodology as a science is studying those means, methods and techniques of scientific research, due to which the subject of scientific cognition gains new knowledge about reality. With the help of techniques and methods, the subject of cognition performs certain actions to achieve pre-set goals, which can be both practical and theoretical, cognitive [11].

Methodology is the doctrine of a system of scientific cognition methods and transformation of reality. Literally, methodology is the doctrine of method. The main purpose of methodology is the study of those means, methods and techniques of scientific research, with the help of which the subject of scientific knowledge gains new knowledge about reality. The concepts and methods of science, and the area of their application are the subjects of its study [23].

Methodology is a conceptual presentation of the purpose, content, research methods that provide the most objective, accurate and systematic information about processes and phenomena. Methodology is a set of means, methods, techniques that are used in a particular science. Methodology is a branch of knowledge that studies the means, principles of organization of cognitive and practical human activities [27].

According to the results of analysis of the content of the mentioned above interpretations, there is a risk of understanding methodology through the prism of mechanical putting together methods, tools, techniques, etc. of scientific knowledge. It should be understood that the mechanical

combination of methods, tools, techniques, etc. is not a methodology, because it is devoid of causal relationships between elements of such a set. In other words, a set of methods, tools, techniques, etc. of scientific knowledge can only be considered at the level of methodology in case if there is a logical relationship between its constituent elements.

Interpretation of the subject of methodology is usually presented through the prism of projection to a specific field of knowledge or academic discipline, for example: "the subject of methodology of science"; "the subject of the methodology of history"; "the subject of methodology of law"; "the subject of methodology of pedagogy"; "the subject of methodology of sociology", etc. Considering focus of our attention within this course, as well as the specialty chosen for study, we consider it appropriate to stop on the first and last of the mentioned "subjects of methodology".

"The subject of methodology of science" is usually interpreted as a structured system of knowledge regarding the mechanisms (means, methods, tools, etc.) for obtaining, verifying, producing scientific knowledge. In other words, the subject of the methodology of science can be presented as a set of means, methods, tools and techniques used for cognition. Before formulating "the subject of methodology of sociology", let us pay attention to a broader category in its content – "the subject of social sciences" (we will remind, that sociology, along with economics, political science and psychology, enters the field of knowledge "Social and behavioral sciences"). The subject of social sciences, along with other subjects of branch sciences (disciplines), is an integral part of the of the methodology of science. In the most simplified form, this component can be presented as a mechanism for obtaining, checking, producing, etc. knowledge, that is profile (branch) in relation to the social sciences. Here we have those tools of scientific cognition that is used to obtain knowledge about society. The profile (branch) specialization of the subject of social sciences, or its so-called specificity (uniqueness) in relation to the subjects of other sciences can be revealed through:

1) peculiarity of the form, content, nature and results of evolution of development (changes, transformations, etc.) of an object of direct attention (object of scientific knowledge), namely: social object (a person, organization, groups of people, society); interaction between a social object and other social objects and (or) their elements; interests, motives, actions

of a social object, etc. The complexity of choosing a methodology for researching objects of social sciences is related to their nearly unlimited diversity in form and content; unequal dynamics and results of evolutionary development; variability of transformational changes, etc. Here it is understood that in order to gain knowledge about each of the social objects, a unique set of tools, methods, techniques etc. is needed (for example, the toolkit that is justified (appropriate) to be used for studying a human in interaction with another human may be ineffective for studying a person's interaction with a team);

2) complexity of the structure of each single studied object and the importance (significance) of the obtained results for further development of society. The social component of any system, regardless of its variety and peculiarities in functioning, cannot be investigated using any universal mechanism (a set of tools, methods, techniques, etc.). This is due to the fact that each social object, despite the identical nature of its formation, has its own unique content and value vector;

3) constant in the time of action, non-systemic in the circle of coverage and unpredictable in the direction of transformation variability of the characteristics of social objects (the characteristics of each of the social objects are not static, and therefore the set of tools for their studying cannot be typical not only by the type of object chosen for the study, but also by the time of its usage).

Methods of scientific cognition in the framework of social sciences can be divided into two main groups, namely: general or typical methods; specific (profile, branch) methods. The general or typical methods include the method of objective, unbiased presentation of scientific knowledge (comprehensive coverage of the content of social theories, concepts, results of scientific research, etc.). The use of this method assumes that the researcher has certain pedagogical abilities and methodological training (the ability to present material; oratory skills, etc.). This method is characteristic for any field of scientific knowledge. Specific (profile, branch) methods include: sociological monitoring of the state of a social object (a person, organization, society) (that is classification, systematization and analysis of socially significant information; surveys (questionnaires, interviews) and clarification of public opinion; conducting social experiments, etc.); scientifically based predicting of directions and dynamics of development of a social object; analysis of the characteristics of social objects, as well as

understanding their value orientations; awareness of social reality; identification of social risks; designing and programming social transformations; critical rethinking of classical and modern social theories; nomination and verification of author's hypotheses, concepts regarding the subject of immediate attention, etc.

The subject of methodology of sociology, along with other disciplines' subjects (specialties of the field of knowledge "Social and Behavioral Sciences"), is an integral part of the subject of social sciences. Methodology of sociology is revealed through the prism of specific content and practice of using the mechanisms for conducting sociological research (principles, methods, algorithms, technologies, tools, goals, tasks, resources, environment, subjects and objects, etc.), as well as paradigms of scientific search. In its most simplified form, sociological methods, as the main determinant of definition of the subject of methodology of sociology, can be considered at the level of a dialectical unity of technologies (techniques) and mechanisms (methods, tools, etc.) within the algorithm of collection, generalization (processing), analysis, interpretation of sociological information. In other words, the subject of sociology methodology is a system of knowledge and practices (techniques, procedures, operations, etc.) regarding empirical and theoretical understanding of the social object and social reality. A simplified list of sociological methods of scientific cognition can have the following forms: methods of information collecting (documents' analysis, observations, surveys, experiments, etc.); methods of information processing and analysis (factor, latent-structural, correlation, regressive, disperse, ranking, scaling, indexing, etc.); methods of the theory construction (deductive, inductive, comparative, causal, structural-functional, genetic, etc.) [12].

2.2. The system, levels and classification groups of methodology. The functions of methodology in science

The system of methodology consists of the following main elements: methodological and general scientific theories and paradigms (philosophical, social and psychological, ethical and aesthetic, etc. theories, paradigms, concepts); mechanisms (methods, tools, principles, techniques, measures, technologies, algorithms, etc.); conceptual and categorical apparatus (definitions, categories, interpretations, generalizations, etc.); laws, patterns and models (models of real objects; idealization; trends, etc.);

norms, standards and rules; components of scientific research (actuality; purpose and goal; object and subject; methods; generalizations, conclusions and concrete results); technology organization of scientific activity and the activity itself (scientific activity).

In its most simplified form, methodology can be disclosed through the prism of such levels of its actualization: 1) a level of fundamental (general scientific) determinants and principles (it is considered that these principles themselves determine the so-called pure methodology); 2) a level of particular scientific determinants and principles (it is considered that these principles are the basis of the theory of this or another field of scientific knowledge); 3) a level of specific methods, algorithms, tools (is considered to be the level of direct use of certain mechanisms of scientific cognizance).

Methodology, in accordance with the scale of its actualization, can be conditionally divided into two main groups, namely: the group of general methodological determinants (principles, methods, concepts, etc.), that is, those determinants that can be used in any field of knowledge, regardless of its focus of attention (this group forms general philosophical basis for organizing scientific research); a group of specific in their content (principles, methods, concepts, etc.) methodological determinants, that is, those determinants that can be used in the framework of a specific field of knowledge (this group is actualized due to specification of the first group in accordance with the specific features of the manifestation of content of a particular field of knowledge, its unique principles, methods, tools, etc.).

The functions of methodology in science:

– determines mechanisms (ways, methods, principles, practices, etc.) of organization of cognitive activities for obtaining results;

– determines comprehensive, complete, multi-level (covers each of the levels of the object's actualization) and systemic (consideration of the object and its components through the prism of its/their interaction with other objects/elements of other systems) consideration of the object of research attention;

– promotes formation of a research culture of subjects of scientific research and provides a certain unification to the processes of scientific cognizance;

– provides clarification, producation, classification and dissemination of new scientific information;

– promotes development of categorical content of already existing scientific definitions (improvement of the content of previously formulated interpretations), as well as the introduction of new terminology definitions into scientific circulation.

2.3. Approaches to the interpretation of the category "scientific research"

The Law of Ukraine "On scientific and scientific-technological activities" [37] contains interpretations of the main terms that are usually used in scientific circulation for characterizing the content of scientific and scientific-technological activities, namely:

– scientific activity – is an intellectual creative activity aimed at gaining new knowledge and (or) finding ways to apply them, the main types of which are fundamental and applied scientific researches;

– scientific (scientific-technological) products are scientific and (or) scientific-technological (applied) results intended for implementation;

– scientific (scientific-technological) work consists of scientific researches and scientific-technological (experimental) developments carried out in order to obtain scientific, scientific-technological (applied) results. The main types of scientific (scientific-technological) work are scientific-research, development, design, research-and-technological, technological, search project-search works, production of research prototypes or quantities of scientific-technological products, as well as other works related to bringing of new scientific and scientific-technological knowledge to the stage of practical use;

– scientific result is new scientific knowledge obtained in the process of fundamental or applied scientific researches and recorded on information carriers. A scientific result can be in the form of a report, a published scientific article, a scientific report, a scientific notice on scientific research, a monographic study, a scientific discovery, regulatory and legal act, a regulatory document or scientific and methodological documents, preparation of which requires relevant scientific research or contains a scientific component, etc.;

– scientific-technological (applied) results are new or significantly improved materials, products, processes, devices, technologies, systems, new or significantly improved services, implemented new constructive or technological solutions completed tests, developments that are introduced or

can be introduced into public practice that are obtained during conducting applied scientific researches, scientific-technological (experimental) developments. The scientific-technological (applied) result can be in the form of a preliminary design, an experimental (research) sample or its operating model, a design or technological documentation for scientific and technical products, a prototype, a draft of a regulatory and legal act, a regulatory document or a scientific and methodological documents, etc.;

– scientific-technological activity is a scientific activity aimed at gaining and using new knowledge to solve technological, engineering, economic, social and humanitarian problems, the main types of which are applied scientific researches and scientific-technological (experimental) developments.

The Law of Ukraine "On scientific and scientific-technological activities" does not contain the wording for the category of "scientific activity" in the so-called pure form. At the same time, the authors of the Law disclose the content of scientific-technological activities and scientific (scientific-technological) work by appealing to the categories of scientific activity and scientific research, which creates certain basis for understanding the phenomenon of scientific activity.

In the framework of the educational and scientific literature, we can find such basic approaches for disclosing the categorical content of the definition of "scientific research", as "a very broad concept that covers all processes, regardless of their scale – from the origin of an idea to its implementation in the form of new theoretical principles, creation of new technologies, etc. A scientific research is usually a special kind of human activity that aims to gain new, deeper, more accurate knowledge, that as a rule serves as practical purposes for creating new or improving old knowledge that a person has acquired during their life" [22, p. 77]. The interpretation of the content of the category of "scientific research" is presented in Table 2.1. [22, p. 77].

The most successful in its content interpretation of the category of "scientific research" was formulated by O. Krushelnitska, namely, "scientific research is a purposeful cognition, the result of which is a system of concepts, laws and theories. The goal of a scientific research is to determine a specific object and a comprehensive, reliable study of its structure, characteristics, connections on the basis of scientific principles and cognition methods, implementation of useful results into production"

[24].

Table 2.1 – Definitions of the concept of "scientific research"

№	Author of the definition	Content of the definition
1	2	3
1	G. Birta, Y. Burg	is purposeful learning, the results of which act as a system of concepts, laws and theories. When characterizing scientific research, attention is usually paid to its following distinctive features: it is certainly a purposeful process, the achievement of a consciously set goal, clearly formulated tasks; it is a process aimed at searching for the new, at creativity, at discovering the unknown, at proposing ideas, at new coverage of previously considered issues; it is characterized by consistency: here, both the process of research, and its results are ordered, brought into the system; it is characterized by strict evidence, consistent justification of made generalizations and conclusions [2]
2	V. Vasylenko	is a process of studying of an object or phenomenon for identifying patterns of its occurrence and development, as well as the possibilities of its change and usage in the interests of society's well-being
3	N. Hnasevych, N Goncharuk, M. Guryk	is a process in which an object or phenomenon is investigated using certain scientific methods, with the purpose of the study being an establishment of patterns of its occurrence, development and transformation in the interests of rational use in people's practical activities. Scientific research should be systematic and purposeful[18]
4	A. Konverskyi	is a special kind of human activity that is aimed on gaining new, deeper, more accurate knowledge that as a rule serves as practical purposes for creating new or improving old knowledge that a person has acquired during their life [22, p. 77]
5	L. Lipych, S.Bortnik, I. Volynets	is a purposeful knowledge, the result of which is a system of concepts, laws and theories. An aim of a scientific research is definition of a specific object and comprehensive, reliable studying of its structure, characteristics, connections and implementation in the production of useful results basing on the foundations of scientific principles and methods of cognition [27]
6	O. Otych	is a process of gaining new scientific knowledge by the subject of scientific activity (a scientist, group of scientists, scientific school), as well as the kind of cognitive and practical scientific activity. At the same time, we can understand scientific activity as an intellectual creative activity aimed at gaining and using new knowledge. Scientific activity exists in various forms, in particular: research activity; scientific-organizational activities; scientific-pedagogical activity; scientific-informational activity; scientific and auxiliary activities, etc
7	I. Rassokha	is a special form of the cognition process, a systematic, purposeful studying of objects, in which the means and methods of science are used and which completes formation of knowledge concerning the studied object. Scientific research is a complex and multifaceted process that combines organizational, technical, economic, legal and psychological aspects. Studies vary in purpose, sources of funding and timing, they require different technical, software, information and methodological support[39]

End of table 2.1

1	2	3
8	E. Shishkina	is a process of studying a certain object or phenomenon using scientific methods, which aims at establishing patterns of its occurrence, development and transformation in the interests of rational use in the practical human activity [43]

Test questions for self-checking on topic 2

1. Reveal the content of the category of "methodology" (when answering, compare the categorical content of several interpretations of the corresponding definition)

2. Formulate the interpretation of the subject of methodology through the prism of the field of knowledge and specialty within which you are receiving a higher education

3. Reveal the content of classification groups of scientific cognition methods within the social sciences (during the answer, pay attention to the general or typical methods and specific (profile, branch) methods)

4. Identify the main elements of the system of methodology. Reveal the content of some of this system's elements (during the answer, pay attention to: methodological and general scientific theories and paradigms; mechanisms; conceptual-categorical apparatus; laws, patterns and models; norms, standards and rules; components of scientific research; technology of scientific activity organization)

5. Characterize levels of actualization of methodology in accordance with its content direction and the scale of coverage of objects of direct attention. Reveal the content of the functions of methodology in science.

6. Reveal the content of the category of "scientific research" (when answering, compare the categorical content of several interpretations of the corresponding definition).

TOPIC 3. CLASSIFICATION (TYPOLOGIZATION) OF SCIENTIFIC RESEARCHES

Goal*:* to consider the existing in the scientific, educational and methodical literature approaches to the classification of scientific researches, as well as to determine the place of ones' scientific research in the future within the relevant classifications

3.1. Classification of sciences

Content: a comparative analysis of the scientists' views regarding the interpretation of the content of the phenomenon of sciences classification, as well as determining its significance for the ordering of scientific knowledge; dialectics of development of the problems of classification of sciences; list of knowledge branches and specialties in which applicants' training for higher education is carried out

3.2. Classification of scientific researches and characterization of the content of the main classification groups

Content: analysis of the content of available in the scientific, educational and methodical literature approaches to classification of scientific researches; classification of scientific researches in accordance with: methods used within their limits, the area of the results' application, varieties of relations with social production, the degree of importance of their results for national economy, sources of financing, duration of scientific research, the level of bringing scientific and scientific-technological knowledge to the stage of their practical application, locations of holding of scientific research, the composition of qualities of the studied object, etc.

Recommended literature

1. Birta H.O., Burhu Yu.H. (2014) *Metodolohiia i orhanizatsiia naukovykh doslidzhen: navch. posib. [Methodology and organization of scientific research: teaching. manual]*. Kyiv : «Tsentr uchbovoi literatury».

2. Hutorov O.I. (2017). *Metodolohiia ta orhanizatsiia naukovykh doslidzhen: navch. posibnyk.[Methodology and organization of scientific research: teaching. manual.]* Kharkiv: KhNAU.

3. Lipych L.H., Bortnik S.M., Volynets I.H. (Eds.) (2018). *Metodolohiia ta orhanizatsiia naukovykh doslidzhen (haluzi znan: 05 – sotsialni ta povedinkovi nauky, 07 – upravlinnia ta administruvannia):*

navch. Posib [Methodology and organization of scientific research (fields of knowledge: 05 – social and behavioral sciences, 07 – management and administration): teaching. manual]. Lutsk : Vezha-Druk.

4. Perelik haluzei znan i spetsialnostei, za yakymy zdiisniuietsia pidhotovka zdobuvachiv vyshchoi osvity: zatv. Postanovoiu Kabinetu Ministriv Ukrainy 29.04.2015 r. № 266 [List of fields of knowledge and specialties for which higher education applicants are trained. Resolution of the Cabinet of Ministers of Ukraine 04/29/2015 No. 266]. URL: https://zakon.rada.gov.ua/laws/show/266-2015-p#Text

5. Chmylenko F.O., Zhuk L.P. (2014). *Posibnyk do vyvchennia dystsypliny «Metodolohiia ta orhanizatsiia naukovykh doslidzhen» [Guide to studying the discipline "Methodology and organization of scientific research"]*. Dnipro: RVV DNU.

3.1. Classification of sciences

According to the practice of using the norms of international standards of statistical classifications, under classification is understood “an exhaustive and structured set of described categories, which are most often presented in the form of a hierarchy using digital and letter codes” (Standard Statistical Classifications: Basic Principles. – UN Statistical Commission (Thirtieth session), 1999). Within the norms of national (state) statistical classifications, the definition of “classification” is interpreted as “the distribution of a set of objects into subsets basing on their similarity or dissimilarity” (GOST 1.10: 2005 National Standardization. Rules for development, construction, teaching, design, and maintenance of national classifiers).

In the framework of the scientific literature, we can find many approaches to determining of categorical content of the definition of “classification”. The most common approach within the encyclopedic literature is the interpretation of classification through “a multi-level, consistent division of the scope of the concept in order to systematize, deepen and gain new knowledge regarding the members of the division” (Philosophical encyclopedic dictionary compiled by scientists of H.S. Skovoroda Institute of Philosophy of National Academy of Sciences of Ukraine). It is traditionally believed that the result of classification is a structured (ordered) system of interrelated concepts.

According to the research by O. Krushelnytska, classification of

sciences not only determines the place of each of the sciences in the general system of scientific knowledge, but also establishes the relationship between sciences. "The classification of sciences in science studies performs the functions of grouping scientific knowledge into specific systems, which contributes to the unification of science, its international relations and the growth of the development pace. The modern classification of sciences expresses the relationship between natural, technical, humanitarian sciences and philosophy. This classification is based on the specific features of the studying of the objects of material world by various sciences. Classification fixes (reflects) the natural connections between objects, determines their place and basic properties in the wholesome system, is a means of preserving and searching for information" [24]. In his turn, O. I. Hutorov pays attention to the fact that the level and nature of connection between the sciences is determined by the subject, method and conditions of studying the objects, the goals and aims of science, their practical significance and other factors. The purpose of the classification of sciences is to reveal mutual connection between sciences on the basis of certain principles and to show these connections in the form of a logically reasoned arrangement, grouping a set of sciences into a consolidated system of knowledge [19]. Aristotle at one time drew attention to the need to classify the sciences (to order scientific knowledge). By classifying the sciences according to the theoretical level and the historical conditions of their origin, he "separated philosophy, mathematics, physics, on the one side and art and sciences, which serve neither for pleasure nor for necessary needs, on the other. This proves that he considered scientific knowledge as self-worth regardless of its possible practical application" [2].

Francis Bacon had a similar in its content approach. The scientist divided knowledge into those that characterize (describe) nature and those that interpret it (reveal the meaning of phenomena). In the basis of his classification, F. Bacon tried to put the internal logic of science development. A more complex in its content classification of sciences was proposed by Friedrich Engels. "Considering the principles of the material unity of the world and its inexhaustible qualitative diversity, he divisioned the sciences according to the forms of motion of matter described by them. On this basis, Engels argued that the classification of sciences, each of them analyzing a separate form of motion or a number of interrelated and passing one into the other forms of motion, according to the inherent sequence of

these forms of motion is both a classification and an arrangement. He based the differentiation of sciences on the principle of objectivity, according to which, differences between sciences are caused by differences in the objects of their research. They are the existing forms of motion of matter (mechanical, physical, chemical, biological, social)" [2].

According to A. Konverskyi, the classification of sciences is carried out together with formation of scientific knowledge, performs functions of grouping the scientific knowledge into certain systems, that contributes to the unification of science, its international relations and growth of the pace of development. The modern classification of sciences expresses relationship between natural, technical, humanitarian sciences and philosophy. This classification is based on the specific peculiarities of studying the objects of the material world by various sciences. The level and nature of relationship between the sciences is determined by the subject, method and conditions of cognition of objects, the goals and objectives of science, their practical significance and other factors[21].

According to O. Korobochka, the problems of classification of sciences can be presented through showing relationships built on the basis of certain principles that are structured within a logically built series. "Material objects of nature determine the existence of many branches of knowledge, so science today covers a large branch of knowledge and includes about 15 thousand disciplines that are increasingly interact with each other... Due to this fact, all sciences are divided into: natural sciences (physics, chemistry, biology, etc.); social (economic, philological, historical, etc.); about thinking (philosophy, logic, psychology, etc.). There also exists an approach to divide sciences into research (fundamental, theoretical) and applied ones".

A modern and reasonable in its content approach to the classification of sciences can be found in the approved Resolution of the Cabinet of Ministers of Ukraine of April 29, 2015. № 266 "On approving the list of fields of knowledge and specialties in which higher education applicants are trained" [34]. The corresponding list classifies the fields of knowledge and specialties, and also sets their equivalent in accordance with the international classification. The list of fields of knowledge and specialties in which higher education applicants are trained is given in Table 3.1

With certain abstractions, we can accept this list at the level of the general classification of sciences.

Table 3.1 – A list of industries and specialties in which higher education applicants are trained

Code and name of the field of knowledge*	Code and name of a speciality	Code and name of the relevant detailed field of knowledge according to the International Standard Classification of Education
1	2	3
01 Education/ Pedagogics	011 Educational, pedagogical sciences	0111 Education science
	012 Preschool education	0112 Training for pre-school teachers
	013 Primary education	0113 Teacher training without subject specialization
	014 Secondary education (by subject specialization)	0114 Teacher training with subject specialization
	015 Professional education (by specialization)	0114 Teacher training with subject specialisation
	016 Special education	0113 Teacher training without subject specialisation
	017 Physical education and sport	1014 Sports
02 Culture and Art	021 Audiovisual art and Production	0211 Audio-visual techniques and media production
	022 Design	0212 Fashion, interior and industrial design
	023 Fine art, decorative art, restoration	0213 Fine arts 0214 Handicrafts
	024 Choreography	0215 Music and performing arts
	025 Musical art	0215 Music and performing arts
	026 Performing arts	0215 Music and performing arts
	027 Museology and heritage studies	0322 Library, information and archival studies
	028 Management of sociocultural activities	0413 Management and administration
	029 Information, library and archival studies	0322 Library, information and archival studies 0415 Secretarial and office work

Continuation of the Table 3.1

1	2	3
03 Human sciences	031 Religion studies	0221 Religion and theology
	032 History and archeology	0222 History and archaeology
	033 Philosophy	0223 Philosophy and ethics
	034 Culture studies	0314 Sociology and cultural studies
	035 Philology	0231 Language acquisition 0232 Literature and linguistics
04 Theology	041 Theology	0221 Religion and theology
05 Social and behavioral sciences	051 Economics	0311 Economics
	052 Political science	0312 Political sciences and civics
	053 Psychology	0313 Psychology
	054 Sociology	0314 Sociology and cultural studies
06 Journalistics	061 Journalistics	0321 Journalism and reporting
07 Administration and Governance	071 Accounting and taxation	0411 Accounting and taxation
	072 Finance, banking, insurance and stock market	0412 Finance, banking and insurance
	073 Management	0413 Management and administration 0415 Secretarial and office work
	075 Marketing	0414 Marketing and advertising
	076 Entrepreneurship and trade	0413 Management and administration 0416 Wholesale and retail sales
08 Law	081 Law	0421 Law
09 Biology	091 Biology and biochemistry	0511 Biology 0512 Biochemistry 0522 Natural environments and wildlife
10 Natural sciences	101 Ecology	0521 Environmental sciences 0522 Natural environments and wildlife
	102 Chemistry	0531 Chemistry
	103 Earth sciences**	0532 Earth sciences
	104 Physics and astronomy	0533 Physics

Continuation of the Table 3.1

1	2	3
	105 Applied physics and nanomaterials	0533 Physics 0588 Inter-disciplinary programmes and qualifications involving natural sciences, mathematics and statistics
	106 Geography	0314 Sociology and cultural studies 0532 Earth sciences
11 Mathematics and Statistics	111 Mathematics	0541 Mathematics
	112 Statistics	0542 Statistics
	113 Applied mathematics	0541 Mathematics 0588 Inter-disciplinary programmes and qualifications involving natural sciences, mathematics and statistics 0613 Software and applications development and analysis
12 Information Technology	121 Software Engineering	0613 Software and applications development and analysis
	122 Computer Science	0613 Software and applications development and analysis
	123 Computer engineering	0612 Database and network design and administration 0714 Electronics and automation
	124 System analysis	0688 Inter-disciplinary programmes and qualifications involving Information and Communication Technologies (ICTs)
	125 Cybersecurity and information protection	0612 Database and network design and administration 0688 Inter-disciplinary programmes and qualifications involving Information and Communication Technologies (ICTs)

Continuation of the Table 3.1

1	2	3
	126 Information systems and technologies	0611 Computer use 0612 Database and network design and administration
13 Mechanical Engineering	131 Applied mechanics	0715 Mechanics and metal trades
	132 Materials science	0588 Inter-disciplinary programmes and qualifications involving natural sciences, mathematics and statistics 0715 Mechanics and metal trades 0788 Inter-disciplinary programmes and qualifications involving engineering, manufacturing and construction
	133 Industrial machinery engineering	0715 Mechanics and metal trades 0716 Motor vehicles, ships and aircraft
	134 Aviation and space-rocket equipment	0716 Motor vehicles, ships and aircraft
	135 Shipbuilding	0716 Motor vehicles, ships and aircraft
	136 Metallurgy	0715 Mechanics and metal trades
14 Electrical engineering	141 Electricity, electrical engineering and electromechanics	0713 Electricity and energy
	142 Power engineering	0713 Electricity and energy 0716 Motor vehicles, ships and aircraft
	143 Nuclear engineering	0713 Electricity and energy
	144 Heat power engineering	0713 Electricity and energy
	145 Renewable energy sources and hydropower	0713 Electricity and energy
16 Chemical Engineering and Bioengineering	161 Chemical technologies and engineering	0711 Chemical engineering and processes
	162 Biotechnology and bioengineering	0512 Biochemistry 0711 Chemical engineering and processes

Continuation of the Table 3.1

1	2	3
	163 Biomedical engineering	0588 Inter-disciplinary programmes and qualifications involving natural sciences, mathematics and statistics 0788 Inter-disciplinary programmes and qualifications involving engineering, manufacturing and construction
17 Electronics, automation and electronic communications	171 Electronics	0714 Electronics and automation
	172 Electronic communications and radiotechnics	0714 Electronics and automation
	173 Avionics	0714 Electronics and automation 0716 Motor vehicles, ships and aircraft
	174 Automation, computer-integrated technologies and robotics	0714 Electronics and automation
	175 Information and measurement technologies	0714 Electronics and automation 0788 Inter-disciplinary programmes and qualifications involving engineering, manufacturing and construction
	176 Micro- and nanosystem technology	0714 Electronics and automation 0788 Inter-disciplinary programmes and qualifications involving engineering, manufacturing and construction
18 Production and technology	181 Food Technologies	0721 Food processing
	182 Technologies of light industry	0723 Textiles (clothes, footwear and leather)
	183 Environmental protection technology	0712 Environmental protection technology
	184 Mining	0724 Mining and extraction
	185 Oil and gas engineering and technologies	

Continuation of the Table 3.1

1	2	3
	186 Publishing and printing	0211 Audio-visual techniques and media production 0611 Computer use
	187 Woodworking and furniture technologies	0722 Materials (glass, paper, plastic and wood)
19 Architecture and construction	191 Architecture and urban planning	0731 Architecture and town planning
	192 Building and civil engineering	0732 Building and civil engineering
	193 Geodesy and land management	0532 Earth sciences 0731 Architecture and town planning
	194 Hydrotechnical construction, water engineering and water technologies	0732 Building and civil engineering
20 Agricultural Sciences and Food	201 Agronomics	0811 Crop and livestock production
	202 Protection and plant quarantine	0811 Crop and livestock production
	203 Gardening, horticulture and viticulture	0811 Crop and livestock production 0812 Horticulture
	204 Technology of production and processing of livestock products	0811 Crop and livestock production
	205 Forestry	0821 Forestry
	206 Landscape gardening	0812 Horticulture
	207 Water bioresources and aquaculture	0831 Fisheries
	208 Agroengineering	0716 Motor vehicles, ships and aircraft 0888 Inter-disciplinary programmes and qualifications involving agriculture, forestry, fisheries and veterinary
21 Veterinary	211 Veterinary	0841 Veterinary 1022 Occupational health and safety
22 Healthcare	221 Dental studies	0911 Dental studies
	222 Medicine	0912 Medicine

Continuation of the Table 3.1

1	2	3
	223 Nursing	0913 Nursing and midwifery
	224 Medical diagnostic and treatment technology	0914 Medical diagnostic and treatment technology
	225 Medical psychology	0313 Psychology
	226 Pharmacy, industrial pharmacy	0588 Inter-disciplinary programmes and qualifications involving natural sciences, mathematics and statistics 0711 Chemical engineering and processes 0916 Pharmacy
	227 Therapy and rehabilitation	0915 Therapy and rehabilitation
	228 Pediatrics	0912 Medicine
	229 Public health	0413 Management and administration 0988 Inter-disciplinary programmes and qualifications involving health and welfare 1021 Community sanitation 1022 Occupational health and safety
23 Social work	231 Social work	0921 Care of the elderly and of disabled adults 0922 Child care and youth services 0923 Social work and counseling
	232 Social welfare	0413 Management and administration 0923 Social work and counselling
24 Service sector	241 Hotel and restaurant business	1013 Hotel, restaurants and catering
	242 Tourism and Recreation	1015 Travel, tourism and leisure
25 Military Sciences, National Security and Security of the State Border	251 State security	1031 Military and defence
	252 State border security	1031 Military and defence
	253 Military management (by type of armed forces)	1031 Military and defence
	254 Provision for troops (forces)	1031 Military and defence

Continuation of the Table 3.1

1	2	3
	255 Arms (weapons) and military equipment	1031 Military and defence
	256 National Security (in certain areas of security and activities) ***	1031 Military and defence
	257 Information security management	1031 Military and defence
26 Civil security	261 Fire safety	1032 Protection of persons and property
	262 Law Enforcement	1022 Occupational health and safety
	263 Civil security	1032 Protection of persons and property
27 Transport	271 Sea and inland water transport ****	0716 Motor vehicles, ships and aircraft 1041 Transport services
	272 Aviation transport	0716 Motor vehicles, ships and aircraft 1041 Transport services
	273 Rail transport	0716 Motor vehicles, ships and aircraft 0732 Building and civil engineering 1041 Transport services
	274 Automobile transport	0716 Motor vehicles, ships and aircraft 1041 Transport services
	275 Transportation technologies (by type)	1041 Transport services
28 Public administration and governance	281 Public administration and governance	0413 Management and administration
29 International relations	291 International relations, public communications and regional studios	0312 Political sciences and civics 0314 Sociology and cultural studies 0388 Inter-disciplinary programmes and qualifications involving social sciences, journalism and information
	292 International economic relations	0311 Economics 0312 Political sciences and civics
	293 International law	0421Law

End of table 3.1

* Establishing the compliance to the field of knowledge of the International Standard Classification of Education is carried out only by establishing the compliance of the specialty to the the field with the International Standard Classification of Education.
** A speciality that invoelves studying of the composition and structure of the Earth, including geology, geophysics, mineralogy, geochemistry, volcanology, seismology and other physical sciences of the Earth, meteorology and other atmospheric sciences (including climatic research), hydrology, oceanology.
*** The type (types) of activity is approved by the relevant state body, that in coordination with the Ministry of Education and Science of Ukraine ensures the fulfillment of tasks in the field of national security.
****Until December 31, 2021 speciality 271 is known as "River and sea transport".

3.2. Classification of scientific researches and characterization of the main classification groups content

According to results of analysis of content of domestic researchers' scientific views regarding the classification (typologization) of scientific research, we can speak about absence of a so-called unified view on the relevant issue. A sufficiently balanced in its content approach to the classification of scientific research was worked out by F. Chmylenko. According to the scientist, scientific researches, depending on the methods used, can be *theoretical, theoretical-experimental and experimental.*

Theoretical scientific research is based on the use of logical and mathematical methods of cognition. Their result may be establishment of certain dependencies, qualities, connections of the studied objects, etc. (for example, the study of the essence and role of the environment's acidity during the reaction). Theoretical-experimental scientific research are research of a theoretical character connected at the same time with experimental verification of the detected dependencies, qualities, links, etc. (for example, the study of factors that affect formation and purity of sediment in gravimetry). Experimental scientific research are the studies that are carried out in specific objects in order to identify new dependencies, qualities, connections or to check previously proposed theoretical provisions (for example, studies of the formation of complex particles of a certain composition) [7].

According to the classification by F. Chmilenko, scientific researches, *depending on sphere of their results usage*, can be divided into fundamental, applied and development ones. Fundamental scientific researches are experimental or theoretical researches aimed on obtaining fundamentally new knowledge about patterns of development of nature, society, the human, and their relationships. The need for such researches is caused by the needs of the national economy or industry. The result can be recommendations for creation of applied research on determination of the possibilities of practical use of the obtained scientific knowledge, scientific

publications, etc. An applied scientific research is a scientific and scientific-technical activity aimed at obtaining and using knowledge for practical purposes, searching for the most rational ways of practical use of the results of fundamental scientific research in the national economy. Their final result are recommendations for the creation of technical novelties (innovations) (for example, studying of effectiveness of labour mechanization in the current analysis of water). Fundamental and applied scientific researches are the main forms of scientific activities. Development is a focused process of transforming of applied scientific researches results into technical applications. The developments are aimed at creating new equipment, materials, technologies, etc., and include design and technological work, work on creation of prototypes (batches) of products, as well as design work for construction [7].

According to the classification by F. Chmilenko, scientific researches, *by types of connection with social production*, can be divided into scientific-research works: aimed at creating new processes, machines, structures, etc., that are fully applied to improve production efficiency; focused on improving industrial relations, increasing production organization level without creating new means of labour; carried out in the field of social, humanitarian and other sciences and applied for improving social relations, increasing the level of spiritual life of people [7]. Below, we present the characteristics of other classification groups of scientific studies processed by F. Chmilenko.

By the degree of importance for the national economy, scientific researches can be divided into: the most important works performed according to the plans of the National Academy of Sciences of Ukraine; scientific-research works carried out according to the plans of branch ministries and departments; scientific-research works performed at the initiative of research organizations.

Depending on the sources of funding, scientific research can be divided into: state budget (financed on account of the state budget); contract (financed in accordance with the concluded contracts of customer organizations), and unfunded ones.

By development duration, scientific researches are divided into long-term, carried out during several years, and short-term ones, that are usually performed within a year.

By the stages of research, scientific and research works are

differentiated into exploratory, scientific-research and scientific-production developments. In the course of formulation of any scientific and technical issues of an applied nature, the researcher primarily pays attention to the consideration of results of fundamental researches and practical achievements in a particular area. If such information is not available, exploratory studies are performed. They involve determining the factors affecting the object, as well as finding ways for creation of new technologies and techniques based on methods proposed as a result of fundamental researches (for example, studying a possibility of "catalysis of catalysis", or second-level catalysis in the synthesis of functionalized materials). Scientific-research development in comparison with exploratory research is more specific and is aimed at creating new technologies, research equipment, devices, developing of recommendations (for example, recommendations for reagents' storing). Scientific-production development involves bringing the results of science and research development to conditions of practical application and includes checking recommendations of science and research developments, their coordination with the needs of specific organizations and enterprises (for example, recommendations on the rate of reagents' merging).

Researches that are related to bringing of scientific and scientific-technical knowledge to the stage of their practical application (experimental design, design, technological, research, design and survey work, production of prototypes or batches of scientific and technical products) are the main forms of scientific and technical activities.

Depending on the venue, scientific researches are divided into laboratory and production ones. The venue determines organization of studying, methods, tools, research tools, as well as the choice of the object of study.

By the composition of the object's qualities, complex and differentiated scientific researches are distinguished. Modern scientific researches are mainly complex. Complex works involve performing a number of research on different groups of qualities of a particular object independent in place and time or in methods and means. Differentiated researches include studying of one of the object's qualities or a group of homogeneous qualities [19].

Classification of scientific researches, formulated in accordance with the results of scientific researches by F. Chmilenko, is presented in figure 3.1.

Under a slightly different focus of research attention, the problems of classification of scientific research are considered by the author's team led by L. Lipych. According to the researchers' belief, classification of scientific researches can have the following general form:

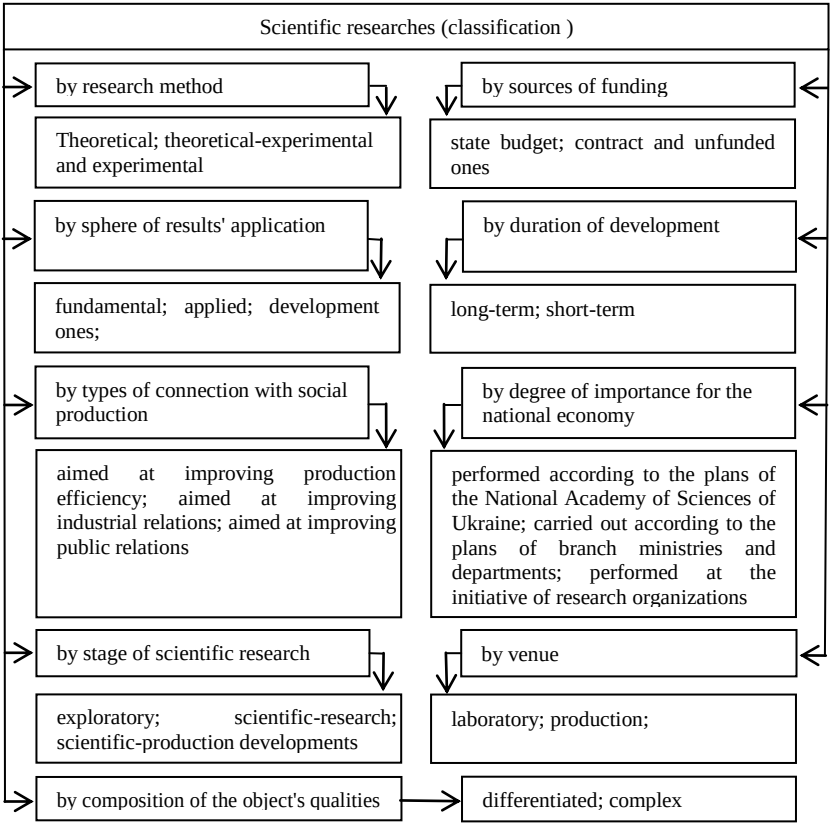


Figure 3.1 – Scheme of of scientific researches classification [7]

1) by the subject of the research, namely: the subject area (natural, technical, economic, social, political, pedagogical, etc.); the level of

diversity of the object's representation (complex, non-complex); level of display of the object dynamics (point, repeat, panel);

2) by the research method, namely: analysis's depth and complexity (exploration, pilot or zonal, descriptive, analytical); dominance of the method used (observation, analysis of documents, experience, experiment, analysis, etc.); type of research activity (empirical, empirical-theoretical, theoretical);

3) by the type of the research subject, namely: the subject's structure (collective, author (personal)); the number of goals that the subject imposes (multi-purpose, equal to the target);

4) by the conditions and preconditions of the study, namely: the type of conditions of the object' location (field, laboratory); providing with prior information (information-secured, information-unsecured);

5) by the acquired knowledge, namely: the novelty of the received knowledge (innovative, compiler); type of knowledge obtained (empirical, empirical-theoretical, theoretical); role in science (fixing facts, hypothesis testing, generalizing, analytical, synthesizing, predictive, retrospective, etc.);

6) according to the area of the knowledge implementation (applied, theoretical and applied, theoretical) [27].

In the framework of scientific literature there is quite a common approach to classifying scientific research through the prism of the: research object and subject (physics, mathematics, chemistry, history, geography, etc.); research area (natural, social and technical); ways and methods of obtaining new knowledge (theoretical and empirical sciences); relations with the subject activity (theoretical and practical sciences).

The examples of scientific researches classification mentioned before attest to the existence of a variety of approaches to the criteria for the redistribution of scientific researches by classification groups.

Test questions for self-checking on topic 3

1. Reveal the content of approaches to the classification of science (when answering, give examples of views of domestic scientists on the content and features of the classification of science).

2. What areas of science can you name? (when answering, reveal the specialties that are provisoned by the branch of science within which your training is carried out). Explain the logic of structuring of knowledge areas.

3. Reveal the content of the classification of scientific researches through the prism of methods used for their performing. Provide a description of such varieties of scientific researches as: theoretical, theoretical and applied, and applied studies.

4. Reveal the content of the classification of scientific researches through the prism of the area of their results use. Characterize the fundamental and the applied scientific researches.

5. Reveal the content of the classification of scientific researches through the prism of their connection with social production. Characterize those scientific researches that are aimed on: improving production efficiency; increasing the level of production organization without creating new means of labour; studying the socio-economic and socio-political relations

6. Reveal the content of the classification of scientific researches through the prism of their importance for national economy and sources of financing

7. Reveal the content of the classification of scientific researches through the prism of their duration and performance stages (when answering, pay attention to exploratory, research and scientific and production developments).

8. Reveal the content of the classification of scientific researches through the prism of their focus on bringing the results to practical use (when answering, pay attention to: development, design, project and search work, production of prototypes or batches of scientific and technical products, etc.)

9. Reveal the content of classification of scientific researches through the prism of place of their performance (when answering, pay attention to the laboratory and production ones) and content of qualities of the selected object (when answering, pay attention to complex and differentiated scientific researches).

10. Highlight the place and the role of scientific researches classification in the system of their standardization and knowledge management.

TOPIC 4. THE DIALECTICS OF UNITY OF SCIENTIFIC APPROACHES, PRINCIPLES AND METHODS IN THE FRAMEWORK OF SCIENTIFIC RESEARCH

Goal: to find out the logic of the relationship between scientific "approaches", "principles" and "methods", as well as to consider the dialectics of their unity within the framework of scientific research

4.1. Approaches to scientific knowledge

Content: the place and the role of scientific approaches in the methodological support of scientific researches; analysis of the content of the approaches to the interpretation of the definition "scientific approach" available in the scientific and educational literature; general characteristics of the content of the main approaches of scientific knowledge

4.2. Principles of scientific knowledge

Content: analysis of the content of the approaches to the interpretation of the definition "Principles of scientific knowledge" available in the scientific and educational literature; general description of the content of the basic principles of scientific cognition; actualization of the logic of the relationship between scientific "approaches", "principles" and "methods"; sequence of actions of a young scientist to choose theories, directions, principles and methods of organizing a scientific research

Recommended literature

1. Vazhynskyi S.E., Shcherbak T.I. (Eds.) (2016). *Metodyka ta orhanizatsiia naukovykh doslidzhen : navch. Posib [Methodology and organization of scientific research: teaching. manual]*. Sumy: SumDPU imeni A.S. Makarenka.

2. Derii Zh.V., Zosymenko T.I. (Eds.) (2018). *Metodolohiia naukovykh doslidzhen. Teksty lektsii dlia studentiv haluzi znan 05 – Sotsialni ta povedinkovi nauky, spetsialnosti 051 – Ekonomika, osvitnoi prohramy "Ekonomika dovkillia ta pryrodnykh resursiv" dennoi formy navchannia [Methodology of scientific research. Texts of lectures for students of the field of knowledge 05 - Social and behavioral sciences, specialties 051 - Economics, of the full-time educational program "Economics of the environment and natural resources"]* Chernihiv: ChNTU.

3. Rakitianska L.M. (2018). Naukovi pidkhody yak teoretyko-

metodolohichne pidgruntia pedahohichnykh doslidzhen [Scientific approaches as the theoretical and methodological basis of pedagogical research]. *Naukovi zapysky. Seriia: Pedahohichni nauky*. 163. 124–129..

4. Filiniuk V.A. (2016). *Povsiakdenne zhyttia selianstva pravoberezhnoi ukrainy v period tsentralnoi rady: dys. [Everyday life of the peasantry of Right Bank Ukraine during the period of the Central Council: diss]*. Kamianets-Podilskyi..

5. Chmylenko F.O., Zhuk L.P. (2014). *Posibnyk do vyvchennia dystsypliny «Metodolohiia ta orhanizatsiia naukovykh doslidzhen» [Guide to studying the discipline "Methodology and organization of scientific research"]*. Dnipro: RVV DNU.

4.1. Approaches of scientific cognition

It is traditionally believed that cognition of the surrounding world by the subjects of scientific activities is performed using the main approaches, namely: systemic, historical, complex, terminological, dialectical, cybernetic, synergetic, activity, cultural, informational, axiological, anthropological, structural and functional, etc. The above approaches can be considered universal in relation to the fields of knowledge (each of these approaches can be used within the framework of any field of knowledge). At the same time, among the approaches there are such, the use of which is determined by a certain area. For example, within the framework of pedagogical scientific thought, the following approaches specific in focus and content of their attention can be used: child-centered, personal, competence, ethnopedagogical, culturological, dialogical, complex, integrative, holistic-emergent, hermeneutic, polyartistic, acmeological, interdisciplinary, praxeological and others [38].

Each of these approaches can be represented by research principles and methods. In its simplest form, the practice of the researcher's use of the approaches, principles and methods can be revealed through the following paradigm: a researcher, depending on a certain (chosen) subject of scientific research, chooses one or several approaches; within the framework of the chosen approach, the principles and methods of research are updated (it should be understood that the principles and methods are not “bound” to any approach, that is, we cannot talk about the fact that any principles and methods are exclusive determinants of a one direct approach. In other words, the same principles and methods can be actualized within the

practice of different approaches). We agree with the opinion of L.Rakityanska that "a particular approach chosen by a researcher in the process of scientific search sets and directs its general strategy, determines the initial scientific positions in the direction of studying a specific aspect of a researched problem. For its conceptual solution in a broad scientific context, as modern research proves, a comprehensive application of methodological approaches is important, the multiplicity of which allows us study comprehensively the researched phenomenon in all its versatility, and form its holistic understanding" [38]. Therefore, during the scientific search, the researcher should not focus on using only one of the approaches, because only a comprehensive and in-depth simultaneous use of the tools of several of the approaches can ensure the achievement of a certain goal. In science, simultaneous use of potentials of several approaches at once was called "multi-approach" .

The dictionary of the modern Ukrainian language interprets the definition of "approach" as a set of ways, methods of considering something, influencing someone, something, an attitude to someone, something [5]. Z. Kurland defines the "approach" as a "kind of scientist's initial (starting) position, the content of which actually determines (directs) the research, design, organization of any phenomenon, process" [25]. Therefore, the researcher's choice of one or another approach (approaches) for organizing research in a certain way affects the formation of available tools for the scientists' use .

Quite often, within the framework of the educational-methodical and scientific literature, the category of "approach" is presented through the prism of methodological and (or) scientific-methodological approaches (here we mean the fact that in the scientific discourse, instead of the definition "approach", the definitions "methodological approach" and (or) "scientific-methodological approach" are used). The categorical content of these phenomena was sufficiently fully considered in works by L. Rakityanska. In her research, the scientist analyzes the definitions of the relevant categories that were formulated by E. Yudin and O. Novikov, namely, "the methodological approach interpreted by E. Yudin as a fundamental methodological orientation of the study, the point of view from which the object of research of the concept or the principle controlling the overall research strategy is considered. In the scientific interpretation of O. Novikov, methodological approaches to the study of various phenomena

of reality appear in two meanings: as some of researcher's initial principles, positions, main positions or beliefs and as directions for studying the subject of research. Scientific-methodological approaches specify the content of the methodology's multi-level structure (*Gr*. methodos - method, logos - doctrine) – a general system of theoretical knowledge that plays a role of leading principles of scientific knowledge, ways and means of implementing a scientific research" [38].

Despite the fact that each approach has its own, albeit not always unique, share of competence in the organization of scientific research, some of them are more popular than others. Today, almost every research is implemented using the tools of systematic, complex, informational, etc. approaches (it is difficult to find a research that would ignore tools of systemic or complex approaches). Such approaches have certain signs of their versatility in usage. Let's discuss some of the most popular approaches among researchers.

Systematic approach "directs the researcher to a systemic vision of reality, to cognition of the world from the point of its system structure. The principle of consistency implies that any object of reality can be represented as a relatively independent system, having a certain structure and its own laws of functioning and development"[44, p. 8–9]. The methodological specificity of the systematic approach lies in thefact that the purpose of the research is to study the patterns and mechanisms of the formation of a complex object from certain components. At the same time, special attention is paid to the variety of system's internal and external relations, to the process (procedure) of combining basic concepts into a unified theoretical picture, which makes it possible to identify the essence of the integrity of the system [26]. The methodological specificity of the systematic approach implies that the purpose of the research is to study the patterns and mechanisms of the formation of a complex object from certain components. At the same time, special attention is paid to the variety of system's internal and external relations, to the process (procedure) of combining basic concepts into a single theoretical picture, which makes it possible to identify the essence of the integrity of the system[50].

Complex approach involves a comprehensive study of the object of direct attention (phenomenon, subject, etc.) with the help of information obtained from various sources (analysis of normative-legal documents and expert reports; experts' conclusions based on the results of the survey;

evidence of direct participants in the process (event); results of toponymics and linguistic examination, etc.). The purpose of using a complex approach is to create an objective view of the content, characteristics and features of the structure of the object of attention. In its most simplified form, a complex approach can be presented through the prism of the researcher's use of information received about the object of direct attention within other fields of knowledge (for example, studying of consumer behavior of a certain group of people within the framework of sociological scientific thought should be carried out not only through the prism of the tools of sociological knowledge, but also using tools of other sciences (pedagogy; psychology, management, history, religious studies, etc. In other words, the object of direct attention should be considered comprehensively (should not be confused with systematically), that is, through the prism of each branch of scientific knowledge that has at least some relation to the chosen object of direct attention).

Informational approach can be considered as a "set of scientific cognition methods, principles, conditions that represent an informational aspect of reality, are supported with informatics and are implemented in the process of informational-analytic activity" [35]. Usually, the informational approach is used by researchers to identify and analyze information aspects of the manifestation of qualities and characteristics of the object of direct attention. The informational approach is based on the principle of being informational, the content of which is revealed through the following assumptions: any object of research attention is informational (information is a fundamental category for characterizing an object); the content of the object can be revealed through its information basis (information is a carrier of the content of any objects, phenomena and processes); all relationships, regardless of the nature of their creation and the level of actualization, have informational nature). The researcher's use of the informational approach foresees a possibility not to "follow" the path of forming of the modern content of the object of attention from the stage of its primary actualization, that is, the researcher immediately "moves on" to the level of the so-called latest knowledge about the object, thereby bypassing outdated information (within the framework of the scientific literature, this principle of the information approach can be found under the name "overtake without catching up"). The informational approach involves researcher's accumulation and analysis not only of information that is directly related to

the focus of actual attention, but also of information that may be hypothetically useful.

Historical (chronological) approach "makes it possible to study development of processes and events in chronological sequence. This approach is especially often used in the human sciences, such as pedagogy, sociology, psychology, while studying the development stages and the formation of certain branches of science, the development of certain phenomena. The study of historical experience, determining the stages of formation and development of the object of research from the moment of occurrence to the time of studying the problem by a scientist, significantly enriches scientific research, increases the level of its results' reliability, indicates the researcher's competence and objectivity" [4]. According to F. Chmylenko, the study of historical experience, determination of the stages of formation, development of the object of research and the idea from the time of occurrence to the stage of performance of the task significantly enriches scientific research, that proves reliability of its results and conclusions, confirms researcher's scientific objectivity and competence. "The historical approach makes it possible to study the development of processes and events in chronological sequence in order to identify internal and external connections, patterns and contradictions. Within the framework of the historical approach, the comparative historical method is actively used, which is a set of cognitive tools, procedures that allow to determine the similarity and difference between the studied phenomena, to establish their genetic relationship (connection by origin), to identify the general and specific details of their development" [7]. That is it, in the most simplified form, the historical approach enables us to research formation (occurrence) and development of the object of direct attention through the prism of the temporal and spatial paradigm of actualization of its content. It should be understood that the historical approach is a general scientific one, and therefore should not be perceived exclusively within the framework of the tools of historical sciences.

Synergetic approach (within the scientific literature, one can meet the justification that the synergistic approach is a method of interdisciplinary researches within the systematic approach) allows the researcher to consider the object of direct attention at the level of an open, nonlinear self-organized system. Of the most significant determinants of the synergistic approach content the following are traditionally distinguished:

self-organization (intrasystemic processes that allow the system to adapt promptly and with the least loss to changes in the functioning environment); openness (connection of the system with the external, to the organizational space, environment); non-linearity (variety of alternative directions (ways, options, algorithms, etc.) of development with actual methods and tools of reflection on external influences); the absence of the balance (the system is not in a state of rest); bifurcation (the presence of states in the development of the system due to which it is possible to change vectors and paradigms of further development; in Latin means "split"); fluctuation (the possibility of changing the characteristics of the system with the prospect of the formation of new structural and (or) system formations); dissipative structures (having occurred from the imbalance of the system of new structures); attractor (conditionally final, stable state of the system; subject or determinant of influence on the system). Therefore, "the synergetic approach is a higher level of research methodology than the systematic approach that requires the maximum possible consideration of all aspects of the problem in their relationship and integrity, highlighting of the main and essential, the determination of the nature of the connections between aspects, properties and characteristics. Synergetics is the direction of interdisciplinary research, the objects of which are the processes of self-organization in open systems" [36].

Above, we drew attention to the fact that the methodology of organizing a scientific research involves a sufficiently extensive system of scientific approaches, and therefore the approaches we considered (systematic, complex, informational, historical (chronological) and synergetic approaches) should not be perceived at the level of mandatory use. The researcher independently, given the peculiarities of the development of his/her scientific research, chooses the most expedient approaches to use. In other words, the methodology for organizing scientific research does not dictate a list of mandatory or desirable approaches to scientific cognition.

4.2. Principles of scientific knowledge

Science learns the world around with the help of approaches, that in their turn include research principles and methods. The principle is the basis (in this regard, it acts as an idea) of solving a particular scientific problem,

and in the broader plan of any problem); its content is expressed in certain requirements that are normative and regulatory in nature [14]. According to D. Chernilevskyi, modern science is guided by three basic principles of knowledge: *the principle of determinism, the principle of accordance and the principle of subsidiarity (of complementarity)* [6].

The principle of determinism, being general scientific one, organizes the construction of knowledge in specific sciences. Determinism acts primarily in the form of causality as a set of circumstances that precede in time any given event and cause it. That is, there is a connection of phenomena and processes when one phenomenon, process (cause) under certain conditions generates, produces another phenomenon, process (consequence). The modern understanding of the principle of determinism implies the presence of various objectively existing forms of relationships between phenomena, many of which are expressed in the form of relations that do not directly have a causal character, that is, they do not directly contain the moment of generation of one by another. This includes spatial and temporal correlations, functional dependencies, etc. [47]. The modern understanding of the principle of determinism foresees the presence of various objectively existing forms of relationship of phenomena, many of which are expressed in the form of relations that do not directly have a causal character, that is, they do not directly contain the moment of generation of one another. This includes spatial and temporal correlations, functional dependencies, etc. Including, in modern science, in contrast to the determinism of classical science, the relations of uncertainties formulated basing on probabilistic laws or the ratio of fuzzy sets, or interval quantities, etc. are especially important.

The principle of accordance means the continuity of scientific theories. New theoretical knowledge is useful for the development of science, but if they do not relate to the former ones, then science will stop being integral [47]. According to Zh. Derii, young researchers, when organizing their scientific searches, do not always adhere to the principle of accordance. “Recently, in human and social sciences works began to appear, in which attempts are made to create new theories, concepts, etc., that have little or nothing in common with the previous theories (these works are often written by people who came to these fields of science from other, "strong" areas of scientific knowledge). New theoretical constructs are useful for the development of science, but if they do not correlate with

the previous ones, then science will no longer be integral, and scientists will soon stop to understand each other at all" [10].

The principle of subsidiarity (complementarity) was formed as a result of new discoveries in physics also at the turn of the 19th and 20th centuries, when it turned out that the researcher, studying the object, makes certain changes in it, including those using the research tools. The principle of subsidiarity significantly changed the whole system of science. If classical science functioned as an integral entity focused on obtaining a system of knowledge in a final and complete form, on an unambiguous studying of events, excluding influence of the researcher's activities and the means used by him/her from the context of science, on assessing scientific knowledge as absolutely reliable one, then with appearance of the principle of subsidiarity the situation has changed.The inclusion of the researcher's subject activity into the context of science has led to a change in the understanding of the subject of knowledge: it has now become not reality "in its pure form", but as a slice of it, given through the prism of accepted theoretical and empirical means and ways of its mastering by the studying subject. Subsidiarity implies that interaction of the studied object with the researcher (including with the help of devices) cannot but lead to a different detection of properties of the object, depending on the type of interaction with the subject who studies in different, often mutually exclusive conditions. And this means the legitimacy and equality of various scientific descriptions of the object, including different theories describing the same object, the same subject area. It is important to emphasize that the same subject area can, according to the principle of subsidiarity, be described with different theories [10]. Therefore, in the most simplified form, compliance with the principle of subsidiarity (complementarity) implies the researcher's reproduction of the phenomenon's integrity. Using this principle, equivalence between classes of concepts is usually established, contradictory situations in different areas of knowledge (general understanding of the principle of complementarity) are comprehensively described [47].

According to M. Bukach, the issues of methodological principles can be actualized through the *principles of objectivity, essential analysis, the unity of the logical and historical, the leading role of practice*. Below there are provided characteristics of these principles that were formulated in accordance with the scientific views of M. Bukach [4].

A leading principle of any scientific research is the methodological *principle of objectivity*. It is manifested in a comprehensive consideration of factors that give rise to a particular phenomenon, in finding adequate research approaches and means to obtain true knowledge about the object. This principle implies the exclusion of the possibility of subjectivism, one-sidedness and bias in the selection and assessment of facts. The principle of objectivity requires the validity of the initial data, the logic of research actions, their sequence and on this basis through reliable facts, reliable conclusions can be achieved. The effectiveness of the principle of objectivity largely depends on how much the researcher was able to identify and evaluate all possible solutions, to identify all points of view on the question under study.

An important methodological principle is the *principle of essential analysis*. Compliance with this principle is associated with the correlation in the phenomena that are studied, the general, special and single, penetration into their internal structure, the disclosure of the laws of their existence and functioning of the conditions and factors of their development, the possibilities of purposeful change. This principle implies the movement of the researcher's thought from a description to an explanation, and hence to prediction of development of phenomena and processes. An important requirement in the application of this principle is the need to take into account the continuous changes in the development of processes and phenomena. For example, communication with a client in some conditions can give positive results, and in others (when a person is in a hurry) negative ones. Multi-vector variety of influences, requires distinguishing of the main factors that determine the development of the process. The principle of essential analysis involves the disclosure of contradictions in the subject of research, tracing the relationship and interdependence of quantitative and qualitative changes, moving to higher levels of development with the preservation of everything positive.

The principle of unity of the logical and historical, which in every research requires to combine studying of history of an object in its present state, as well as the prospects for its development. Historical analysis is possible only from the position of a certain scientific concept, based on ideas about the structure and functions of these or other elements and relationships, and theoretical analysis is impossible without studying the object's genesis (origin, formation).

The principle of the leading role of practice. Perceiving practice as a conscious human activity of changing nature and society, a fundamental criterion for reflecting reality, we must state that scientific-research works related to practice, tested by practice, solve more effectively scientific problems, especially in such areas as social work. All this gives grounds to assert that practice is the basis for the development of cognition [4].

In their turn, A. Zaychuk and N. Onishchenko propose a slightly different set of principles of scientific knowledge. According to scientists, the corresponding list can include: *the principle of scientificity; the principle of comprehensiveness; the principle of historicism; the principle of complexity; the principle of objectivity*. Below are provided characteristics of these principles that were formulated in accordance with the scientific views of A. Zaychuk and N. Onishchenko [51].

The principle of scientificity implies the dominance of objective scientific knowledge over certain temporary conjunctural interests of individual researchers or social groups. This is primarily due to the fact that scientific truth in research (analysis, explanation and prediction of changes in the object of direct attention, for example, state-legal or social phenomena and processes) should prevail over everything else. Sometimes there may be a situation in which the researcher will be tempted to use the results of scientific research or change the focus of attention within the chosen subject. Having succumbed to such a temptation, the researcher not only violates the scientificity principle, but also activates the action of the so-called multiplier in the production of knowledge distorted in its content. Trying to "fit" the scientific result to the expectations of the customer of scientific products, there is a distortion of scientific activity and degradation of scientists involved in such activities. The scientific activity of people involved in it should ensure that society obtains objective, reliable, comprehensively substantiated scientific knowledge.

The principle of comprehensiveness is revealed through the prism of studying the object of direct attention not in itself, but in its unity (interaction) with other objects (phenomena) related in meaning (essence). In other words, during the scientific search, the researcher must examine the object chosen by him/her not from a single aspect, but taking into account all aspects that form a general vision of the studied phenomena. We are talking about multidimensionality in the research of the chosen object, because when science focuses only on certain signs or properties of the

phenomenon and ignores others as supposedly insignificant and sideway, it cannot provide a scientific (objective) result. Such situations can be avoided by the *pluralistic approach*, due to which not only conflicting views on the same object (phenomenon) are taken into account, but also unequal ideas about their origin, essence, direction of development, structure, etc. Due to the comprehensiveness and pluralism in approaches to cognition of general regularities of the existence and development of the object of direct attention, a system of knowledge is formed which is balanced in its content, a system that reflects objective data about actual reality.

The principle of historicism involves considering the object of direct attention chosen by the researcher from the point of view of historical retrospective, as well as those relationships that determined the evolution of its content. Within the framework of this approach, the historical context of the actualization of the object under study is usually considered. At the same time, it should be understood that the historical approach is not focused on the analysis of the past, and includes as well the analysis of the current state of the selected object.

The principle of complexity involves the organization of research of the object of scientific search through the prism of several branches of knowledge, primarily those of them that are related in focus of their attention. For example, a study of a social phenomenon should not be limited exclusively to the tools of sociological scientific thought, but should involve usage of methods of other socio-humanitarian sciences, first of all philosophy, political economy, political science, etc. This principle avoids the so-called narrow perception of the content of the object of direct attention.

The principle of objectivity creates prerequisites for a researcher to obtain the so-called true knowledge (the true reflection of the object of direct attention implies its reflection in scientific knowledge as it exists in the real world). The researcher's following the principle of objectivity in the organization of scientific research implies scientist's abstracting from the subjective perception of the object, that is, such perception is based only on the researcher's available knowledge (it is traditionally believed that the objectivity of considering the object of direct attention can be ensured only if the researcher receives new knowledge, because the knowledge available to the scientist will always be incomplete and relatively outdated).

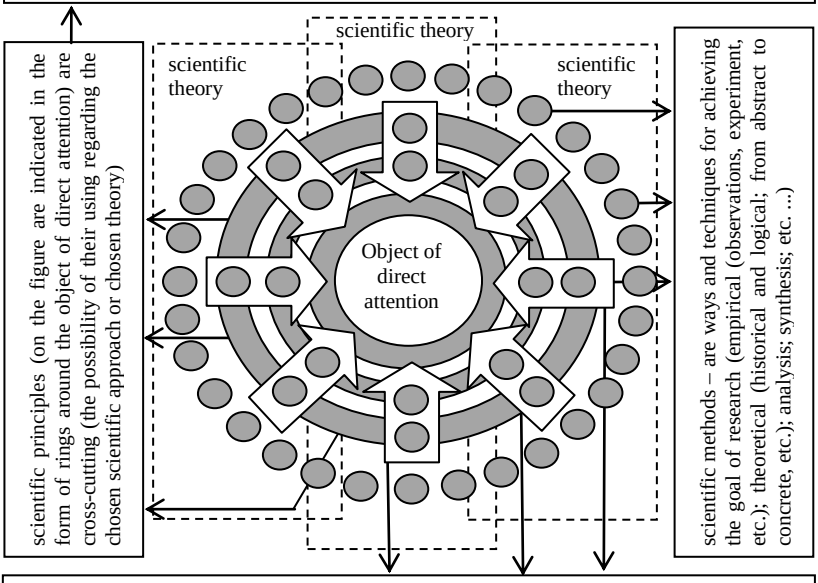
The principle of specificity foresees the researcher's possibility to

distinguish the main, significant properties, connections and trends in the development of the object of knowledge. The practice of actualization of certain phenomena (characteristics) should be taken into account and appropriately reflected in the categories and concepts used by the researcher [51].

The mentioned above principles, regardless of their specification within the scientific views of these or other scientists, are often correlated with relevant in their content approaches and methods. For example, we can talk about "historical approach", "the principle of historicism" and "historical method". Such conditional consonance between these categories should not be taken as a basis for their conditional identification. Of course, all these categories focus on "history", but the level of actualization of the relevant issues is fundamentally different. Recall that: "approaches" are a set of basic ways of obtaining new knowledge and methods of solving issues within any science. In scientific literature, we can also find an opinion when "approaches" are actualized through the prism of concepts, within the limits of how the object of direct attention is actually considered (the most general category in its focus of attention is among those to which we paid attention above); a "principle" is the main position of a scientific theory, it acts as the initial form of systematization of knowledge (this category is often considered through the prism of its actualization within the framework of scientific approaches. At the same time, there is an opinion that "principles" are derived not from approaches, but from general scientific theories. Under this condition, "approaches" and "principles" are positioned at the same level and are relatively independent determinants in structuring scientific knowledge); "methods" are ways that allow researcher to obtain new knowledge about the object of direct attention (this category can be considered on the level of the basic one in relation to those that were discussed above. In other words, "methods" are derived from "principles" and "approaches"). A simplified visualization model of the relationship between "approaches", "principles" and "methods" is presented in Figure 4.1. In Figure 4.1, along with "approaches", "principles" and "methods", among other things, scientific theories are also visualized. In the dictionary for graduate students and applicants for higher education, it is formulated that a scientific theory is "the highest form of organization of scientific knowledge, which gives a comprehensive idea of the patterns and significant connections of the studied area of reality. The term "theory"

comes from the Greek “theoria” that means observation, consideration, investigation, conclusion.

scientific principles are general provisions, rules, basic ideas, norms, etc. that researcher uses in the process of scientific research organizing (the principle of systemicity; the principle of integrity; the principle of historicism; the principle of objectivity; the principle of social approach; the principle of alternativeness; the principle of comprehensiveness, the principle of subordination, the principle of dynamism, etc.). Scientist's compliance with the scientific principles determines achievement of a scientific result. Each of the principles is important for organization of scientific research, but the researcher, in accordance with a specific object of direct attention, independently determines those of the principles, the complying with which is a mandatory requirenment for achieving the goal. As a rule, the principles determined by the scientist must be justified (explanations on the choice of certain principles for compliance)



scientific approaches (on the figure are indicated in the form of large arrows aimed at the object of direct attention) – the fundamental methodological orientation of a scientific research, a point of view through the prism of which the object of direct attention is actually considered. As a rule, a young researcher chooses two or three approaches within which the chosen problem is considered (activity, systematic, complex, procedural, behavioral, global, marketing, functional, structural, normative, integration, situational, etc.). Each of the approaches involves a conditional set (list) of specific methods of scientific cognition. This list is not a constant, and therefore may vary depending on the preferences of the researcher's preferences and the object of attention chosen by him

Figure 4.1 – Model of the relationship between “approaches”, “principles” and “methods”

Scientific theory is a system of logically interrelated statements, contains a reference mechanism for constructing knowledge, embodies a specific research program, which ensures the integrity of theory as a single system of knowledge. From a methodological point of view, scientific theory should strive for maximum completeness and adequacy of description, integrity and deductibility of positions from each other, internal non-contradiction. The components of scientific theory are the empirical basis (facts obtained during the experiment), the theoretical basis (postulates, regulations in which idealized objects are described), the logic of the theory (rules of logical inference and evidence), the set of the statements and results obtained".

A general algorithm of the young scientist's actions on the choice of theories, directions, principles and methods for organizing a scientific research is shown in Figure 4.2.

Below is presented an example of a scientist's explanation of a choice of theories, directions, principles and methods for organizing a scientific search.

"The scientific-theoretical and methodological basis of a dissertation research is the *fundamental provisions of the theory* of public, the scientific works of domestic and foreign scientists on the problematics of formation and implementation of the state policy in the field of higher education, as well as international and regional practices of public management of the higher education quality.

The systematic and synergistic approaches used in the dissertation work made it possible to comprehensively study the problematics of the state's and society's participation in ensuring the higher education quality, as well as to determine the features of the formulation of the content and implementation of practices of public administration mechanisms relevant to this sphere.

In addition, during the scientific research, *philosophical and general scientific principles and methods* of scientific cognition were used, namely: search and bibliographic as well as monographic methods to determine the scientific-methodological and information-analytical basis for considering the problematics of public administration of ensuring the quality of higher education; the method of comparative analysis – to study conceptual and methodological approaches and theoretical and practical summaries of

domestic and foreign scientists regarding the features of formation of higher education quality assurance systems at the university and state levels;

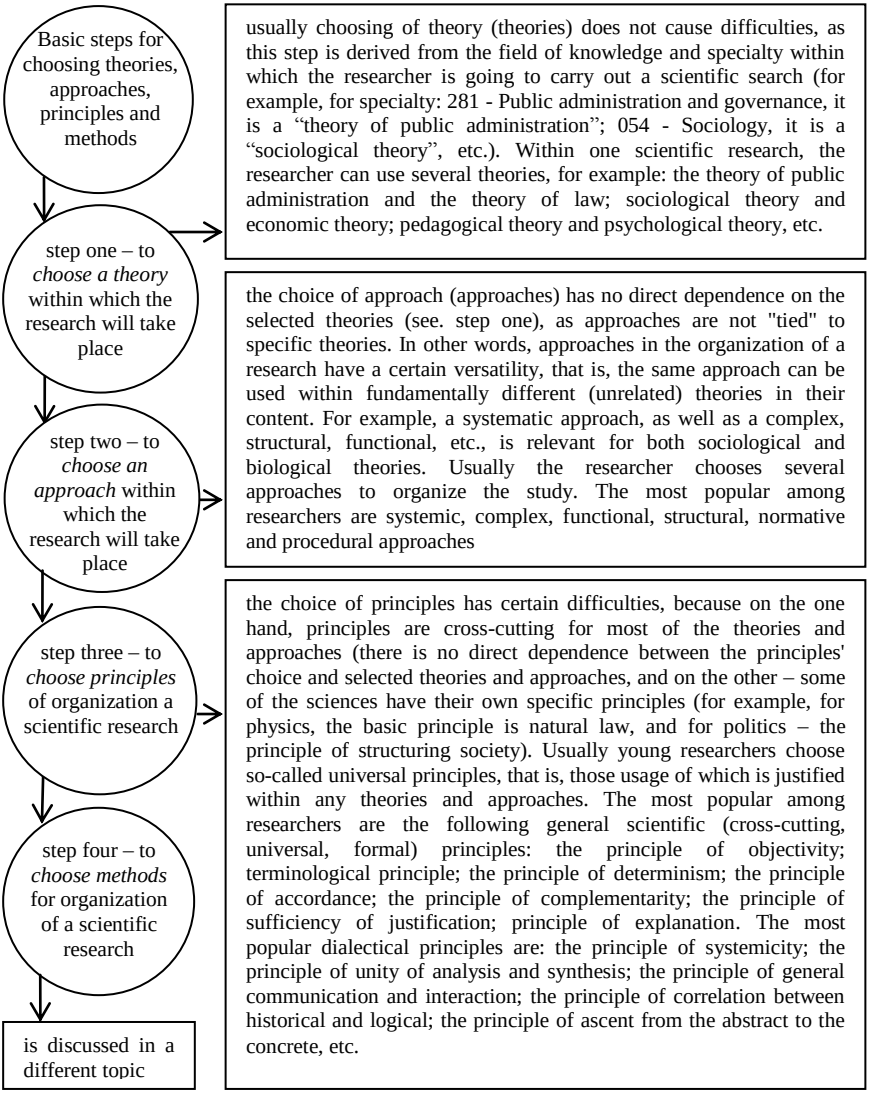


Figure 4.2 – A general algorithm of the young scientist's actions on the choice of theories, directions, principles and methods for organizing a scientific research

the method of terminological analysis and the logical-semantic method – for development of the categorical content of the basic to the chosen problems of the study definitions, as well as for determining the essence and content of the complex mechanism of public administration in the area of quality assurance of higher education; problem-chronological method – to identify general trends and peculiarities of functioning of system of the higher education quality assurance in Ukraine; method of retrospective analysis – to study the directions of development of the knowledge paradigm regarding the phenomenon of higher education quality at different stages of formation of models of higher education quality assurance; method of analysis and synthesis – to clarify the content of the assurance system of higher education quality, as well as to fiend out the determinants that determine the effectiveness of its functioning; abstract-logical method – to formulate conclusions and proposals in the areas of research; formalization method – to study the assurance system of higher education quality, to determine its subjects and objects; extrapolation method – to spread information obtained during the analysis of the place and role of the state in the functioning of systems of higher education quality assurance in some of the OCED countries, to the system of higher education quality assurance operating in Ukraine; system-analytical method – to analyse legislative acts and other regulatory documents.

The information basis of the dissertation research was: the laws of Ukraine, international quality standards; official reports of international monitoring missions; scientific publications on the studied issues; analytical information from databases of the European Higher Education Area, as well as individually performed studies" [32].

Test questions for self-checking on topic 4

1. Reveal the content of the category "approaches to scientific cognition". Explain the features of the formation of the content of approaches to scientific cognition depending on the field of knowledge.

2. Reveal the content of the category "Principles of scientific knowledge". Give a general characteristics of the main principles of the scientific knowledge.

3. Explain the dialectics of the relationship between the approaches to scientific knowledge and methods of scientific cognition (when answering, give examples of the positioning one phenomenon in relation to

another)

4. Explain the dialectics of relationship between approaches of scientific knowledge and principles of scientific cognition (when answering, give examples of the positioning one phenomenon in relation to another).

5. Explain the dialectics of relationship between principles of scientific cognition and methods of scientific cognition (when answering, give examples of the positioning one phenomenon in relation to another).

6. Reveal the content of systemic and comprehensive approaches and identify their main potentials for methodological support of scientific research.

7. Reveal the content of information and historical approaches and identify their main potentials for methodological support of scientific research.

8. Reveal the content of the synergistic approach and identify its main potentials for methodological support of scientific research.

9. Reveal the content of the principles of determinism and accordance. Explain the peculiarities of actualization of the content of these principles within the framework of the main procedures for organizing and conducting a scientific research.

10. Reveal the content of the principle of subsidiarity (complementarity). Explain the peculiarities of actualization of the content of this principles within the framework of the main procedures for organizing and conducting a scientific research.

11. Reveal the content of the principles of objectivity and essential analysis. Explain the peculiarities of actualization of the content of these principles within the framework of the main procedures for organizing and conducting a scientific research.

12. Reveal the content of the principle of unity of the logical and historical and principle of the leading role of practice. Explain the peculiarities of actualization of the content of these principles within the framework of the main procedures for organizing and conducting a scientific research.

13. Reveal the content of the principles of scientificity and comprehensiveness. Explain the peculiarities of actualization of the content of these principles within the framework of the main procedures for organizing and conducting a scientific research.

14. Reveal the content of the principles specificity and complexity.

Explain the peculiarities of actualization of the content of these principles within the framework of the main procedures for organizing and conducting a scientific research.

15. Reveal the content of the main stages of a young scientist's actions on the choice of theories, directions, principles and methods for organizing a scientific research.

TOPIC 5. METHODS OF SCIENTIFIC RESEARCHES

Goal: to figure out the place and role of scientific research methods in the methodological support of scientific research, as well as to summarize the characteristics of each of the scientific methods

5.1. Methods of scientific researches: categorical content of the definition interpretation

Content: a comparative analysis of the interpretations of the categorical content of the definition of "method" ("research method") available in the scientific and educational literature; the place and role of scientific methods in organization of scientific research

5.2. General classification of scientific research methods

Content: analysis of the content of approaches to the classification of scientific research methods available in the scientific and educational literature; general characteristics of the content of the classification groups

5.3. General characteristics of the main methods of scientific research

Content: general characteristics of scientific cognition methods; directions and potentials of usage of some of the methods of scientific cognition

Recommended literature

1. Halian O.V. (2021). *Metodolohiia ta orhanizatsiia naukovykh doslidzhen: navch.-metod. Vydannia [Methodology and organization of scientific research: teaching method. edition]*. Lutsk: Vezha-Druk.

2. Hutorov O.I. (2017*). Metodolohiia ta orhanizatsiia naukovykh doslidzhen: navch. posibnyk.[Methodology and organization of scientific research: teaching. manual.]* Kharkiv: KhNAU.

3. Vazhynskyi S.E., Shcherbak T.I. (Eds.) (2016). *Metodyka ta orhanizatsiia naukovykh doslidzhen : navch. Posib [Methodology and organization of scientific research: teaching. manual]*. Sumy: SumDPU imeni A.S. Makarenka.

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administration): teaching. manual]. Lutsk : Vezha-Druk.

5. Sych T.V. (2016). Sych T.V. The essence of the concept of research methodology in modern scientific thought. Science and Education a New Dimension. Pedagogy and Psychologe. IV (46). Issue : 97. 52–55

5.1. Methods of scientific researches: categorical content of definition interpretation

When considering problematics of methodology of scientific researches, we drew attention to the fact that in scientific literature one can find approaches within which the questions of methodology are revealed through the prism of research methods. This approach makes sense because almost every definition of "methodology" appeals to methods (methods are presented at the level of one of the mandatory determinants of the methodology). For example:

– methodology is a conceptual presentation of the goal, content, research methods that provide the most objective, accurate, systematic information about processes and phenomena. Methodology is understood as the doctrine of the scientific method of cognition or a system of scientific principles on the basis of which research is built and the choice of means, methods and techniques of cognition is carried out. The main purpose of the methodology is to study those means, methods and techniques of scientific research, due to which the subject of scientific knowledge obtains new knowledge about reality [42];

– methodology is a doctrine of a system of scientific cognition methods and transformation of reality. Literally, methodology is the doctrine of method. The subject of methodology's studying is a concept and methods of science, scope of their implementation [16];

– methodology is a science of method; a system of general principles, regulations and methods that form the basis of this science; a set of applied research techniques; [20] etc.

Despite the fact that almost every definition of methodology is presented through the prism of methods, these categories are not identical. We agree with the opinion of T. Sych, who, according to the results of her scientific research, came to the conclusion that methodology can study the process of methods creating and using, but cannot be equalled to research methods [45]. To understand the difference between methodology and methods, consider existing in the scientific literature interpretations of the last of these categories. The most common approaches to determining the

categorical content of the definition of “method” (“research method”) are presented in Table 5.1

Table 5.1 – Determination of the categorical content of the definition of “method” (“research method”) in the context of scientific views of domestic scientists

№	Scientist	Definition
1	2	3
1	G. Birta, Y. Burg	method (Greek – a way of cognition) in the broadest sense of the word is a “path to something”, a method of the subject's activity in any of its forms; method of research is a set of techniques and operations, methods of justifying a system of knowledge, monitoring the objectivity of the obtained results, building models of reality; the main function of the method is the internal organization and regulation of the process of cognition or practical transformation of this or other object. Therefore, a method (in its one form or another) is reduced to a set of certain rules, techniques, methods, norms of cognition and action. Method is a system of instructions, principles, requirements, which should orient at solving a specific problem, achieving a specified result in this or other activity area. It disciplines the search for truth, allows (if it is correct) to save efforts and time, to move towards the goal in the shortest way. A true method serves as a kind of compass with the help of which the subject of cognition and action paves their way; helps to avoid mistakes [2]
2	S. Vazhynskyi T. Shcherbak	a method is a way to achieve the goal. Method combines subjective and objective aspects of cognition. Method is objective as it allows to reflect reality and its relationships. Consequently, method is a program of theory construction and its practical application [47]
3	O. Gutorov	scientific methods is an entire arsenal of accumulated research methods, as well as stages of scientific activity (methods, methodology) that are used in the process of scientific activity in a specific cycle. In particular, problems and hypotheses are also considered to be scientific knowledge, but they are more significant than the stages of scientific activity. [19]
4	O. Krushelnytska	methods is an ordered system in which their place is determined in accordance with a particular stage of the research, usage of techniques and holding operations with theoretical and practical materials in a certain sequence [24]

End of table 5.1

1	2	3
5	A. Konverskyi	a method (from Greek “metodos”) in the broadest sense of the word is a “path to something”, a method of the subject's activity in any of its forms; a way of research, the way of cognition, a theory, a doctrine, a conscious way to achieve a certain result, implementation of a certain activity, solution of certain problems. It acts as a set of certain rules, techniques, methods, norms of cognition and action. It is a system of regulations, principles, requirements that guide the subject in solving a specific task, achieving a certain result in a certain field of activity; a method is a tool for solving the science's main goal: discovery of objective laws of reality. A method determines the necessity and place of application of induction and deduction, analysis and synthesis, abstraction, formalization, modeling, comparison of theoretical and experimental studies [21]
6	L. Lipych, S. Bortnik, I. Volynets	a method of scientific research is a basic empirical process of identifying and demonstrating the object's weighty characteristics necessary for scientific research, including formulation of hypotheses for its occurrence and development, experimental researches aimed to identify the truth of the proposed hypotheses, formulation of a conclusion on its acceptance or rejection; a scientific research method's goal is to find out the truth of hypotheses and the level of their reliability, since its center is the confrontation of an idea (hypothesis) with the facts on which it is based (regardless their source) [27]

F. Bacon compared the method with a lamp showing a traveller the road in the dark, and believed that one could not count on success in studying any issue, going the wrong way. He considered induction to be such a method, which requires science to proceed from empirical analysis, observation and experiment in order to know the causes and laws on this basis. R. Descartes called method “accurate and simple rules”, observance of which helps to increase knowledge, allows to distinguish the false from the true. He said that it is better not to think about finding any truths than to do it without any method, especially without deductive and rationalistic ones [2].

According to L. Filshtein, a method, in the most general understanding of content of this phenomenon, means “a way of achieving a goal, a way of studying a phenomenon that determines a systematic

approach to their scientific cognition and determining the truth". In its turn, a scientific method is "a way of cognition of the phenomena of reality in their relationship and development, a way to achieve the goals and objectives of the study and answers the question: "How to learn?" [15].

Among the scientific tools, we can find many variations in the formulation of definitions applying the category of "method", both at the level of basic terminological formulations (research methods; scientific cognition methods; scientific methods, etc.), and at the level of the so-called sectoral apparatus (sociological methods; economic methods; management methods, etc.). At this stage of consideration of the educational content determined by the educational program, we will focus only on those of the varieties of methods that are relevant to the basic or general scientific level.

5.2. General classification of scientific research methods

Nowadays, any scientific research, regardless the level of positioning of its results (level of research, namely – master's work; PhD thesis; dissertation for the degree of Doctor of Science; a research carried out within the framework of international or national projects, etc.) necessarily contains a description of the used methods of scientific cognition. Presence of such a description allows: for a reader of scientific literature – to understand both the logic of the study itself and the architectonics of its development as a whole; for a specialist – to obtain information on the thoroughness of the study held and the level of reliability of the obtained results (usually, the more methods researcher used the more reliable the obtained result is). The traditions of writing a scientific text foresee researcher's justification of the methods they chose for conducting a scientific search and disclosing information on each of the methods (which specific method was used to obtain this or that result). Let's consider general classification of scientific research methods.

According to G. Birta, a multi-level concept of methodological knowledge works quite successfully in modern science. In this regard, all methods of scientific knowledge can be divided into the following main groups.

1. Philosophical methods, among which the most ancient are dialectical and metaphysical. In fact, every philosophical concept has a methodological function, is a kind of way of mental activity. Therefore, philosophical methods are not limited with two methods. They also include

such methods as analytical (characteristic for modern analytical philosophy), intuitive, phenomenological, etc.

2. General scientific approaches and research methods that have been widely developed and applied in science. They act as a kind of intermediate methodology between philosophy and the fundamental theoretical and methodological provisions of special sciences. Such concepts as information, model, structure, function, system, element, optimality and probability are most often considered as general scientific ones. On the basis of general scientific terms and concepts, appropriate methods and principles of knowledge are formulated that provide connection and optimal interaction between philosophy of special scientific knowledge and its methods. General scientific principles and approaches include systemic and structural-functional, cybernetic, probabilistic, modeling, formalization and a number of others. Recently, such a general scientific discipline as synergetics has been developing especially rapidly – the theory of self-organization and development of open integral systems of any nature – natural, social, cognitive. Among the basic concepts of synergetics one can name such as order, chaos, nonlinearity, uncertainty, instability. Synergistic concepts are closely related and interconnected with a number of philosophical categories, especially with such as being, development, formation, time, the whole, a chance, a possibility.

3. Private science methods are a set of methods, principles of cognition, research techniques and procedures used in this or other science that corresponds to information of a basic form of the matter movement. These are methods of mechanics, physics, chemistry, biology and socio-humanitarian sciences.

4. Disciplinary methods are a system of techniques used in this or other scientific discipline, included in any branch of science or arising at the joint of sciences. Each fundamental science is a complex of disciplines that have their own specific subject and their own peculiar research methods.

5. Methods of interdisciplinary research are a set of a number of synthetic, integrative methods aimed mainly at joints of scientific disciplines. These methods are widely used in implementation of complex scientific programs.

Therefore, the methodology cannot be reduced to one, even very important method [2].

An interesting and sufficiently understandable in its content is a

classification of research methods that was worked out by a team of authors led by M. Bukach [4]. The corresponding classification is given in figure 5.1.

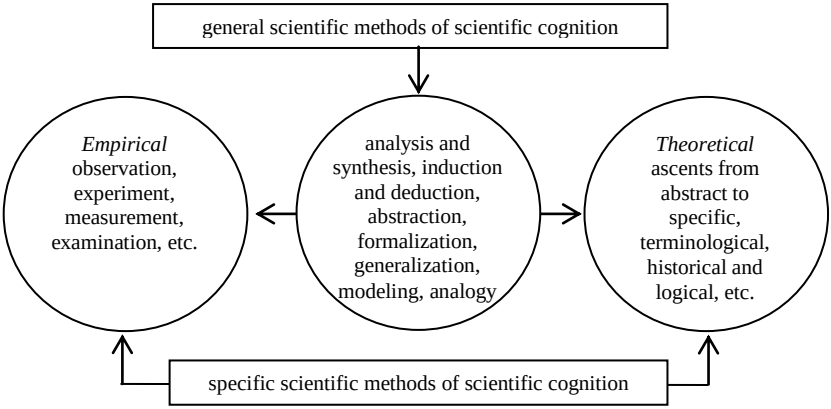

Figure 5.1 – General classification of methods of scientific cognition

According to the team of authors led by S. Vazhinsky, research methods can be classified into the following main groups: 1) general, operating in all fields of science and at all stages of research; 2) general scientific, that is, suitable for all sciences; 3) partial – suitable for certain sciences; special – suitable for one specific science [47]. Such a classification is sufficiently conventional and general in its content (for example, a boundary between the general and general scientific methods is not clear and such that would allow to distinguish between the corresponding classification groups).

In his turn, O. Gutorov proposes to distinguish between philosophical, general scientific and special methods. According to the scientist, 1) *philosophical methods* and their role in scientific cognition are caused by the presence of two extreme models that have developed in solving this extremely complex issue, including: a speculative and philosophical approach (natural philosophy, philosophy of history, etc.), the content of which is to directly derive the initial principles of scientific theories directly from philosophical principles in addition to analyzing the material of a certain science; positivism, according to which "science is philosophy itself". The role of philosophy in partial scientific knowledge is

either absolutized or, conversely, diminished to the point of complete denial. Although both models had some positive results, agreement between them was not reached. Philosophical methods are not strictly fixed regulators, but a system of "soft" principles, operations, techniques that are universal in nature, that is, located on higher "levels" of abstraction. Therefore, philosophical methods are not described in clear terms of logic and experiment, are not prone to mathematization and formalization. They do not replace special methods and do not directly determine the final result of knowledge, but only set the most general regulators of research; 2) *a structure of general scientific methods* consists of the following classification groups: methods of empirical research (observation, experiment, comparison, description, measurement); methods of theoretical knowledge (formalization, axiomatic method, hypothetical-deductive method and ascent from abstract to concrete); 3) *general logical methods and research techniques* (analysis, synthesis, abstraction, idealization, generalization, induction, deduction, analogy, modeling, system approach, probabilistic (statistical) methods) [19]. In our opinion, classification proposed by O. Gutorov is quite reasonable in its content and successful in its structure. Each of the methods mentioned above will be considered within a separate topic.

5.3. General characteristics of the main methods of scientific research

The vast majority of researchers agree with the classification according to which general scientific research methods are actualized within three main groups, namely: *methods of empirical research; methods of theoretical cognition; general logical methods and research techniques.* Below are characteristics of the methods for each of the groups formulated in accordance with the scientific views of O. Gutorov [19].

1. Methods of empirical research (observation, experiment, comparison, description, measurement).

Observation is a purposeful study of objects, mainly based on data obtained from sense organs (feeling, perception, imagining). During observation, not only knowledge about the external aspects of the object of study is gained, but also about its essential properties. Observation can be direct and indirect. The latter is carried out with the help of various devices and technical means, and with the science development becomes more and

more complex.

Experiment is a purposeful and active intervention in the studied process, appropriate changes in the object or its reproduction in specially created and controlled conditions. The main stages of the experiment are planning, control and the results' interpretation. Experiment has two interrelated functions: experimental verification of hypotheses and theories, and formation of new scientific concepts. Depending on these functions, the following experiments are distinguished: research (search), verification (control), reproducing, isolated ones, etc.; depending on the nature of the objects – physical, chemical, biological, social, etc. Therefore, the experiment – is the most general empirical method of cognition, which not only includes observations and measurements, but also rearranges, changes the object of study, etc. In this method, one can find out an influence of one factor on another.

Comparison is a cognitive operation underlying in the basis of conclusions about the objects' similarity or difference (or the degrees of the object's development). With the help of comparison, qualitative and quantitative characteristics of subjects are revealed. The simplest and the most important type of relations revealed during comparison is the relation between identity and difference. Moreover, the comparison makes sense only in the set of “homogeneous” objects that form a class. Comparison is the basis of such a logical technique as an analogy, and is the starting point of a comparative historical method. The latter is the one with the help of which, by comparison, general and special characteristics are revealed in historical and other phenomena, understanding of different degrees of development of the same phenomenon or different existing phenomena is achieved. This method allows to identify and compare the levels of development of the studied phenomena, the changes that have occurred, to determine the trends of development.

Description is a cognitive operation lying in recording of results of an experiment (or observation) with the help of certain systems of indications adopted in science.

Measurement is a set of actions that are performed with the help of measuring means to find the numerical value of the measured value in the accepted measurement units .

2. Methods of theoretical cognition (formalization, axiomatic method, hypothetical-deductive method and ascent from abstract to

concrete).

Formalization is a reflection of knowledge in a sign and symbolic form (formalized language). The latter is created to accurately express opinions in order to exclude the possibility of their ambiguous understanding. Under conditions of formalization, thoughts concerning objects are transferred to the plane of operation with signs (formulas). Formalization is based on the differences between natural and artificial languages, because natural languages as a means of communication are characterized by polysemy, versatility, flexibility, inaccuracy, imagery, etc., while formalized (artificial) languages are used for a more accurate and clear expression of meaning. Language of formulas of an artificial language becomes a tool of cognition.

Axiomatic method is a way of constructing a scientific theory, which is based on some initial provisions – axioms (postulates), from which all other statements of this theory are derived in a purely logical way, by way of proof. To derive theorems from axioms (and generally some formulas from other ones), special inference rules are formed.

The hypothetical-deductive method is a method of scientific cognition, the essence of which lies in creating a system of deductively related hypotheses, from which statements about empirical facts are derived. The method is based on deducing conclusions from hypotheses and other references, true meaning of which is unknown.

3. General logical methods and research techniques (analysis, synthesis, abstraction, idealization, generalization, induction, deduction, analogy, modeling, system approach, probability (statistical) methods).

Analysis is division of an object into components in order to study them independently. Types of analysis are mechanical separation, determination of dynamic composition, identification of forms of interaction of elements of the whole, determining the causes of phenomena, identification of the level of knowledge and its structure, etc. A variation of analysis is dividing objects into classes (sets) into subclasses – classification and periodization.

Synthesis is a union, of real and cognitive, of different sides, parts of an object into a unified whole. Synthesis is not an arbitrary, eclectic combination of separate parts, "pieces" of the whole, but a dialectical unity with highlighting of the essence. Synthesis is one of the special methods of science. Each science has its own specific subject of research, so common

to it techniques of analysis and synthesis, systematization of the observed results, experiment and processing of research data are created. Analysis and synthesis are meaningfully linked. As a result of the analysis, it is possible to distinguish the general as the essential in an object, as something that will become the basis for synthesis. The task of analysis is to find out the part from which the object itself arises and develops. The object in the synthesis is the unity of opposites, with its emergence and development being reproduced. If the synthesis initially appears in the analysis, it later on includes the analysis. In modern scientific cognition, theoretical analysis and synthesis are inextricably linked with practical analysis and synthesis – with the practice of experimentation.

Abstraction is a process of cognitive distraction from a number of properties and connections of a phenomenon that is studied, with a simultaneous highlighting the properties (primarily essential, general ones) that are of interest for the researcher. There are different types of abstractions: abstractions of identification, isolating abstraction, abstraction of actual infinity, abstraction of potential carrying out. Abstractions are also distinguished by level (order). Abstractions from real objects are called first order abstractions; abstractions from abstractions of the first level – second order, etc.

Idealization is a cognitive procedure associated with formation of abstract (idealized) objects that are fundamentally unrealizable ("ideal gas", "absolutely black body", "point", etc.), but for which there are prototypes in the real world. In the process of idealization, there is a distraction from the real properties of the subject with simultaneous introducing into the content of the concepts that are being formed, of such features that are really unrealizable. As a result, a so-called "idealized object" is formed, which can guide theoretical thinking in displaying real objects.

Generalization is a process of formation of an object's general properties and features. It is closely related to abstraction. Categories of a general and a single lie in the epistemological basis of generalization.

Induction is a logical method of research connected with generalizing the results of observation and experiment and thought proceeding from the single to the general. Since experience is always infinite, inductive generalizations are therefore probabilistic in nature. Inductive generalizations are considered as experimental truths or empirical laws. Among inductive generalizations, an important role belongs to

scientific induction, which, in addition to formal justification and generalization obtained inductively, gives an additional meaningful justification for its truth, including through deduction (theories, laws). Scientific induction gives a reliable conclusion due to the fact that the emphasis is on the necessary, logical and causal relationships.

Deduction is a shift in the process of cognition from the general to the single, the derivation of the single from the general; the process of logical inference, that is, the transition according to certain logic rules from some proposals-references to their consequences (conclusions). The essence of deduction lies in using of general scientific regulations for the study of specific phenomena. In the process of cognizance, the induction and deduction are inextricably linked, although at a certain level of scientific research one of them prevails. Induction is guiding in the process of generalizing of empirical material and making hypothesis. In theoretical knowledge, deduction is more important, as it allows to order experimental data logically and construct a theory based on the logic of their interaction. Researches are completed using deduction.

Analogy is a process of establishing similarities in some properties and relationships between non-identical objects. On the basis of the identified similarity, a corresponding conclusion is made – a conclusion by analogy. The analogy gives unreliable, but probabilistic knowledge. In conclusion, by analogy, the knowledge gained from considering a certain object ("model") is transferred to another, less studied and less accessible object.

Modeling is a method of examining objects on their models. In the logic and methodology of science, a model is an analogue of a certain fragment of reality, conceptual and theoretical images, etc. The forms of modeling are diverse and depend on the use of models and the scope of modeling.

System approach is a set of general scientific methodological principles (requirements), which are based on the consideration of objects as systems. These requirements include: a) identifying a dependence of each element on its place and functions in the system, with taking into account the fact that the properties of the whole cannot be reduced to the sum of the individual properties of these elements; b) analysis of how exactly the system's behavior is determined by both the features of its individual elements and by the properties of its structure; c) studying the mechanism of

interaction between the system and the environment; d) studying the nature of hierarchy inherent in a particular system; e) providing a comprehensive multi-aspect description of the system; f) considering the system as a developing dynamic integrity.

Probability-statistical methods are based on taking into account the actions of a set of random factors that are characterized by a stable rate. Probabilistic methods rely on the probability theory, which is often called as science of chance. In the laws of the dynamic type, predictions have a specifically defined character. In statistical laws, predictions are not reliable, but probable. Probability-statistical methods are widely used in researching of mass phenomena, especially in such scientific disciplines as mathematical statistics, statistical physics, quantum mechanics, synergetics, etc. [19].

Test questions for self-checking on topic 5

1. Formulate a categorical content of the definition of "method" and explain its relationship with the content of the category of "methodology" (when answering, give several approaches to interpreting of the content of the relevant categories).

2. Compare the general philosophical approaches to understanding the meaning of the definition of "method" (when answering, use the interpretations provided by F. Bacon, R. Descartes, etc.) with those approaches to the interpretation of the relevant category that were formed within the framework of modern scientific discource (when answering, use the interpretations by modern domestic scientists).

3. Reveal the content of the main approaches to methods of scientific knowledge classification (when answering, use a model of the general classification of methods).

4. Which methods of scientific cognition can be attributed to general scientific methods? Explain the peculiarities of the researcher's use of general scientific methods of scientific cognition.

5. Which methods of scientific cognition can be attributed to the so-called philosophical methods? Explain the peculiarities of the researcher's use of philosophical methods of scientific cognition.

6. Provide a general characteristic of empirical research methods. For which varieties of scientific researches the use of empirical methods is the most justified? Reveal the content and explain the features of using of

such empirical methods: observation, experiment, comparison, description, measurement

7. Provide a general characteristic of theoretical cognition methods. For which varieties of scientific researches the use of theoretical cognition methods are most justified? Reveal the content and explain the features of using of the following methods of theoretical cognition: formalization, axiomatic method, hypothetical-deductive method and ascent from abstract to concrete, etc.

8. Provide a general characteristic of general methods of scientific knowledge. For which varieties of scientific researches the use of general methods of theoretical knowledge is most justified? Reveal the content and explain the features of usage of such general logical methods as: analysis, synthesis, abstraction, idealization, generalization, induction, deduction, analogy, modeling, system approach, probability-statistical mehods, etc.

9. In accordance with the area of your scientific interests, determine those methods of scientific cognition, the use of which can provide a comprehensive consideration of subject of scientific research determined by you (when answering, justify your choice of that or another methods).

TOPIC 6. INFORMATION SUPPORT OF SCIENTIFIC RESEARCH

Goal: to determine the place and the role of information resources in support of scientific research, as well as to acquire skills of their practical use within the framework of performing specific tasks of scientific research

6.1. Documentary sources of information

Content: approaches to the interpretation of the categorical content of the phenomenon of "document"; characteristics of document's general and special functions; document's properties

6.2. Kinds of scientific documents

Content: approaches to the classification of documents; types of publications and their general characteristics: a book, a magazine, a newspaper, a letter, a booklet, a card edition, a leaflet, a loose-leaf encased set, audiovisual media, unpublished works, etc.; official documents

6.3. Reference documents and standards

Content: types of reference documents: dictionaries, catalogs, standards, etc.; the place and role of reference documents in the information support of scientific research; general characteristics of standards as one of types of reference documents; varieties of standards; general characteristics of dictionaries as one of the varieties of reference documents; features of the researcher's work on the analysis of the conceptual-categorical apparatus

6.4. Organization of scientific texts examination

Content: general characteristics of the expert assessments method; varieties of expert assessments; typical methodology of analysis and assessment; assessment criteria and features of their use; the bibliographic method of document analysis

6.5. Informational and bibliographic sources of information

Content: the place and the role of information resources in support of scientific research; general characteristics of information resources; features of using bibliographic manuals

6.6. The technique of working with special literature

Content: varieties of special literature and features of work; stages of studying scientific sources and practice of working with them; ways of highlighting scientific facts during the processing of special literature; the place and the role of quotations in the preparation of a scientific text; rules for the quotations' usage; the technique of reviewing literary sources

6.7. The digital search for scientific information

Content: peculiarities of organization of digital search and processing of scientific information; general characteristics of digital search services and features of their use; potentials of Google Scholar for information support of scientific research; recommendations for organizing electronic digital search for scientific information

Recommended literature

1. Birta H.O., Burhu Yu.H. (2014) *Metodolohiia i orhanizatsiia naukovykh doslidzhen: navch. posib. [Methodology and organization of scientific research: teaching. manual]*. Kyiv : «Tsentr uchbovoi literatury».

2. Hladkyi S.O. *Osnovy naukovykh doslidzhen navchalno-metodychnyi posibnyk dlia samostiinoho vyvchennia navchalnoi dystsypliny pidhotovky bakalavra spetsialnosti 081 «Pravo» [Basics of scientific research, educational and methodological guide for independent study of the academic discipline of bachelor's training, specialty 081 "Law"]*. URL: http://www.pravo.puet.edu.ua/files/lic2016bac/ond_03.pdf

3. Danylian O.H., Dzoban O.P. (2019). *Metodolohiia naukovykh doslidzhen: pidruchnykiu [Methodology of scientific research: a textbook]*. Kharkiv: Pravo.

4. Medvid V.Iu. Danko Yu.I., Koblianska I.I. (2020). *Metodolohiia ta orhanizatsiia naukovykh doslidzhen (u strukturno-lohichnykh skhemakh i tablytsiakh): navch. Posib [Methodology and organization of scientific research (in structural and logical schemes and tables): teaching. manual]*. Sumy: SNAU.

5. Tolok I.V., Prokhorov O.A., Ryzhykov V.S. (Eds.) (2019). *Metodolohiia provedennia naukovykh doslidzhen u viiskovykh navchalnykh pidrozdilakh zakladiv vyshchoi osvity: navchalnyi posibnyk [Methodology of conducting scientific research in military educational units of higher education institutions: study guide]*. Kyiv: VIKNU.

6.1. Documentary sources of information

The presented below material is presented in accordance with the generalizations formulated by G. Birta on the methodology of organizing a scientific research [2], as well as the experience accumulated by this manual's author in training highly qualified scientific staff.

A theoretical study of any social phenomenon, including a

document, can be carried out in various aspects. First of all, one should identify its semantic content, consider it as a reality, establish its volume. Such an approach in science is called ontological.

A concept of a document can be distinguished only basing on general theoretical regulations developed in philosophy, computer science, and documentary. It is known that among researchers there is no common opinion on the issue of how to interpret this definition, which is explained by the multidimensional nature of the phenomenon itself. Within the framework of scientific literature, one can often find those approaches to the interpretation of the "document", within which the content of the relevant phenomenon is presented through the prism of the presence of such attributes as signature, date, seal, etc.

All of the document's functions are divided into general and special ones. Performing general functions is typical for all documents without exception, while special ones – only for a limited group of documents.

General functions include:

– social – the document is a socially important object, as it is created by social need and implements itself in the social system;

– informative – the document acts as a means of fixing, storing and transmitting information;

– communicative – the document acts as a means of communication between public structures and individuals, it not only informs but also integrates public consciousness, contributes to the creation of a single public opinion, the development of collective reactions, the consolidation of the whole society;

– cultural – the document serves as a means of consolidation and sharing of social experience and cultural traditions.

Special functions include:

– legal – the document is a means of consolidating and changing of legal norms and legal relations in society. In addition, assessing the reported information and events, the document contributes to the formation of legal consciousness, development of socially approved behavior models, the assimilation of moral and ethical norms;

– educational – fixing accumulated social experience, the document contributes to the transfer of knowledge from generation to generation, participates in the process of personality formation, their socialization;

– cognitive – a document based on a fixed text allows you to build

the most generalized, abstract, theoretical models of reality. Documentation acts as an important element of cognition of the surrounding world, a means of fixing its process and result;

– administration – the document is a management tool, promotes planning, coordination and regulation of the collective activities of society members for its optimal organization;

– memorial – the document acts as a source of historical information about development of society, its individual structures and features. Documents are the simplest, most convenient for reproduction and the most effective kind of people's memory;

– accounting – accompanying production and economic activities at all its stages, the document contributes to implementation of accounting of its results;

– aesthetic – fixing the results of figurative and artistic mastering the reality in the structure of material media, the documents thereby accumulate, store and transfer the generalized aesthetic experience.

In the basis of formation of separate kinds of documents lies originality of their quality that is characteristic of a whole group of documents. This qualitative uniqueness allows this group of documents to perform socially necessary functions more optimally.

In the history of science, there have been many attempts to study the diversity of documents by identifying similarities and differences between them, finding ways to identify them, stable combinations of properties and their grouping in the form of a generalized idealized model.

Any document has many properties inherent to its form and content. Presence of identical properties in other documents enables combining them into a group, kind. In a similar group, these properties come to the foreground, and therefore it is possible to study and use them in practice. One type includes such groups of sources that have stable features that arise and are fixed due to the common functions of these sources in the society's life.

The defining distinguishing moments are: the socio-functional purpose of the document, which determines the fact of its occurrence; material structure; reader address; significant nature of information; connectivity (non-connectivity) with other publications; temporary edition features.

Since there are many properties in the document, this determines the

possibility of its multidimensional studying, in which the document can be simultaneously considered in terms of various properties, can be counted among different types, and included in different groups.

Types of documents in terms of their constructive form. The constructive form of the document is quite diverse. From this point of view, documents can be divided into paper documents (in the form of one or more pages), stack (several pages that are not stapled together, which together represent one document), codes (pages stapled in a notebook, brochure, book), tape (photo, film, video, and audio tapes), disc (compact discs) [2].

6.2. Kinds of scientific documents

The material presented below is presented in accordance with the generalizations formulated by I. Tolok about the methodology for conducting scientific research [46], as well as the experience gained by the author of this manual in training a highly qualified scientific personnel.

Types of documents in terms of the iconic nature of information. The iconic nature of information is another feature involved in the process of documents' specialization. It is defined as the form of signs with which the main material of the publication is fixed and transmitted: letters of the alphabet, numbers and punctuation marks (for works of writing), musical signs (for musical works), graphic, artistic and cartographic images.

According to the iconic nature of information, there are: written documents containing information in the form of a written text (verbal, digital, hieroglyphic, formula or mixed); musical documents, most of the volume of which is occupied by notation of musical work; cartographic documents (maps, atlases, globes); pictorial documents, most of the volume of which is occupied by images. Under the image is understood a reproduction of a picturesque, graphic, sculptural work, special or artistic photography and other graphic works; audio and audiovisual documents containing a recording of sound and a moving image (tape recordings, films, videos, compact discs).

Written documents, in their turn, are divided into published ones, which are brought to public attention through replication and, after publication, receive the name of the publication, and unpublished ones, not designed for wide distribution. Published documents are called publications.

Their variations:

– book publication is a publication in the form of a block of stapled

sheets of printed material of any format in a cover or binding;

– journal publication is a publication in the form of a block of stapled sheets of printed material of established format, technically adapted to the specifics of a given periodical;

– newspaper publication is a publication in the form of one or more sheets of printed material of an established format, technically adapted to the specifics of the given periodicals;

– letter publication is a publication in the form of one or more sheets of printed material of any format without stapling;

– booklet is a paper publication in the form of one sheet of printed material, folded in any way in two or more folds;

– card publication is a paper publication in the form of a card of the established format printed on a material of increased density;

– leaflet is a card edition printed on one or both sides;

– poster is a paper publication in the form of one or more sheets of printed material of the established format, printed on one or both sides of the sheet, intended for exhibiting;

– complex publication is a set of publications collected in a folder, case, parcel or enclosed in a cover.

From the point of view of the publication periodicity, all publications are divided into non-periodical, released only once and not having a continuation (most often – books), and serial ones.

The basis of the book is a book block – it is a set of stapled notebooks or sheets containing all the pages and components of the future edition, designed to be inserted into the binding cover.

A notebook is a printed and folded (folded into several sheets) printed sheet. Notebooks are stapled into a book block and fastened with an endband.

Endband is a tape with a thickened edge. It is glued to the upper and lower edges of the root of the trimmed book block. Serves to strengthen it, as well as one of the elements of the book's design.

In order to prevent notebooks from mixing in the process of preparation of a book publication, each of them is marked with a sign – a serial number of the printed sheet that is placed in the lower field of the first strip of the notebook of the book block before the norm.

The norm is a short, often abbreviated title of the publication, the name of the author or the number of the printing order, which are placed in

the lower field of the first page of each notebook of the book block to control the forming notebooks in the publication copies.

The book block is covered with a hardcover – a solid cover of cardboard, plastic or cardboard plates covered with leather, paper, cellophane. It serves to protect the block from damage and getting dirty, for initial information about the publication, as well as an element of the decoration of the book. The hardcover itself consists of front and back sides connected by a spine.

A spine is a lateral side of the book block, the place of stapling of notebooks or block sheets, and also covers this part of a hardcover. The hardcover is connected to the book block with a help of endpaper.

Endpaper is a folded in the middle sheet of paper (or a construction of two sheets connected by a strip of fabric), that connects the first notebook of the book block with the front side of the hardcover and the last notebook with the back side of the hardcover.

The book block begins with the title page. This is the first page of the publication containing basic information about it, allowing to distinguish it from any other publication. The occupied first page is called the main title page, it contains all the most essential information about the publication or its part. The second page is the reverse side of the title page, sometimes it also contains basic information.

Often the title page takes not two, but four pages, in this case it is considered to be a complex title page. Each page has its own name. The first page is called a titulus (or foretitle), it precedes the title page and has a decorative-composition purpose (may contain a publishing stamp, series name, epigraph, etc.). The second page is the reversal title. The third and the fourth page – accordingly – the main title page and the reverse side of the title page.

Depending on how the source data is located on such a complex title sheet, a reversal and expanded title sheets are distinguished. If the second page (reversal title) contains information relating to a multivolume or serial edition as a whole, and the third page contains information characterizing a separate volume of a multivolume or serial edition, then such a title page is called a reversal.

If information begins on the second page (reversal title) and passes to the right page (main title page) without repeating, then such a title page is called expanded. If information on the reversal title and the main title page

is simultaneously reproduced in different languages, then such a title page is called parallel.

Sometimes the title page not only presents the entire publication as a whole, but also its separate structural parts. Such a separate sheet or page with the title of the part, section of the publication, title of the work without the main text of the printed work is called half-title. In old-printed books, half-title was considered as an additional title placed in before the title page to protect it from dirtying.

The book ends with the publishing data – part of the basic information, that includes the date of submission of the publishing original to the set, the date of signing the publication for publication, paper size, page share and other production, technical and economic data.

The format of the publication is the page's dimensions (length and width) after trimming the book block, that are indicated in millimeters or in the form of a paper sheet format in centimeters and the proportion that the page makes of the paper sheet.

Characteristics of serial publications. Serial publications are publications that come out over time, usually in isolated issues that have the same title.

The first group of serial publications are called periodicals – they are released at regular intervals, a constant number of issues for each year, uniformly designed, in numbered issues and having the same title. These include magazines, newspapers, bulletins, calendars.

Magazines are periodicals that have a permanent heading and are officially approved as this type of publication. They contain articles and essays on various socio-political, scientific, industrial and other issues, literary and artistic works.

There are the following kinds of magazines: socio-political, that contain articles and materials of relevant socio-political topics and are intended for wide circles of readers; scientific, that contain articles and materials on the theory of research, as well as applied articles and materials intended for scientists; popular science, that contain articles and materials on the basics of sciences, on theoretical and experimental researches in the field of science, culture and practical activities and serve to spread knowledge and for self-education; production-and-practical, that contain articles and materials on technology, technology, economics, organization of production or practical activities, methodological developments and other

materials intended for employees of a certain industry; popular magazines, that contain articles and materials on culture, life, sports, fashion, etc. and are intended for a wide range of readers; literary and artistic magazines, that contain works of fiction, as well as journalistic and critical articles and materials; abstract journals – publications that are officially approved as a journal and contain abstracts of books, articles and other types of documents.

A newspaper is a periodical hat is published at short intervals, contains official materials, operational information and articles on relevant socio-political, scientific and other issues, as well as literary works and advertising. Among the newspapers, the following stand out: general political newspapers, systematically covering issues of domestic and foreign policy of the country, as well as international life; specialized newspapers, systematically covering specific problems of public life, science, technology, culture and other areas of activity and are addressed to a certain category of readers. There are national, regional, city, district, large-circulation newspapers, as well as a special newspaper issue – a publication prepared by the visiting or public editorial office of the main newspaper for a prompt delivery of information to readers, has a current and gross number, year, date of publication, that is published for a limited period.

Calendars are also considered to be periodicals – periodic reference publications containing a sequential list of days, weeks, months of the year, as well as other information of a different nature. The following types of calendars are distinguished: a report-card calendar, which is an annual calendar in a form of a page edition containing a list of days of the year arranged by month in the form of a table, as well as a tear-off/flip calendar, a book-type calendar, a calendar of significant dates, etc.

So-called ongoing publications are also considered to be serial ones – they are released at indefinite intervals depending on accumulation of the material, they are similarly designed, numbered in issues and have a common title. Usually, these are collections of works produced by research institutions and higher education institutions with a common title.

Another type of publications are bulletins – they can be both periodic and ongoing. These are the publications that are issued promptly and contain brief official materials on issues within the terms of reference of the organization issuing it.

Bulletins can be distinguished as the following: a normative bulletin,

that contains materials of a normative, directive or instructive nature, usually issued by some state body; a reference bulletin, that contains reference materials located in the order convenient for their search; an advertising bulletin, that contains information about products, services and measures in an attractive form to create demand for them; a bulletin-chronicle, that contains messages reflecting activities of the publishing organization; a table bulletin, that contains actual data of a digital or other nature arranged in the form of a table; a statistical bulletin, that contains operational statistics characterizing specific area of society's life and activity.

Unpublished documents. Unpublished documents collected and stored in the funds of scientific and technical libraries include materials that are created in the process of work of various organizations, research institutions and remain in the manuscript or are replicated in a small number of copies. The special value of unpublished documents is due to their reliability, accuracy and completeness of the information contained in them, relevance and efficiency.

They include scientific and technical reports, translations, dissertations and their abstracts, description of algorithms and programs, projects and estimates, deposited manuscripts, drawing-and-design documentation, materials of conferences, meetings, seminars, information maps, analytical reviews, acts of state tests, descriptions of rationalization proposals, product passports, exhibition materials, protocols of experiments, survey documentations, laboratory logs, route maps, applications for inventions, industrial designs and trademarks, license agreements, cards of technical level and quality, etc.

These materials, as a rule, exist in single copies, prepared in the form of separate sheets, brochure materials, as well as collections of unpublished materials that are stored in folders.

Sometimes there is no strict border between published and unpublished documents. This made it possible to introduce a term into scientific circulation – intermediate forms of publication. These include, for example, a preprint – an advance release of prints of articles and other printed materials for sending to authors and other interested parties, usually in a limited amount of copies, before the official publication.

There is also a group of documents that fundamentally can be publicized due to their functional purpose. They are necessary for the

adoption of specific administrative decisions, contain the initial factual information, indicators, parameters intended for the preparation of new generalized management documents (administrative-economic, organizational-management, planning-economic, financial-accounting, technological documentation).

An audiovisual document is a document that contains text, visual and/or audio information, the reproduction of which requires usage of appropriate equipment.

This group of documents includes: phonodocument – audiovisual document on tape or disk media containing audio information; video document – an audiovisual document on tape or disk media that contains information recorded through video recording; film documents – an audiovisual document on a film carrier that contains objects fixed on it using cinematic technology in the form of sequentially arranged photographic images (in a sound film it also contains sound information); photo document – an audiovisual document containing information recorded on it using photographic equipment; objects in the form of separate photographic images. A document on micro-forms is also considered as kind of photo document – it can be recorded on a film or other medium, which requires a corresponding increase, with the help of micrographic techniques, for its manufacture and usage.

Document types in terms of their purpose. The purpose is a characteristic of the publication in terms of the public function it performs. Depending on the purpose, activity area the documents serve, they are divided into scientific, popular science, educational, reference, production, official, patent, literary and artistic.

Scientific documents contain the results of theoretical or experimental research, reveal the ways and nature of scientific research, describe the methodology and course of research, trace the history of the most important discoveries, cultural cites and historical documents, and they are scientifically prepared for publication.

They are characterized by the presence of descriptive factual material obtained during scientific observations and experiments; theoretical material, including hypotheses, scientific theories and laws, as well as worldview interpretation of scientific laws and theories.

Such documents are orientated at scientists, specialists in a specific field. Therefore, their text is the most difficult to understand. It is

characterized by the use of numerous scientific terms without explaining the scope of their concept.

The order of material presentation in such documents is set by the logic of scientific research itself.

Most of scientific documents are published, that is, they are publications. Among them the following ones stand up: complete collections of works of science and technology classics; selected works of outstanding scientists; monographs – scientific publications containing a complete and comprehensive research of one problem or topic and belong to one or more authors; thematic collections, that contain articles by different authors and are dedicated to presentation of several issues of a particular topic (unlike the monograph, such publications do not cover a topic as a whole, but consider in detail its individual aspects that are most relevant or especially significant ones; materials of congresses, conferences, symposiums, that contain materials of preliminary nature published before the beginning of scientific forums (annotations, abstracts, reports, theses, messages), as well as summarize their results (recommendations, decisions).

A large number of scientific documents also belong to the group of unpublished ones. Among them, a special place is occupied by dissertations and their authors' abstracts.

The dissertation is a qualifying scientific work in a certain field of science, that has an internal unity, contains a set of scientific results, scientific provisions put forward by the author for public defense and prove the author's personal contribution to science and his/her qualities as a scientist.

There are special requirements for dissertations. It should be a fundamental scientific work, a completed scientific research, contain new knowledge, formulated and substantiated scientific concepts. Dissertations should contain a critical review on the topic under study, summarizing the experience of other previous scientific studies, giving an idea of the degree of study of a scientific problem.

This scientific research is presented in a specialized council on obtaining the degree of a doctor (or candidate) of sciences, where the dissertation is subjected to examination and multi-stage verification. Dissertations are printed in single copies, but the ideas and facts set forth in them are considered to be officially put into scientific circulation. The procedure for their public defense involves preliminary acquaintance with

the scientific contribution of the dissertation to the general scientific community.

For this purpose, there exists the author's abstract – it is a presentation of the main thoughts of the dissertation, compiled by the author him/herself and published in a limited edition (100 –150 copies). The abstract contains the main ideas and conclusions of the dissertation, shows the author's contribution to the performed study, the degree of novelty and practical significance of the results. Although a stamp "On the rights of the manuscript" is placed on its cover, it still has all the rights of a publication.

Unpublished scientific documents include deposited manuscripts. The sense of depositing lies in manuscripts' transferring for storage into special information bodies recommended by the scientific council of institutions and organizations, which are entrusted with the functions of storing such materials.

These are completed scientific works designed for a narrow circle of specialists, the publication of which in the form of journal articles or monographs is impractical for these or other reasons. The information about the manuscripts' content is distributed through the publication of abstract information about them. If needed, any consumer can get a copy of the desired manuscript. Deposited manuscripts have all the rights of published works and are protected by copyright.

Reports on the results of a completed research and development works serve as an important source of scientific and technical information and also relate to unpublished scientific documents. Some of them are typographically multiplied, although they are not considered as publications in the full sense of the word.

In terms of content, they should include an assessment of the current state of the solved issue, a justification for choosing the accepted direction of research, methods for solving, analyzing and summarizing the obtained results, the nature and content of theoretical studies performed, an assessment of the completeness of the solution to the problem, reliability of the results obtained, their comparison with similar results of domestic and foreign works.

A fairly large range of publications can be counted as popular science documents in the broad sense of the word. In the narrow sense of the word – a set of publications, which popularize scientific knowledge, theories, laws. But, as a rule, these documents' text contains only main

elementary questions of the theory.

Popular science documents, by its intended purpose, are designed for readers who are not specialists in this field. Therefore, the material presented in them is expressed in a clear and accessible language, avoiding complex terms and theoretical structures, with an abundance of explanatory and illustrative material.

The order of the material's presentation depends on its purpose and categories of readers this material is intended for. In publications for initial self-education, for people who have a superficial idea of revealing the range of issues, the material is arranged in a logical sequence – from simple to complex. In publications for in-depth study, for expanding of the readers' theoretical notions, the material is arranged in a different logical sequence – from the general to the particular.

Official documents are publications issued on behalf of state or public organizations, departments, institutions and enterprises.

Among the official publications, a special place belongs to the legal documents regulating the state's life and bind are mandatory for all areas of its development for all social structures and institutions, as well as for the country's population.

On the basis of laws, separate bylaws corresponding to the laws' articles are prepared, among which a significant role belongs to orders. Other important types of legal acts are resolutions, decrees, regulations, appeals, statements, orders, explanations, instructions, instructional letters, instructions and international treaties.

An important variety of official documents are party documents – programs, charters, manifests, declarations, etc. of various political parties and public organizations that direct and regulate their activities and are mandatory for execution within the framework of these social structures.

Organizational and administrative documents are issued at the level of a separate institution, organization, enterprise. They contain rules, norms, provisions that establish the organization's status, its competence, structure, number of personnel and official staff, the functional content of the organization as a whole, its divisions and employees, their rights, duties, responsibilities.

Organizational-and-administrative documents include the organization statute, regulations on the organization, regulations on structural units, institution's collegiate and advisory bodies, regulations on

collegiate and advisory bodies, management and administration apparatus, staff schedule, orders, instructions concerning certain activities, descriptions of employees' positions, rules, memos.

Organizational and administrative documents contain mandatory provisions. They implement the norms of administrative law and are the legal basis for an institution's activities [46].

6.3. Reference documents and standards

The following material is presented in accordance with the generalizations formulated by O. Danilyan on the methodology of scientific research [8], as well as the experience gained by the author of this manual in training a highly qualified scientific personnel.

Reference documents are intended to obtain brief (but sufficient for a particular purpose) evidence on a particular issue. Reference documents accumulate information about a particular system. From the point of view of the order of the material, all reference documents are divided into dictionaries and reference books. A dictionary is characterized by an alphabetical way of the material arrangement, and the reference book is systematic (thematic). The main requirements that apply to them: the completeness of the collected actual information, a special design that allows a reader to quickly search for the necessary data. The style of writing of reference documents is characterized by a certain dryness, brevity caused by the need to place a large actual material in a limited space.

There are the following groups of reference documents: universal and branch encyclopedias – publications that contain in a generalized form basic information on one or all areas of knowledge of practical activity, presented in the form of short articles, arranged in the alphabetical or systematic order; industrial and technical reference books – applied publications that are practical in nature, have a systematic structure or alphabetical titles of articles; explanatory dictionaries – language dictionaries that explain words' meaning, giving their grammatical and stylistic characteristics, examples of use and other information; terminology dictionaries – publications that contain terms from a certain field of knowledge or topic and their definitions; bilingual and multilingual dictionaries – dictionaries that contain a list of language units with their characteristics or translation into another language; normative reference books – publications that contain a set of norms, rules, requirements for

industrial facilities; statistical reference books – publications that contain a systematic list of statistical materials; biographical directories – publications that contain information about persons' life and activities; bibliographic reference books – publications that contain biographical information about specific people, lists of their works and literature covering their life and work; guidebooks – publications that contain information about any geographical point or cultural and educational institution, which are located in a convenient for visiting order; reference books – designed for individual groups of consumers.

Educational documents serve such areas of public practice as education and upbringing. These include those publications that in their content and presentation meet education needs and are adapted for the training purposes in educational institutions of various types.

As a rule, the text of educational documents includes the following parts: the main theoretical provisions of one or another field of knowledge and their evidence; necessary factual material, explanatory and illustrative material, practical instructions of varying degrees of detail and validity, depending on the students' category.

The main groups of educational publications are textbooks and teaching manuals. A textbook is a publication containing a systematic presentation of an academic discipline (its section, part) corresponding to the curriculum, and officially approved as this type of publication. A teaching manual is a publication that supplements or partially (completely) replaces a textbook, and is officially approved as this type of publication. A teaching manual teaches the material in a methodically proved system and sequence, but unlike the textbook it does not necessarily correspond to the program, often covering only some of its topics, or on the contrary, significantly going beyond its scope. A special kind of educational publications are collections of tasks (exercises). They do not teach the course systematically, but serve as a means of more conscious and deeper understanding of already known material by students. This group also includes: visual aids, the content in which is transmitted mainly through the images; anthologies – publications containing literary and artistic, historical and other works or their parts, that describe the object of study of the academic discipline; workshops – contain practical tasks and exercises that contribute to the assimilation of already learned material; practical guides designed for independent mastery of any skills.

A number of educational documents are designed not only for education applicants, but also for teachers. First of all, a curriculum – it is a document that defines the content, volume, as well as the sequence of studying and teaching of any academic discipline (its section, part). Education and methodology manuals contain materials on the methodology of teaching the discipline (its section, part) or the methodology of education.

Production documents are distinguished by the purely applied nature of the content, which is characterized by a combination of instructional-normative and reference data. Documents of this type are very diverse in composition, purpose, areas of use.

The basis for this specific set of documents are publications to help master a profession, professional improvement and exchange of advanced experience, as well as production and practical publications containing information on the technology and organization of production. These publications that explain the essence of production processes, contain a description of the principles of action, devices, features of maintenance and repair of machines and mechanisms, as well as a statement of the methods of processing raw materials and manufacturing products.

There also exists a group of documents regulating production processes. A developed technological process (manufacture, processing, assembly, control of products, methods and techniques) is issued by a complex of technological documents that reveal the methods, means and procedure for implementing the technological process as a whole.

The technological documentation includes in its entirety technological specifications, route and operational maps, sketch and diagram maps, material cutting maps, technological instructions, information about standard equipment, information about non-standard equipment and information about normalized tools.

They contain a description of the technological processes of product's manufacturing and repair, recommend the division of technological process into operations. It also includes the operational documentation regulating the modes of operation of the equipment (way to use, safety rules, process control).

Another group of production documents is documentation for material resources, labour means and equipment. Inventory of natural resources is carried out in the so-called cadastres (the water, wind, land

cadastres are maintained). Documentation for mineral resources is also included there.

In industry, an important form of documentation for labour means and equipment are passports that characterize factories, workshops, individual machines, equipment and manufactured products. They contain descriptions of the device's system, the principle of its operation and the list of parts of machines, devices, equipment and have the nature of the prescription for installation, storage, transportation, operation.

Equipment documentation has the character of drawing-and-design materials. An important group of documents are standard construction projects, information on technical equipment.

Industrial catalogs are lists of products manufactured by industrial enterprises or sold by trade organizations. As a rule, industrial catalogs contain technical characteristics (dimensions, productivity, power consumption, etc.) of a product (or groups of products), their images and instructions concerning their use. Industrial catalogs are widely used when choosing equipment for enterprises, workshops, laboratories, when checking the technical characteristics of finished products, designing and creating of samples of industrial products.

Industrial catalogs usually do not contain prices of industrial products. This information is contained in the adjacent publications – in price lists which are lists of advised products, materials and equipment, as well as household services with prices. Their features are efficiency and fragility. After price changes, price lists are replaced with the new ones.

So-called regulatory and production publications comprise a large group as well. These publications establish norms and requirements for products, technological processes and control systems. They are mandatory or recommended in nature for the regulation of production activities within the country, a particular department, industry, or an individual enterprise.

First of all, this group includes standards. Standardization is an activity aimed at developing and establishing of both mandatory and recommended requirements, norms, rules and characteristics.

The purpose of standardization is achievement of an optimal degree of order in a specific area through the wide and repeated use of established provisions, requirements, norms.

The object of standardization is usually a product, a process or a service for which certain requirements, characteristics, rules, parameters are

developed. A standard is a regulatory document approved by a recognized body aimed at achieving of an optimal degree of arrangement in a particular area. For general and repeated use, the standard establishes general principles, rules, characteristics relating to various activities or their results [8].

The following material is presented in accordance with the generalizations formulated by G. Birta on the methodology of organizing a scientific research [2], as well as the experience gained by the author of this manual in training a highly qualified scientific personnel.

The standard development process includes five stages: the proposal stage, at which new proposals on the subject of development are collected; the preparatory stage, the result of which is the release of the working plan; the stage of review of a working plan; the stage of approval and finalization of a working plan; the stage of publication.

Each standard is reviewed at least every five years to establish whether it shall be subject to revision, repeal or approval for using in the next five years. This measure ensures constant updating of standards.

A standard may contain the following structural elements: title page; preface; contents; introduction; name; scope of implementation; normative references; definition; designations and abbreviations; requirements; applications; bibliographic data.

The title page, preface, name and requirements are mandatory elements, all others are optional. The designation of the state standard consists of an index (State Standards of Ukraine or Derzhavni Standarty Ukrainy (DSTU)), a registration number and separated by dashes the last two digits of the year of its approval.

Depending on the object of standardization, snadards can be devided into the following:

– fundamental standards, that are developed to promote mutual understanding, technical unity and interrelation of activities in various fields of science, technology and production. This type of documents establishes such organizational principles and regulations, requirements, rules and norms, which are considered as common to these areas and should contribute to the fulfillment of goals common to both science and production. In general, they ensure their interaction in the development, creation and operation of a product in such a way that the requirements for environmental protection, product or process safety for human life, health

and property are met;

– product standards, that establish requirements either for a particular type of product or for groups of homogeneous products;

– standards for work, that establish requirements for specific types of work carried out at different stages of the product life cycle: development, production, operation, storage, transportation, repair, disposal;

– standards for control methods (tests, measurements, analysis) that recommend using methodologies which best ensure the assessment's objectivity.

Scientific concepts are designated by special words – terms. Terms form the basis of the scientific language. A term is a word or a stable phrase to which a certain scientific or special concept is attributed. The term does not name the concept as an ordinary word, but the concept is attributed to the term given to it. The meaning of the concept designated by the term can be understood only through definition – a short logical description that establishes the essential distinctive features of the subject or meaning of the concept, that is, the content and boundaries.

Terms should possess a number of features: systematic – the term should always be associated with other terms of the specific area; must have their own definition; monosemy – unambiguous interpretation of the meaning within one subject area, one scientific discipline; lack of expressiveness and possess stylistic neutrality.

A terminology system of any science is very dynamic. There is an active process of occurrence of new terms. There is a quantitative increase. There is a radical restructuring of the conceptual apparatus, which is associated with promotion of terms that earlier did not take high levels in the hierarchy. The meaning of a previously hardly used concept with a small amount of content can immeasurably expand due to changes in social conditions.

The terminology system also includes the abbreviation of terms – words formed from the initial letters or the initial sounds of the words included in the original phrase, or from the truncated parts of the words. Recently, the number of abbreviations has significantly increased, which indicates development of the terminology system.

In the practice of terms usage, there are cases when the term receives a new meaning while saving the old one. The polysemy of the term is twofold. On the one hand, it reflects a deeper view of the subject, on the

other hand, it leads to a blurring of the concept and a distortion of the term's meaning.

There is also a synonymy of terms – describing of the same concept with several terms. Experts distinguish the so-called falsely oriented terms – terms that contradict the essence of the concepts they designate.

The terminology system of any science receives a strong influence from related sciences. The flow of terminological borrowings increases significantly, that fully corresponds to the modern trend of sciences' integration. Interpenetration of terms of various terminological systems is an objective process.

Terminological research has become one of the most important areas. In various scientific texts, the conceptual apparatus has a different degree of development and is a kind of indicator of the level of science development.

A lag in the conceptual apparatus is a serious barrier to the advancement of science.

Since the internal form of words, and therefore of the term, manifests itself primarily in the initial period of naming things and phenomena, there is a natural need to analyze terms taking into account their genesis in history. Terminological analysis allows us to reveal the essence and semantic meaning of modern terms by studying the history of their origin and development, to reveal the terms' interaction, to establish the place of each of them in the conceptual apparatus, to identify groups of related terms.

Term analysis consists of four interdependent stages.

The first stage is the targeted learning (in the first approximation) of the terms that create a thematic group of the researcher's interest. It lies in identifying the terms and the concepts corresponding to them, highlighting the basic (key) term and the terms subordinate to it. The latter is important to show in such a connection, which has developed in practice of their use. At this initial stage, there already appear individual comments, assumptions concerning the inaccuracy or illogicality of individual terms and their definitions. All doubts are taken into account. In order to identify modern terms and their definitions, one should use literature on the research topic, various terminological dictionaries and reference books, reviews, works. The terms are written on cards.

The second stage involves an etymological analysis, the purpose of

which is to clarify the primary meaning of the word (or combination of words) that has become a term. The word, on the basis of which the term was formed, is considered in the linguistic environment that served as its original source.

The third stage is studying the changes in terms and the concepts they reflect from the moment of their entering the terminology system of science, that is, studying the process of concepts' formation and development within science.

Having become a term, a word becomes part of the terminology system and along with other terms undergoes evolution, experiences their influence within it. That is the way how concept fixed in a specific term evolves. This means that it is necessary to study the term in all its relations and mediation, taking into account the laws of the entire system's development. This approach is called contextual analysis. It requires the researcher to determine the nature of the use of the term in texts written at different times, to be aware of its specific meaning in the language of a particular work, to pay attention to the semantic and emotional expressiveness of texts.

At the fourth stage, the researcher one more time returns to their terminology system, clarifies its composition, taking into account new materials obtained at previous stages, gives a clear formulation to each concept.

The normalization of the terminology system is solved with the help of terminology dictionaries, that establish a strictly unambiguous system of concepts and terms and contribute to the ordering of terminology and ensuring its stability.

Standardization is a qualitatively new direction of terminological work, that had a significant impact on selection of terms for use, their formulation and definition. Over the past decades, several terminology standards were developed and still operate, that include terms that are mandatory for use in documentation of all kinds, including educational and reference literature. The standardization of the terminology system is aimed at achieving unity of terms' use in each specific area.

Content analysis is a method of quantitative study of the content of a document. The essence of this method is to calculate the frequency of units occurrence in the test: signs, combinations of signs, letters, words, terms, phrases, surnames of individuals. After counting, the selected units are lined

up in the order of descend in frequency of their use in the text, that is, a thesaurus is formed. The results of the calculation allow us to see what is diffused in the text and is not visible at first glance.

The most difficult and responsible stage is that the researcher outlines those semantic units, the presence (or absence) of which interests him/her in the studied text. Since the same semantic meaning can be expressed using different linguistic means, after choosing semantic units, the researcher must formulate their specific empirical indicators, that is, formalize the units.

Last but not least, a question of the counting unit is solved – it can be not only the frequency of occurrences, but also such values as a number of lines given to a specific semantic unit, or the area of a newspaper column. After counting all preparatory procedures, a system of clear rules is formed, that is, a certain algorithm with the help of which the content of the considered text is analyzed.

There are several types of content analyses depending on the purpose of studying and choice of indicators. For example, semantic content analysis is used. It is focused on identifying the meaning of the text. Semantic units, enclosed in words, phrases and statements are chosen as indicators for counting. In literary studies, linguistic content analysis is used.

Each literary text is characterized by its own characteristics: length of paragraphs and phrases, order of words in sentences, phrases that are most common. Each indicator can serve as a unit for counting, the statistical processing of which allows us to make reasonable conclusions: who wrote this text, which genre it belongs to.

Any author can be characterized from this side, in terms of the length of words and suggestions, favorite phrases and stylistic turns. In controversial cases, when authorship is unknown or attributed to several persons at once, such an analysis allows us to prove that the text belongs to a specific author if the results of the content analysis match the results of the analysis of other texts by this person.

There is a category of texts called scientific ones. They offer their own content analysis. In scientific texts, it is customary to refer to the person from whom the author borrowed something (an idea, a method, a fact) with what they agree or disagree[2].

6.4. Organization of scientific texts examination

The following material is presented in accordance with the generalizations formulated by I. Tolok on the methodology of organizing a scientific research [46], as well as the experience gained by the author of this manual in training a highly qualified scientific personnel.

The method of expert assessment is used for analysis and solving poorly formalized problems, in which the relationship between causes and consequences is not entirely clear, and the value and quality of the parameters of researcher's interest cannot be measured directly. In addition, expert assessments and expertise in general are indispensable in forecast-related tasks, the solution of which usually relies on exemplary, estimated data.

Expertise's organization involves implementation of the following main stages: selection of specialists for the role of experts; development of questionnaire that normalizes the evaluation procedure and makes further processing of results easier; conducting a collective survey and agreeing with the results obtained.

Expertise is based on involvement of highly qualified specialists in issues outlined in the texts of the documents. The basis for the recognition of certain materials are the experts' views concerning the documents' usefulness in scientific and practical activities. Professional knowledge, horizons of experts, their ideas about the ways of development of certain branches and directions of science and technology act as a basis for comparison (assessment standards).

The central concept in expert assessments is an expertise, that is, the actual process of interviewing experts, collecting and primary analysis of expert information. There is direct expertise, in which questions of interest are directly asked to experts, and indirect, in which the answers to such questions are deduced as a result of processing other answers.

Individual and collective expertise can be distinguished in the expert assessment. In the first case, the standard of assessment is experience, knowledge, horizons and intuition of an experienced specific expert. An example of such assessments is practice of reviewing manuscripts, which is actively used in the editorial and publishing practice. When the standard of evaluation is collective knowledge, experience of a specially selected group of experts, we can talk about collective expert evaluation.

It also seems legitimate to highlight examination methods, the basis

of assessments in which is potential utility, and the standard is professional knowledge, experience and intuition of assessment subjects, and examination methods, the basis of assessments in which is established utility, and specially created scales and ranked lists of signs indicating the significance of documents (type, type of document, its volume, circulation) act as the standards.

The establishment of potential utility requires involvement of people with relevant knowledge and experience in the role of evaluation subjects, that is, highly qualified specialists specializing in specific field (they are called experts).

Requirements for experts: they must have the necessary professional knowledge; be able to solve new problems; realize obvious problems and predict the future of the objects or phenomena in question; to be able to oppose their own opinion to prejudice, to see the problem from different points of view; have experience in holding an expertise.

But for the results' assessment and conditions' comparison in all cases to be sufficiently justified and reliable, the experience and intuition of individual experts is not enough, a standard method of analysis and evaluation is required.

Creation of such a technique is based on the choice from a variety of existing and possible characteristics of the largest number of the most important, most informative ones; on determining the comparative importance, significance of the selected characteristics, ranking them by the degree of influence on processes and results.

Using questionnaires' questions, experts determine the properties of the information contained in the documents – novelty, completeness, relevance, reliability. In addition, the examination is carried out on the basis of general criteria for assessing the origin, content, external features of the document.

Significance of events, phenomena, objects and facts disclosed in documents can be called criteria for the content assessment; as well as the value of the information recorded in them, its repeatability in other documents; purpose, varieties of a particular document.

The criteria for evaluating the document's external features include peculiarities of the text transmission, the material basis of the information carrier, its physical condition, method of transmitting information.

In addition, each group of documents has its own specific criteria for

assessment: significance of information for the development of science, technology, production, novelty of the tasks and proposed solutions, authorship's priority, economic efficiency, social significance, completeness and wholesomeness of presentation.

The bibliographic method of studying documents.

Methods aimed at studying the quantitative totality of documents include bibliographic and scientometric methods. It is customary to study a set of documents in statics and dynamics. When studying documents in statics, there arises such a concept as an array of documents, when studying in dynamics they talk about flow.

An array of documents is a certain set of documental objects unchangable in time. The array is characterized with a number, which is expressed by the unit of editions, publications, storage unit. Arrays form collections of libraries, archives, book collections. When studying arrays of documents, its properties and components are studied as stable ones, that are established at the moment .

Document flow is a time-varying set of objects in motion, dynamics. The flow is characterized by intensity, which is expressed with a number of units of publications, publications per unit of time (month, year).

If arrays are reality, then the flow exists only in the researcher's imagination, since it is impossible to collect and visually characterize moving documents. Therefore, making a model of a document flow, imagining it in a visually receptive form can be done only with the help of the bibliographic method

The bibliographic method of documents studying lies in their description according to the standard method, the characteristic of the content in the form of an abstract or essay, that is, in creation of bibliographic information, as well as in its grouping according to various features and designing in the form of a bibliographic manual. Bibliographic information, taken together, reflects documentary streams and arrays, carries their qualitative features, serves as a model of the processes lasting in them, makes hidden trends visible.

This method of studying documents has wide application in society. On its basis, state registration is carried out and statistics of printed works is kept, numerous documentary and information search arrays are developed. Any scientific research begins with the analysis of the flow of documents relevant to the topic studies and ends with making a bibliographic list.

A bibliographic method includes documents' qualitative selection, assuming formulation of the relevant criteria, orientation to the requests, interests and tastes of the potential consumer.

Methods of grouping bibliographic information. It is built-up in a different sequence (systematic, thematic, logical, chronological, alphabetical, linguistic) and enables to characterize the studied flow or array in different ways, highlighting a particular feature, determining place of each document.

After establishing a place of individual documents in the flow, it becomes possible to judge their relevance, novelty, reliability and completeness of the recorded information, the efficiency of its display in text messages.

Bibliographic modeling can be applied to both flows and arrays of documents. In the latter case, catalogs and file cabinets, reflecting the funds of libraries, archives and other large collections of printed works can be considered as the bibliographic model of arrays. They serve as a means of orientation in the funds, showing the location of each document.

Bibliographic modeling of document flows has turned out to be the most science-oriented one. The study of bibliographic models of flows in various spheres of knowledge allows us to identify a fundamentally new knowledge, that formed the basis of the scientometric method [46].

6.5. Informational and bibliographic sources of information

The material that follows is presented in accordance with generalizations formulated by G. Birta on the methodology of organizing a scientific research [2], as well as the experience accumulated by the author of this manual in training a highly qualified scientific staff.

Information resources are a collection of data organized in order to effectively obtain reliable information. Library and bibliographic resources are information, material and technical and personnel potential that libraries have to carry out their functions.

In the most general features, information and bibliographic resources are a set of diverse sources of information about documents, facts, etc., which are used to meet needs of society and its individual members (information consumers).

An important component of these resources are information products, which include documents, information arrays, databases and

information services created as a result of the functioning of information systems. In other words, information products are the result of activity of a certain information system (for example, an information center designed specifically for storing, processing, searching, distributing and providing information to everyone who needs it).

Bibliographic products are a kind of information products with bibliographic information, that is, with bibliographic document records.

The concept of bibliographic production is generalizing one. Bibliographic products are documented bibliographic information, which is both the result of the preparation processes and the means of servicing the consumers (readers).

The concept of bibliographic products refers primarily to bibliographic manuals, each one of them being an ordered set of bibliographic records (documents).

Since the needs in bibliographic information for society as a whole and for its individual citizens are different and determined by many factors, this is taken into account by library and information centers involved in the preparation (production) of bibliographic manuals. As a result, bibliographic manuals are created that differ in the form of presentation (traditional and digital), methodological features and structures, purpose, content and other qualities.

Traditional (printed) bibliographic manuals.

The basic types of bibliographic manuals are a bibliographic index, a bibliographic list and a bibliographic review.

The bibliographic index is a bibliographic manual of considerable volume with a complex structure and a scientific reference apparatus. It displays documents and other materials that reveal either a narrow, specific topic (problem), or a wide, multidimensional, and in some cases even a branch of knowledge or a branch of science.

This determines the complexity of its structure (the presence of sections, divisions), affects the grouping of bibliographic records and the order of their arrangement within each division. Bibliographic indexes for the most part have a scientific reference (reference and search) apparatus, the main elements of which are preface, content and auxiliary indexes. The latter reflect information about documents in another aspect with reference to the corresponding bibliographic records.

Bibliographic list is a bibliographic manual with a simple structure.

Such a manual includes bibliographic records on materials on a narrow topic or issue, it is small in volume and simple in structure and therefore does not have a reference and search engine. One of the variants for a bibliographic list is a memo to the reader.

A bibliographic review is a bibliographic manual that presents a clear story. In bibliographic reviews, the characteristics of the works is supplemented with the necessary explanations and factual information. The target and readership assignment, the content of the topic and other features determine the number of works about which information is given in the review, its structure.

Obligatory elements of the bibliographic review are the introductory part, the analytical part and the conclusions (the final part). Among variants of bibliographic reviews we can find conversations and stories about books, the purpose of which is to interest certain groups of readers, to help in choosing the most interesting and accessible literature on current topics and issues, works of writers (domestic and foreign ones).

Moving from simple to complex, from specific questions to more general, the reader receives a certain amount of knowledge.

Some bibliographic manuals combine elements of different types. These are, for example, guidelines mainly addressed to public libraries employees.

Types of bibliographic manuals. The main feature taken into account when preparing bibliographic manuals in various centers is their social purpose (the purpose for which they are created and will be used). On this basis, manuals are distinguished as national bibliography, including state bibliographic indexes (they are extremely important for society as a whole), special bibliographic manuals – scientific and auxiliary, professional and industrial, recommendatory (they are necessary for scientists, practical specialist workers, other groups of readers in educational activities, for development of cognitive interests and abilities), publishing and book-selling bibliographic manuals (inform about planned for publishing or out-of-print products of publishing houses' products, about the assortment of available literature).

Depending on the content of the reflected documents, the following types of bibliographic manuals are created: universal; multi-area; thematic; personal; country studies; local history.

Universal manuals reflect documents on all areas of knowledge and

areas of practical activity, including fiction, while multi-area manuals – documents on several areas of knowledge. Branch manuals include bibliographic records of documents in one field of knowledge (field of science, practical activity).

Thematic manuals inform about documents on a certain topic, and personal – about literature. Country studies bibliographic manuals represent documents about one or more countries, and local history ones – about any area in the country (for example, a city).

Not only information about new products is very important, but also information about documents that were published in the past years (for a certain period of time – several years, decades, and sometimes even centuries).

In addition, information is also needed about the publications that are scheduled for release. Therefore, when preparing bibliographic manuals, a chronological feature is also taken into account, according to which current, retrospective and promising bibliographic manuals are distinguished.

Bibliographic manuals can display documents with different completeness: registration – with maximum completeness, and selective – taking into account some criterion.

Each bibliographic manual is an ordered set of bibliographic records. Orderliness is achieved through the use of the appropriate type of bibliographic grouping, in connection with which various types of bibliographic manuals are created: alphabetical, chronological, systematic and others. First of all, systematic bibliographic manuals need to be explained, in them bibliographic records are grouped in a logical system basing on the adopted classification scheme (Library-Bibliographical Classifications, Universal Decimal Classification (UDC), etc.).

The composition of the bibliographic records' elements in bibliographic manuals can be different: in some they are limited to the title and bibliographic description, in others annotations are additionally provided, while in the abstract records all or most of them are accompanied with essays on primary documents.

Any bibliographic manual can be considered in various aspects and, accordingly can be referred to this or other type. It is important to learn how to consider the different features of bibliographic manuals not in isolation, but in their relationship.

Bibliographic manuals can have an independent publishing and

graphic form, and can be a component of some non-bibliographic publication (book, magazine, newspaper) or serve as an addition to it.

Bibliographic manuals can be non-periodical, one-time (in a form of books and brochures, leaflets and booklets, single-volume and multi-volume publications, series) and periodic (in a form of weekly, monthly, quarterly, semi-annual publications: newspapers, magazines, periodical collections of bibliographic content). Many of them are subscription editions.

Bibliographic publications in the card form are printed cards for books, articles from newspapers and magazines, reviews that are used in libraries to organize traditional catalogs and card files.

A printed book card contains a bibliographic record that includes a title, bibliographic description, subject section, classification indices, author's sign, as well as special (official) information – the serial number of the card in the set, inventory and registration numbers.

A printed card for the article contains an analytical bibliographic description, subject section, classification index, special information, among which it is very important to indicate the date of the card's preparation for release.

Cards printed for reviews contain combined bibliographic records – for works that are reviewed and for reviews devoted to them, published in newspapers and magazines. Bibliographic publications are dependent forms of bibliographic manuals: bibliographic lists, indexes and reviews. Being a component of other publications, they usually have the same target and readership assignment and reflect the same theme as the publication in which they are published [2].

6.6. Technique of working with special literature

The material that follows is presented in accordance with generalizations formulated by G. Birta on the methodology of organizing a scientific research [2], as well as the experience accumulated by the author of this manual in training a highly qualified scientific staff.

Scientific researches are based on scientific achievements, so it is no accident that every article, brochure, book includes links to previous studies.

The report, abstract, course (diploma) work should be related to information materials and contain a review of the literature on the subject of the study, and this requires researcher to work hard with scientific literature.

To be able to work with a book means to understand its structure quickly, to correctly evaluate and fix in a convenient form everything that seems interesting and necessary for holding a scientific research.

It is believed that studying of literature on the chosen topic should begin with general works in order to have an idea of the main issues close to the topic of research, and then go on to a search for new editions of special literature.

Moreover, at the first stage, one should cover as many sources as possible, and then gradually "screen out" unnecessary publications. However, there is a more productive technique according to which from the very beginning of the work the circle of sources is purposely limited, and the study begins precisely with those that are directly related to the topic of scientific research. Experience shows that an excessive range of information sources significantly slows the solution of a particular scientific problem.

Correct work organization is especially important, as it should correspond to the main idea of the scientific organization of labour – the maximum effect with spending minimal time. This means that in any work it is necessary to work out such methods that would allow to perform the same amount of work in a shorter period of time. To learn the rational use of your time budget is equally important for both the student and the scientific researcher.

It is advised to focus on the following: before starting to work, one should focus on subject studies. To do this, it is proposed to be distracted from all current worries and switch to the content and purpose of the work performed. Focusing of one's attention helps to keep their workplace in order.

After that, one should immediately give attention to the intense load, the habit of a slow pace at the beginning of work is harmful.

During the work, it is recommended to decisively decline all side thoughts and associations, think only about work. At the same time, favorable conditions for concentration are gradually created.

The stages in studying the sources of scientific information can be divided into: general acquaintance with the solution of a scientific problem; quick review of the selected literature and its systematization in accordance with the work's content and the sequence of study, processing; reading according to the sequence of material placement; selective reading of individual parts; writing out the necessary material for formation of the text

of research work; critical assessment of recorded information, editing and final writing as a fragment of the text of a scientific work (article, monograph, course (diploma) work, dissertation, etc.).

A slightly different method of working out literary sources is also possible. A sheet of paper is divided in half by a vertical line. On the left side one records the content of the read material, and on the right – their comments with highlighting of particularly significant definitions, formulations. It is necessary to indicate not only the bibliographic description of sources, but also the codes of subject headings that correspond to the section of scientific work; it is not by chance that it is always said about the need to read "with a pencil in a hand". Keeping records when reading literature is obligatory, it contributes to a better assimilation of the information. The main thing is to fix the idea about a specific source of information and, if possible, to predict the future need for the data contained in the book and, within reasonable limits, to take from it everything that may be needed in further work.

There are practical techniques that are aimed at shortening of time for making notes during reading and their subsequent ease of use. If the book belongs to the person, then notes can be made directly on the margins, with one's own system of conditional signs.

Usually, three groups of signs are used: signs of individual expressions in the text (underlining, exclamation marks); signs of misunderstanding, denial – wavy underlining, question marks, words as "What for?", "How?", "Where is it from?" or a link to another page of text; addition signs – to record additional information, reader's suggestions (dotted lines, notes like: "see also...").

If the book belongs to others or to library, of course, making some notes in it is a sign of the lack of culture. In this case one needs to use records in workbooks, or even better – on separate sheets or cards.

Usually only the most significant information from this book or article and what causes a certain professional curiosity and personal interest is written out.

During the process of processing sources, only scientific facts should be selected. A Scientific fact is an element that underlies scientific knowledge, reflects the objective properties of processes and phenomena: novelty, accuracy, objectivity and reliability. It is necessary to select the most authoritative sources containing the latest data, accurately indicate

where the material is taken from.

A special form of factual material is quotations – this is a studied passage of a work, someone's statement that organically fits into the text of a scientific work as confirmation or denial of a certain opinion. It requires special diligence, because any carelessness in data extracting is returned by the loss of additional time to clarify the author's opinion. It often happens that an individual's thoughts are transmitted in the researcher's own words without literal using of quotes.

Basing on their content, the author carries out analysis and synthesis, builds a system of substantiated evidence.

Quotes are also used to confirm individual judgments that the researcher makes. When quoting sources, the following rules should be followed:

– the text of the quotation begins and ends with quotation marks and is given in the grammatical form in which it is presented in the source, with preserving the features of the author's spelling. Scientific terms that are proposed by other authors are not highlighted in quotation marks, except for those that caused general controversy. In these cases, the expression "so-called" is used;

– citation should be complete, without arbitrary reduction of the author's text and without distortion of the author's thoughts. Skipping of words, sentences, paragraphs when quoting is allowed by three dots. They are placed anywhere in quotes (in the beginning, in the middle, in the end). In case there is a punctuation mark before or behind the skipped text, then it is not saved;

– each quote is obligatorily accompanied by a reference to the source, a serial number is placed according to reference number with highlighting in square brackets;

– in case of indirect citation (retelling a thought), which gives a significant saving of the text, one should be extremely accurate in presenting the author's opinions, specific about regarding the assessment of their results and give appropriate references to the source;

– quotes should organically "fit" into the context of scientific work.

Review of literature on issues of interest is quite a difficult job when performing a scientific study. To avoid primitivity and mistakes in the literature analysis, one should carefully systematize the scientists' views in the following order: the essence of the phenomenon, process (position of

several authors coincides in such and such aspects); what makes a content of this process or phenomenon (its components, chains, stages, stages of development); the scientists' views about the ways of solving this problem in practice (who and what offers); what difficulties identified in previous studies occur in practice; what factors, conditions for the effective development of the process or phenomena in this area are highlighted by scientists.

The review of sources makes it possible to determine a new direction of scientific research, its importance for development of science and practice, the relevance of the topic.

A review of literary sources makes it possible to identify the researcher's professional competence, his/her personal contribution to the development of the topic in comparison with already known studies. Literature studying is carried out not for borrowing a material, but for thinking over the information found and developing one's own concept, which can become the author's independent publication. [2].

6.7. Digital search for scientific information

The material that follows is presented in accordance with generalizations formulated by S. Gladkyi on the methodology of organizing a scientific research [17], as well as the experience accumulated by the author of this manual in training a highly qualified scientific staff.

On the Internet there is a huge amount of information, most of which is organized disorderly and distributed between many sites. A significant number of organizations (including official ones) place regulatory information on their own sites. Therefore, for effective search for information on the Internet, there are special software programs called search engines. They use search robots to collect information from sites and further efficient processing using a system similar to building a citation index of scientific literature. Currently, the main search engine is http://www.google.com

The advantages of the Google search engine are the accuracy of searching for certain phrases, a large amount of indexed information (several billion indexed pages), an ability to translate the user's requests into another language using the accompanying service http://translate.google.com/. During the search, you can configure additional basic filters, for example: "Pages in Ukrainian".

Searching for scientific information on the network is a time-consuming and complex process. The problem most beginners face is the lack of skills in differentiating authoritative and non-authoritative sources.

Authoritative sources for scientific work are the works of scientists, monographs, articles. Such sources always have a reference to the author and the publication (bibliographic description or specified collection name, number, pages).

Non-authoritative sources include: abstracts, courseworks, diplomas, journalistic articles, materials that do not specify the author and source data.

In order to master the methods of information search, it is advisable:

1. Use different information search engines (Google, META, Yahoo! and others). Preference can be given to Google, as well as specialized systems for searching scientific information Google Scholar – http://scholar.google.com.ua/. Search engines for scientific information: BASE: Bielefeld Academic Search Engine – one of the world's largest search engines, specialized in searching for open access scientific documents on the Internet. The BASE operator is the library of the Bielefeld University (Germany). BASE collects, normalizes, and indexes repository server data using the "Open Archives Initiative Protocol for Metadata Harvesting" (OAI-PMH). In addition to OAI metadata, BASE indexes selected websites and local library data. All these together can be searched through the same interface. Google Scholar is a system focused on searching scientific literature in various fields of knowledge and various sources. OAIster is a built catalog of millions of records that provides open access to digital resources. OAIster "collects" description information (metadata) from the collection of open access around the world using OAI-PMH (the Open Archives Initiative Protocol for Metadata Harvesting). Today, OAIster includes more than 25,137 million records, represents digital resources from more than 1,157 participants.

SCImago Journal & Country Rank is an analytical portal that presents scientific indicators for journals and countries. The analysis is based on the information contained in the Scopus® (Elsevier B.V.) datebase.

WorldWideScience.org is a global scientific search engine that searches for information on national and international scientific databases and portals.

During the search, one should formulate queries based on keywords,

view a significant amount of materials, and not be limited with the first in the selection list. It should be taken into account that abstracts are the most popular on the Internet, and scientific articles from collections can be found only if you carefully look for them (invest your time).

2. One should learn how to use internet catalogs. Working with them also requires skill, but if you formulate the request correctly, you can make a presentable list of sources. Further, already knowing names of the researchers and the names of their works, you can contact the libraries, look if for not the books themselves, then for quotes from them in the works by other authors. In addition, you can order the relevant literature in scanned form (such service is provided by the Vernadsky National Library of Ukraine).

3. It is advisable to work with collections of scientific papers on the Internet. For this purpose, collections of a certain direction are selected, their content is studied, articles that are close to the topic of research are selected.

4. One can study collections of scientific works in the electronic library of NTU "KhPI".

The main library bibliographical resources for scientific and juridical researches: 1) Verkhovna Rada of Ukraine: Parliamentary media – access mode: https://www.rada.gov.ua/newscenter#press_review 2) Vernadsky National Library of Ukraine – access mode: http://www.nbuv.gov.ua; 3) Yaroslav Mudryi National Library of Ukraine – access to electronic resources: https://nlu.org.ua/ 4) Repository of NTU "Kh PI": website – access mode: http://repository.kpi.kharkov.ua [17]

Test questions for self-checking on topic 6

1. Reveal the content of the main approaches to classification formulation of the category of "document". How exactly are the general and special functions of documents specified?

2. What kinds of documents do you know? Provide a general description of each of the varieties of scientific documents.

3. What are reference documents used for? What types of reference documents exist? Determine the place and the role of reference documents in the ensuring of scientific activities.

4. What are educational documents used for? What types of educational documents exist? Determine the place and role of educational

documents in facilitating the scientific activity of the applicant for higher education.

5. What types of regulatory documents exist? Determine the place and the role of regulatory documents in the ensuring of scientific activities.

6. What kinds of standards do you know? Determine the place and the role of standards in ensuring the scientific activity of the scientist.

7. What is a terminology system and what exactly is it used for? Reveal the content of the main stages of the terms analysis.

8. What is content analysis and what is it used for in a research? Provide characteristics of each of the varieties of content analysis.

9. Reveal the content of the method of expert evaluation and explain the features of its use within the framework of scientific research.

10. For what purpose is an expertise of scientific research carried out and what requirements are put forward to experts? By what criteria can an examination of the process and results of scientific research be carried out?

11. Reveal the content of the bibliographic method and explain the features of its use in scientific research.

12. What information resources are the most available for use by the researcher in the scientific search? Evaluate potentials of each of the varieties of information resources to support a scientific research.

13. What are bibliographic products and how exactly can they be useful for a researcher during a scientific search? What varieties of bibliographic products have the greatest potential to provide scientific research?

14. Reveal the content of stages in the technique of working with special literature. What rules should be followed when quoting the opinions of other researchers?

15. What are the requirements for reviewing literary sources?

16. Reveal the peculiarities of using the potential of digital search for scientific information. What potential does Google Scholar have for organizing and conducting a scientific research?

17. Evaluate the potential of electronic search engines known to you for information support of scientific research.

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The manual offers an exhaustive in its content and logical in the sequence of presentation model c mastering the problematics of theoretical and methodological basics of development and holding a researcl The manual conceptualizes the views of domestic and foreign scientists on the theory and practice of th researcher's use of scientific approaches, principles and methods in the system of methodological support c scientific-research work. In addition, the manual highlights the problematics of the place and role of scienc in assuring the mankind's socio-political and socio-economic development, as well as the issues c formulating the content of the basic categories of the methodology for organizing scientific researches.