METHODOLOGY AND ORGANIZATION OF SCIENTIFIC RESEARCH

**Guidelines for independent work
of protgraduate (third)
educational and scientific level students**

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The main provisions regarding the organization and implementation of
independent work are presented. Guidelines for performing independent work in
accordance with the program of the academic discipline, a description of the
structure of the discipline, a thematic plan, qualification requirements for students,
a description of the technology for performing tasks for independent work, a list of
references, and appendices containing reference information, are given.
For postgraduate (third) educational and scientific level students of all
specialties.

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General methodological provisions for performing independent work

In the context of the development of the information economy or "knowledge economy", the importance of research skills and abilities is obvious, which are now necessary in any professional activity of a person.

The subject of teaching the academic discipline is methods of scientific research, as well as theoretical and methodological foundations of the organization of scientific and research activities.

The purpose of teaching this academic discipline is formation and development of the ability to competently apply methodological principles and methods of scientific activity. To achieve the goal, the following main **tasks have been set.**

● to form graduate students' holistic theoretical understanding of the general methodology of scientific creativity;

● to familiarize students with the requirements for scientific research, the basics of planning and organization of scientific research;

● to equip graduate students with a toolkit of scientific methods that can be usefully applied in the process of researching complex systems, economic, pedagogical, informational, etc.;

● to familiarize students with the requirements for the design of various scientific and research work;

● to develop graduate students' skills of effective work with information sources;

● to transfer to postgraduate students a set of knowledge and skills that will help them in the future to carry out activities of exploratory and creative nature in the process of fulfilling their professional duties.

The multifaceted and creative nature of scientific and research activities means that obtaining even basic research competencies within classroom lessons requires appropriate preparation of the student for this type of activity.

The aforementioned contradiction between the need to obtain complete knowledge of scientific research methods for the successful implementation of further professional activities and the limited classroom workload of postgraduate students determines the ensuring and developing (with new

knowledge) nature of independent work within this discipline, the total volume of which is 130 hours.

Thus, it is determined that the performance of tasks for independent work should provide:

first, supporting students in acquiring basic research competencies in classroom lessons;

second, formation of students' new research competencies within the topics covered in lectures and laboratory classes.

Therefore, **the main goal of extracurricular independent work** in the academic discipline is to provide the opportunity to obtain basic and expand the acquired research competencies.

Taking into account the specified nature and specificity of out-of-classroom independent work (a type of activity that forms students' new knowledge without the direct participation of a teacher), these methodological recommendations contain a plan and program for independent work in the academic discipline, which allow the student to obtain a generalized idea of the content of independent work and plan implementation of this work in accordance with methodological requirements.

The main types of out-of-classroom independent work of students are:

- solving problems under given conditions;
- performing creative tasks on selected topics;
- study of the indicated literary sources;
- development of maps of key concepts and issues on the topics under consideration;
- preparation for lectures;
- preparation for seminar classes;
- preparation for participation in scientific and practical conferences;
- preparation for tests and surveys.

The description of each of the tasks for independent work of students (IWT) set out in these methodological recommendations provides (in addition to didactic analysis and identification of relevant IWT elements) the following general implementation technology:

- study and systematization in the form of expanded memory cards of the main issues and concepts of theoretical material on a specific topic from recommended sources of literature;

- completing a task (or solving a problem) for independent work that requires knowledge of theoretical material;
- preparation for lectures, practical and seminar classroom sessions;
- implementation of other types of extracurricular Independent student work (which are provided for in the Independent student work program and schedule);
- preparation and submission for verification of a comprehensive report on the completion of the task for independent work in the form of an Individual homework; answers to test questions in practical classes and completion of test papers.

Completion of tasks for independent work in the academic discipline **will be evaluated according to** the following **criteria**:

- completeness of consideration of the requirements for completing the task;
- the logic of the presented material and the correspondence of its structure to the content elements provided for in the task;
- completeness, consistency and independence in solving specific tasks and achieving the goal of the task;
- the presence and completeness of consideration of key concepts (definitions, problems, terms, varieties, related concepts, etc.) of the subject area of the task;
- the presence and validity of the student's current critical conclusions;
- the presence and validity of the student's final conclusions;
- processing additional sources to those specified in the recommendations;
- illustrating the material studied by providing their own examples and graphic material.

For the convenience of students in receiving feedback from the teacher regarding the verification of completed tasks, obtaining an objective assessment of the student's answers to questions for self-diagnosis, and providing additional explanations on the topic of independent work, there are two ways to submit the completed task to the teacher for verification.

First, these materials can be transferred directly to the teacher in printed form.

Second, the specified materials can be transferred to the teacher indirectly – through the personal educational system (PES) (Table 1).

Table 1

Competencies and learning outcomes formed by the academic discipline

Competencies	Learning outcomes
1	2
The ability to demonstrate a systematic understanding of the field of study, mastery in terms of skills and research methods used in this field	The ability to choose and effectively use modern research methodology; analyze, evaluate and compare various theoretical concepts in the field of research and draw conclusions; critically analyze, evaluate and compare different scientific theories and ideas; demonstrate systematic understanding of the field of study and the quality and effectiveness of the selected scientific methods
The ability to plan, develop, implement and adjust the complex process of scientific research	The ability to organize, plan and implement the process of scientific research; analyze and process information from various sources; conduct independent scientific research, characterized by academic integrity, on the basis of modern theories and methods; generate their own new scientific ideas, formulate the problem, research topic, object, subject and objectives of the study; conduct patent search and demonstrate experience in transmitting scientific information using modern information and innovative technologies; draw up applications for grants and use project management methods in the management of scientific research
The ability to contribute with their own original research to the expansion of the boundaries of the scientific field that may merit publication at the national or international level	having skills to participate in scientific events, fundamental scientific domestic and international projects; the ability to justify the relevance of the topic, scientific novelty and practical significance of the results obtained; apply the modeling method in scientific research; apply empirical and theoretical research methods; apply the methodology of studying complex systems

Table 1 (the end)

1	2
The ability to critically analyze, evaluate and synthesize new and complex ideas	The ability to conduct a professional and comprehensive analysis of problems in the relevant area; conduct an examination of scientific projects and research; master the techniques and methods of the system approach and system analysis; use multi-paradigm and interdisciplinary methodological approaches in scientific research
The ability to communicate their knowledge and achievements to colleagues, the scientific community and the general public	The ability to communicate their knowledge and ideas to the scientific community, expanding the boundaries of scientific knowledge; apply the skills of public speaking at international scientific forums, conferences and seminars; defend scientific results in the form of discussion as a form of scientific communication; publish research results in articles, monographs, dissertations
The ability to contribute to the development of a knowledge-based society	The ability to use the mechanism of implementation of scientific developments in practical activities; plan and predict their further professional development; use and form the norms of interaction in the scientific community and the scientific ethics of the scientist-researcher; develop their own creative potential and methods of activating scientific creativity

1. Research competencies of postgraduates studying the academic discipline

Before starting to study the academic discipline, students must get familiarized with the subject area of their future professional activity, that is, they must take basic courses in the cycle of professionally oriented disciplines in their specialty.

As a result of completing tasks for independent work within the academic discipline, students should **know**:

principles of organizing scientific activity and scientific research;

algorithms for formulating the topic, problem and goal of scientific research;

principles of systems thinking in scientific creativity;

fundamentals of empirical research methodology;

fundamentals of the methodology for studying complex systems;

methods of theoretical research;

mathematical modeling methods;

characteristics of project forms of scientific research;

principles of organizing scientific work;

technology for presenting, protecting and implementing the results of scientific research.

As a result of completing tasks for independent work, students should be **able to:**

effectively organize research activities;

formulate the topic, problem and goal of scientific research;

identify the object and subject of research;

develop a plan for conducting scientific and research work;

perform analysis of complex systems;

conduct scientific research using empirical methods;

process empirical data and build mathematical models based on them;

formulate hypotheses, develop classifications, obtain and substantiate scientific results;

effectively use existing information resources.

The schedule for independent work is given in the rating plan, which is posted in the work program of the discipline.

Methods of forming information space. Mental maps.

As the main means of forming an information space, it is recommended to choose mental maps as a special tool for reflecting the thinking process and structuring information in visual form.

Knowledge map. Synonym series:

- mind map,
- knowledge map,
- memory card,
- thought patterns.

Mind maps are a special tool for displaying the thinking process and structuring information in a visual form (Fig. 1, 2).
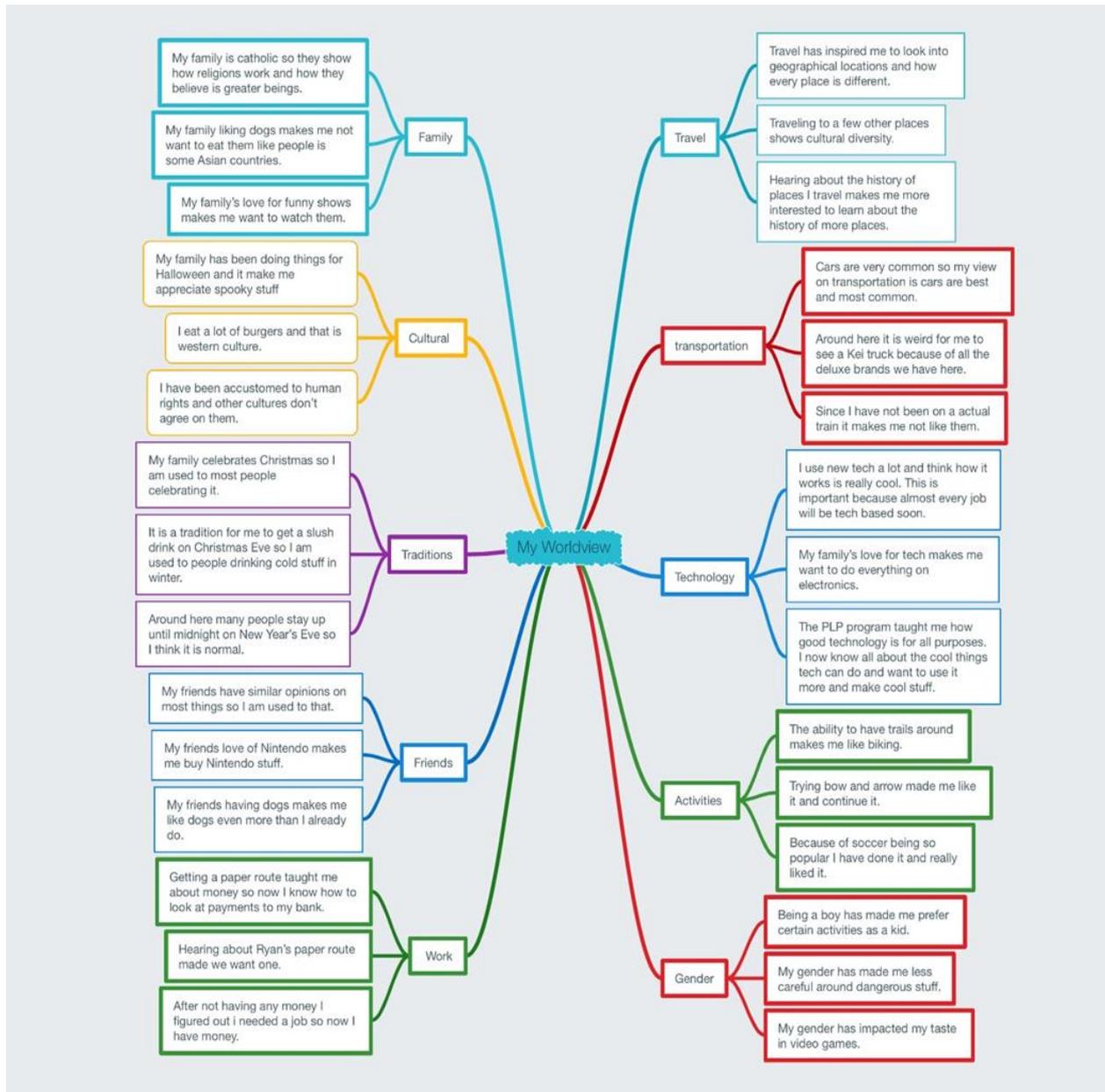
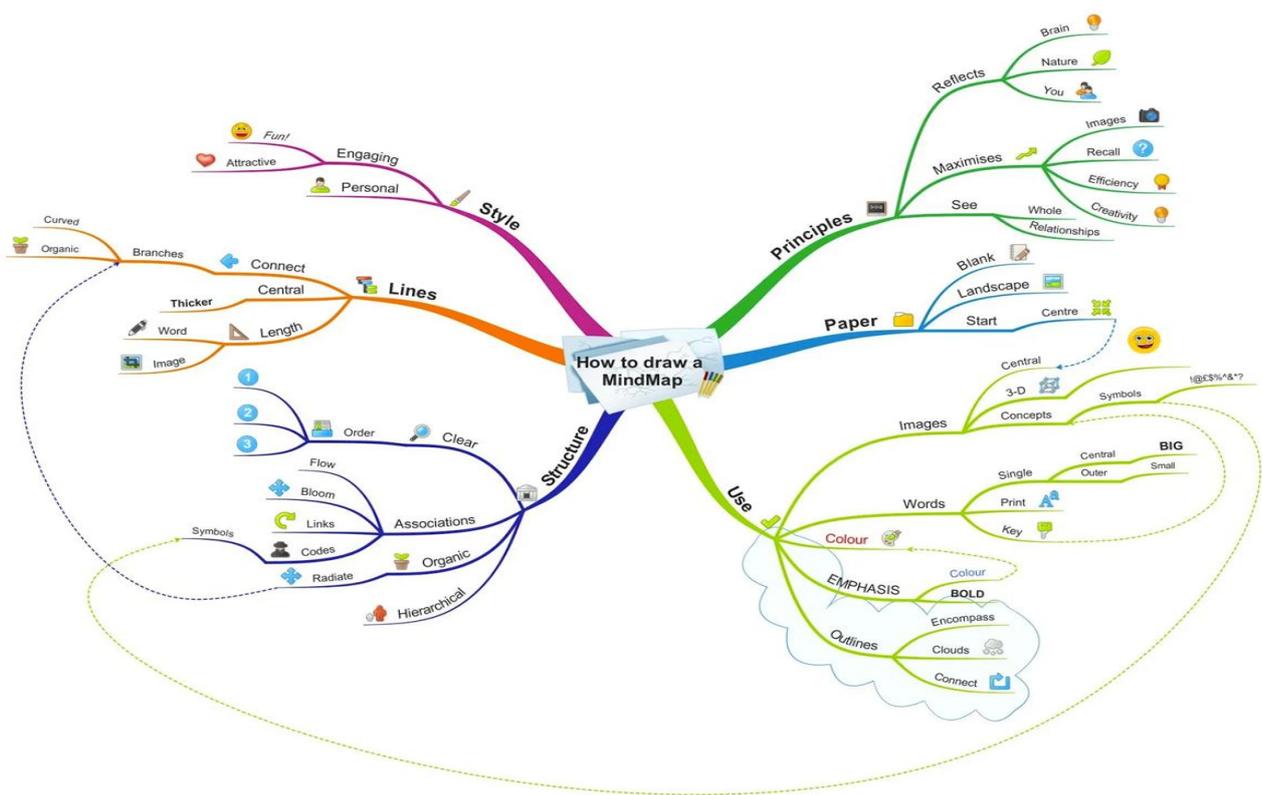Fig. 1. **An example of mind maps, which shows their benefits**

Fig. 2. **The process of building memory cards**

Rules for building mind maps are as follows.

• Visual imagery maps are constructed that create a deep emotional impression.

• Logical connections between ideas are indicated.

• The main ideas of the information received become more concise, clear and understandable.

• They use various graphic tools (pictures, symbols, arrows, different fonts). They are all made in different colors.

• On the screen, the sheet is placed in landscape orientation, thereby allocating more space for the drawing.

• The main idea is indicated in the center of the page.

• Using multi-colored markers, draw lines from the main idea (certain parts of the main topic).

• Each line is signed with a keyword.

• The outline can be detailed, that is, lines can be added.

• Keywords are indicated in capital letters.

- The map should have many pictures and symbols.
- Arrows will show connections between ideas (Fig. 3).

Fig. 3. **The main stages and rules of brainstorming**

Project support.

With the help of mind maps, it is very easy to support projects of various scales and complexity, keep everything under control, quickly adapt to current changes, manage resources and see weak points in the project.

Content module 1
Methodological foundations of scientific research

Topic 1. Science and scientific research

Science as a way of knowing the world. Functions of science. Classification of sciences. Problem, hypothesis. The concept of scientific theory. Standard model of scientific theory. Structure of scientific theories. Methodological and heuristic principles of theory building. Main functions of scientific theory. Scientific paradigm. Knowledge and science as a way of knowing the world. Concepts of scientific knowledge. Science (exploratory,

fundamental and applied) and scientific research (empirical, theoretical, production). Theory. Concepts. Operations with concepts. Concepts of scientific school, normal science, scientific revolution.

Practical component.

Objectives of the task:

● to consolidate the acquired knowledge about the tasks and functions of science;

● to gain experience in identifying general objectives of scientific research.

Task 1.1. Based on the studied material, construct a map of key concepts and questions on the topic "Science and Scientific Research".

Any scientific research is aimed at solving one or more problems. Let us recall that the main problems of science include:

● **description of phenomena** of reality;

● **systematization** of phenomena of reality;

● **explanation of phenomena** of reality;

prediction of phenomena really.

Let us consider the well-known hierarchy of needs proposed by Abraham Maslow [9]. He believed that human needs have a hierarchical structure of 5 levels and at any given moment in time, a person will strive to satisfy the need that is more important or stronger for him. *Physiological needs* (the lowest level needs) are necessary for survival. *Safety needs. Social needs* (needs for belonging, friendship, love). *Esteem needs* include the needs for personal achievement, respect from others, recognition. *Self-expression needs*, self-actualization – the need to realize one's potential.

Analysis of Maslow's hierarchy of needs allows us to draw the following conclusions:

● It is obvious that this hierarchy **solves the problem of systematizing** human needs: needs are grouped and ranked in terms of their importance.

● At the same time, Maslow's hierarchy is **an attempt to explain** why people are motivated by different interests in different situations. In other words, this scientific result solves the problem of explaining the phenomena of reality.

● Moreover, **using Maslow's theory, it is possible to predict** a person's behavior based on information about which of his needs are satisfied and which are not.

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● Thus, the hierarchy of needs proposed by Abraham Maslow **solves the task of describing, systematizing, explaining, and predicting phenomena**.

● It is useful to subject the results of all research to such an analysis. Correctly defining what tasks the scientific research is solving allows us **to correctly determine the scope of application of its results**.

Task 1.2. Find a description of the results of scientific research in literary sources. Determine what tasks (description, systematization, explanation, or prediction of phenomena of reality) each of the results is aimed at solving.

Hypotheses: justification and characteristics.

An example of a general explanatory hypothesis.

● The topic of the research, within the framework of which the hypothesis is formulated. Organization of accounting in Ukraine.

● **A hypothesis.** The majority of accountants at domestic enterprises are women, due to the fact that women are more patient and meticulous, and are also less inclined to change jobs.

● **Justification**. Such qualities of women as patience and pedantry, as well as the lack of inclination to change jobs, lead to the fact that, on the one hand, women themselves are satisfied with the painstaking work of an accountant, and on the other hand, this state of affairs suits management. A man prefers to "grow" all the time, he is more inclined to change jobs, while a woman, having achieved the position of chief accountant, can become a support for the manager for a long time. The constant change of chief accountants will not benefit any organization.

● **Characteristics of the hypothesis**. This hypothesis is general and explanatory. It can be used in the process of human resources management of enterprises, in the organization of training of accountants, as well as in the development of an automated workplace of an accountant. Verification of the formulated hypothesis can be carried out using only the methods of questionnaires and mathematical statistics.

An example of a partial hypothesis.

● **The topic of the study**, within the framework of which the hypothesis is formulated. Accounting for the interaction of enterprises "Alpha", "Beta" and "Gamma" with consumers of products.

● **Hypothesis:** The volume of product sales at the enterprises "Alpha", "Beta" and "Gamma" will increase if consumers are stratified (i.e. grouped) according to the stages of decision-making regarding the purchase.

● **An example of a single hypothesis.**

● **The topic of the research**, within the framework of which the hypothesis is formulated. Formation of the development strategy of the enterprise "Delta".

A hypothesis. The successful development of the Delta enterprise over the next 10 years will be guaranteed if this enterprise becomes a client of the business incubator.

Justification. The Delta enterprise belongs to small enterprises, and according to statistics, of the total number of newly created small enterprises, only 20 % remain after 2–3 years. At the same time, among enterprises that go through a business incubator, the proportion is the opposite: 80 % survive and become well-developed firms, and only 20 % close. Since the staff of the Delta enterprise has a powerful intellectual potential, it can be assumed that after leaving the business incubator this enterprise will successfully develop independently.

Characteristics of the hypothesis. The considered hypothesis is single and descriptive-predictive, as it establishes a connection between the participation of the Delta enterprise in the business incubator and the development results of this business entity.

Task 1.3.

1. For your scientific research topic, formulate 2–3 working hypotheses about the properties, relationships, and causes of phenomena related to the relevant subject area.

2. Offer justification for the formulated hypotheses.

3. Identify the type of each hypothesis.

4. Describe the purpose of hypotheses (in which areas of science and practice can information about the predicted patterns be used).

5. Describe how the validity of each formulated hypothesis can be tested.

Analysis of concepts in the field of study. Consider the example of analyzing the concept of controlling given in Table 2.

Table 2

Main approaches to defining the concept of controlling

Author	Definition	Main function	Source
P. Horvath	Result-oriented support function for the coordination of all management subsystems	Coordination	[134]
L. Malysheva	Management methodology, a set of organizational, mathematical and information models that ensure the most optimal management of the system	Coordination	[71]
L. A. Sukhareva, S. N. Petrenko	Coordination of the management system at the enterprise	Coordination	[122]
J. Weber	An element of social system management that performs the main function of supporting management in solving the general task of coordinating the management system (with an emphasis on planning, control and information tasks)	Coordination	[104]
D. Khan	System of integrated information support, planning and control of enterprise activities	Information support	[134]
E. A. Anankina, S. V. Danylochkin	A holistic concept of economic management of an enterprise, aimed at clarifying all the chances and risks associated with making a profit		[59]
A. M. Karminsky, N. I. Olenev	A system that provides a methodological and instrumental basis for supporting the main management functions: planning, control, accounting and analysis	Base for management functions	[58]

Task 1.4. Perform an analysis according to the given scheme for two or three key concepts of your dissertation research.

Task 1.5. Determine whether the following definitions are correctly formulated. If not, what requirements do they violate?

● A polyvaccine is a medical product.
● An information system is DSS or other information system.
● A weed is an uncultivated plant.

● Quotation marks are paired punctuation marks used to highlight direct speech.

● Scotland is a country where stingy men wear their wives' skirts.

● Algebra is a branch of mathematics.

Task 1.6. Find out which of the listed features form the content of the corresponding concepts, and which do not, and why:

1. geometry is:

1) a section of mathematics;

2) a branch of mathematics that studies spatial relationships, shapes, geometric bodies, and their generalizations;

3) a section of mathematics taught at school.

2. Microeconomic research is:

1) research into the economic activities of private entrepreneurs;

2) economic research at the level of individual economic units.

3. An island is a piece of land that:

1) is inhabited by people;

2) has some area;

3) is surrounded on all sides by the waters of oceans, seas, lakes or rivers.

4. A square is a quadrilateral that has:

1) equal mutually perpendicular diagonals;

2) a certain area;

3) equal sides and right angles.

Task 1.7. Are the concepts in the following examples correctly generalized (justify each statement)? If not, give a correct generalization.

1) people's deputy – Verkhovna Rada;

2) Kharkiv region – Ukraine;

3) criminal – robber;

4) tree – forest;

5) letter – word;

6) proton – elementary particle;

7) Atom – molecule;

8) numeral – part of speech;

9) battalion – regiment.

Task 1.8. Generalize the concepts: capital, simple sentence, choleric temperament, rye, Korobchyne village, car, textbook.

Questions for self-diagnosis

1. Define the essence of science as a way of knowing the world. Define the concept of science.

2. Who is the subject of scientific research?

3. Describe the types of hypotheses.

4. The essence of the scientific problem.

5. Identify and characterize the types of operations with concepts according to various classification criteria.

6. Name the components of the standard model of a scientific theory.

7. Describe the main functions of a scientific theory.

8. Describe the main classifications of sciences. Why are they needed?

9. What are the fundamental differences between the natural and social sciences?

10. Describe the main functions and tasks of science.

11. What is the essence of methodological and heuristic principles of theory building?

12. Describe the models of explanation and classification of the main paradigms of science.

13. Define the concepts of scientific school, normal science, and scientific revolution.

14. What opportunities do multi-paradigm and interdisciplinary methodological approaches open up in scientific research?

15. What is the specificity of scientific thinking?

16. Give a brief description of the stages of the development of science.

17. What phases does the development cycle of any mature science include?

Topic 2. Scientific method. Methodology of scientific research

Scientific method. Subject of scientific methodology. Stages of scientific research work. Correlation between the goal and objectives of the research. Main elements of the methodology of scientific research. Statement of the research topic, problem, goal and objectives of the research. Relevance of the topic. Functions of the hypothesis. Scientific novelty. Practical significance

of the work, analysis of interested organizations and individuals. Structural model of the subject area. General characteristics of scientific methods. Classification of scientific research methods. Technology of scientific research. Research methodology. Research results.

The purpose of independent work: to master the competencies in formulating the provisions of the scientific novelty of the research result based on the consideration of the levels of scientific novelty of the research results in the field of your chosen direction of training and methods of their confirmation.

The object of independent work is the scientific result of research in your chosen field of study.

The subject of independent work is recognized as the level of scientific novelty of research results and methods of their confirmation.

Methods used to perform independent work: analysis and synthesis, comparison, induction and deduction.

As a result of independent work, the student develops the following **research competencies**: to correctly formulate the provisions of the scientific novelty of the research result, determine their level, and confirm scientific novelty by the methods intended for this purpose.

Study the theoretical material on the topic provided in the textbook [2, p. 110–179] and a fragment of an analytical article devoted to the issues of formulating scientific novelty [9], which is given further in the text of the guidelines.

"In economic works, three types of proposals are most often put forward: models (mechanisms), methods (technologies), and concepts.

As the analysis of the formulas for the novelty of defended candidate and doctoral theses in the field of economics shows, among the research results put forward for novelty, applicants for academic degrees indicate either goals or a new positive effect, while it was necessary to characterize the features that ensured the achievement of these goals and a positive effect.

For example, in the scientific novelty section of the doctoral dissertation abstract, the applicant puts forward the following construction as new: "A modified concept of economic fluctuation and a developed model of the development of the regional economic complex according to the bifurcation potential, which takes into account the structural unevenness of

regional development, the potential and speed of changes in reproductive proportions".

Here, two types of proposals are involved in one phrase: concept and model. The disadvantage of the author's justification of novelty is, first of all, that neither new features of the concept nor new features of the model are presented, which distinguish them from the known ones. Instead, the advertisement is given as a characteristic (designation) of a positive effect: "which takes into account the structural unevenness of regional development, the potential and speed of changes in reproductive proportions". It would be appropriate to indicate new features that make it possible "to take into account the unevenness, potential and speed ...".

In the same dissertation, the following formulation is presented for defense as new: "A new methodology for indicative management is proposed that ensures sustainable regional development". This formula contains the name of the object being protected (methodology), a characteristic (designation) of the positive effect "ensures development", but there are no distinctive new features by which the positive effect is achieved, that is, what specific new actions ensure sustainable regional development.

An example of a dissertation on the topic "Formation and regulation of the structure of the national economy: conceptual and methodological aspects". In it the following novelty formula is given: "the differentiation of sectoral regulation policy within the real market sphere is justified". This formula makes an advertising statement that "policy differentiation is justified", but does not reveal what exactly this justification and the differentiation itself consist of, and how it differs from existing approaches, that is, the novelty of the author's contribution is not revealed. Further in the same dissertation, as a new contribution of the author, it is stated that "the principles of formation and financing of sectoral investment programs with state participation are revealed". It is unlikely that the "principles of formation … with state participation" were known and disclosed earlier. From the above formula, it is not clear that it was unknown before the appearance of the dissertation what specifically the author revealed, what distinctive features he introduced and what positive effect they provide. It turns out that the applicant claims for authorship of the disclosure of all the principles of formation … with state participation.

According to the doctoral dissertation on the topic "Methodology of identifying reserves of economic development and formation of internal

investment resources of an enterprise", the following formulas of novelty are given: "Concepts, mechanisms and technologies for identifying reserves and forming internal investment resources of an enterprise are proposed", "An economic category of economic development reserves has been formulated".

It is also advertising without disclosing the essence and novelty of what the author has done. It will be unclear to the next researcher what distinctive features characterize this author's concept, what mechanisms have been developed and how they differ from those that already existed, what new things have been introduced into the technology, how the formulation of the economic category "economic development reserves" differs from similar concepts.

Let us consider the features of the above economic solutions (model, methodology, concept) and, taking into account the defended dissertations, give examples of constructing novelty formulas.

1. Model, mechanism, structure: where is the novelty?

The novelty of the model is characterized by the following features (individually or in combination):

1.1. Blocks and their elements that make up the model (mechanism). This group of features is the most important, because without them it is impossible to imagine a model. The more fundamentally new blocks and their elements in an object, the more prerequisites for identifying significant novelty.

An example: A model of technopark development of the system of innovative support of regional agricultural education and information and consulting agricultural service is proposed, which is distinguished by the introduction of a self-development mechanism that allows it to function and progressively develop in conditions of insufficient funding or absence of budgetary or similar external funding.

Here, as a new contribution to the well-known model, a new block (element) is introduced – a self-development mechanism, which allows for a new positive effect, i.e. progressive development in conditions of insufficient budget funding.

An example: A model of grain and legume crop yield has been developed, a distinctive feature of which is the introduction of natural and climatic factors into its composition.

In this formula of novelty, a new element is introduced into a known model, while the positive effect is not shown (should be in the dissertation).

1.2. Interrelationship of blocks and elements of the model (mechanism).

These features allow us to get an idea of the constructive scheme of the model, since the enumeration of blocks and parts is only a set of elements that make up the object that is submitted for protection as new. By reflecting the connections between the elements, it is possible to reproduce the mechanism proposed in the dissertation in exactly the same way as a particular structure is created from a set of individual building parts by selecting certain relationships. The relationships may be known, they may be new. The novelty of the relationships of blocks and elements in the presence of a new positive effect contributes to the statement of the novelty of the proposal of the author of the dissertation.

For example, one of the works proposes the following formula: "An economic and mathematical model of the labor market has been developed, which is distinguished by the dynamization of the nonlinear dependence between the indicators characterizing the level of unemployment and wages by including elasticity parameters in it, which allowed us to consider the behavioral properties of the labor market depending on the economic situation".

In this formula of novelty, the well-known model is burdened with a connection – dynamization due to the inclusion of elasticity parameters. Here the construction is controversial. On the one hand, a feature of the methodology (method) is dynamization. On the other hand, this dynamization is ensured by the inclusion of elasticity parameters or a connection, or a feature of the model execution. A new positive effect of such a model construction is the determination of the behavioral properties of the market.

1.3. Features of the execution of blocks and elements. One can find models (mechanisms) with identical blocks and elements. Nevertheless, they cannot always be called identical, since the same blocks and their elements may have design features. In economic dissertations, there are often hints at some design features without disclosing these features, while disclosing the features of the design of the proposed author's model may be a sign of novelty.

For example, in one of the formulations of the novelty, a model of modification of the 18-digit tariff grid is proposed, the distinctive feature of which is the expansion of the range of the tariff coefficient to 6.3. In this construction, an expanded range of the tariff coefficient to 6.3 is claimed as a new feature of the construction of the tariff grid model.

1.4. The ratio of sizes of blocks and elements. An unusual value, or ratio of sizes, volumes, which provides a new positive effect, may also be the subject of novelty.

For example, in one of the dissertations, a model of a self-sufficient exhibition complex is proposed, the distinctive feature of which is that the minimum size of the area of exhibition services sold to customers cannot be less than 1000 square meters. In the given formula of the novelty of the model, the lower limit of the commercial area of the exhibition complex is given. The positive effect of such a restriction is that 1000 square meters is the break-even point of the exhibition complex.

1.5. Application for a new purpose. Known mechanisms can find a new application that does not follow from their widely known original purpose.

For example, one of the dissertations indicates as a novelty a model for determining the strategic competitive advantages of a rural area, the distinctive feature of which is the use of an extended SWOT analysis. According to the applicants, the application of SWOT analysis was not known in the available models for forming the strategic competitive advantages of a rural area.

A second example: One of the formulations of novelty offers a model for predicting the level of creditworthiness of potential borrowers, which differs in the implementation of the neural network apparatus. Here one might think that the use of the neural network apparatus was known for other purposes, for its direct purpose. The dissertation council believed that the use of the neural network apparatus occurred for a new purpose, which does not follow from the previous method of application.

2. Methodology: the problem of novelty. Unlike a model (device, structure), a methodology is a way of performing any actions, representing a certain technological process characterized by such new features.

2.1. Actions and operations that make up the methodology. The applicant can introduce new operations into the known methodology that provide a positive effect, or propose a new set of operations. For example, in the formulation of the novelty of the dissertation, the author writes: "A methodology for regulating investment activities in road transport is proposed, the distinctive feature of which is the introduction of a rating assessment, which allows investing in enterprises that contribute to the socio-economic development of the region". Here, the known methodology is supplemented with a new technological technique – a rating assessment is introduced. The

new positive effect of this innovation is the possibility of making better investment decisions.

Another example: A methodology for calculating reserves for increasing grain production efficiency is proposed, which is distinguished by the introduction of a comprehensive, step-by-step economic analysis that takes into account the specifics of agricultural production. In this example, the essence of the proposed methodology is to introduce a new action – a comprehensive analysis. A new positive effect of this innovation is the ability to take into account industry specifics.

2.2. Sequence of actions. The sequence of actions often determines the functionality of a methodological process, because changing the sequence of actions can cause a new positive effect, or can lead to the fact that the process will be impossible to implement at all.

For example, in one of the works, a methodology for distributing the stimulating part of the financial support fund is proposed, the distinctive feature of which is the sequence of actions, in which first the selection of fast algorithms is carried out when discrediting the admissible set, then the filtering of the discretized set is carried out and the provision of an optimal solution that is effective in Pareto and stable in Nash, aimed at increasing the level of budgetary security of municipal entities. The novelty of the methodology declared by the applicant is that, first, one technological method (selection of fast algorithms) is carried out, then another method (filtration).

2.3. Mode of carrying out actions, operations. The methodology may specify conditions and modes of carrying out actions that are new and ensure the achievement of goals and a positive effect.

An example: A formula for a model of an agricultural enterprise is proposed, which is characterized by a 15 percent saturation of the crop rotation with beet crops. Here, a new mode of action is proposed – fifteen percent saturation of the crop rotation.

2.4. Materials, substances, conditions, mechanisms, tools and devices involved in the technological process.

An example here could be a formulation that declares a method of strengthening the material base of an educational institution, a distinctive feature of which is the creation of economic and organizational conditions for the placement of service centers, laboratories, and other marketing structures in the territory of the educational institution, ensuring the constant presence of modern equipment and technologies in the educational space.

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Or, **for example**, a regional budget methodology for strategic planning has been proposed, a distinctive feature of which is the use of a simulation modeling tool.

3. The concept. The characteristics of a concept are similar to those of a methodology, but are more abstract.

3.1. Rejecting some views and turning to another point of view. For example, in one of the works, the novelty is formulated as follows: "Methodological principles and a concept for the development of an infrastructure for innovative support of agricultural education have been developed. Unlike traditional approaches, it is proposed to form this infrastructure not around production facilities or on the basis of production structures, as is done now, but around universities".

Here, the novelty is the rejection of the traditional view and a turn to a new one, taking into account which other structural constructions will be formed.

3.2. Development of known or formulation of new, pioneering views.

For example, in one of the dissertations, the new concept is formulated as follows: "Theoretical propositions on the essence and content of the studied category "regional development sustainability" have been developed based on the use of a reproducible approach, the novelty of which lies in the theoretical justification of the need and possibility of ensuring certain parameters of all reproducible proportions to ensure the sustainable development of the regional economic complex".

This formulation, on the one hand, meets the requirements of the characteristic of the methodology (mode of carrying out actions, operations), because it indicates the modes of carrying out actions "ensuring certain parameters of all reproducing proportions", on the other hand, it does not reveal the novelty of the author's proposal, because it would be necessary to disclose which actions are understood under the term "certain parameters": by whom and how they are defined. The statement proposed by the author contains only a hint that there are some new characteristics. The words "special", "certain", "original" should not be introduced into the formulation of novelty. It is advisable to disclose what these features consist of, what the declared originality and special nature of the characteristics are based on.

An example: A concept for the development of economic potential has been developed, describing the tasks and goals of development, the

difference of which is based on the use of the trends of the organization's evolution in the external environment as a basis for creating the prerequisites for the stable functioning of an industrial enterprise due to its adaptive development.

In this formulation of novelty, known features are indicated before the word "distinction", and new features after this word.

In economic dissertations, along with typical formulas, there are novelty formulas for the following objects of copyright protection: classifications, assessment criteria, assessments, concepts, groupings, principles, categories, indicators, justifications, factors, features, trends, approaches, clarification of the essence or content, measures, and others.

The formulas for the novelty of all these objects are also based on the above-mentioned signs and principles of the characteristics of novelty. **The main principle is not to declare the introduction of something new (classification, principles, trends, etc.), but to show specifically what is new in the classification, what new principles and trends have been discovered.**

Let us give examples of formulations of novelty formulas.

An example: The essence of the category "innovation" is defined and a new meaning is revealed, which, unlike the known ones, interprets it as one that ensures the creation of competitive advantages, a technical, organizational, managerial or social solution to the problem, as well as the category "innovative support" as a set of progressive innovations that are put into practice and ensure competitive social and personnel development of the territory.

This formula of novelty shows a clarification of the essence of a well-known economic category unknown in the literature – a solution that ensures the creation of competitive advantages.

Another example of a novelty formula for category clarification: The concept of the category of reserves has been clarified, which differs from the known ones in that reserves are considered not as losses or stocks, but as unused opportunities for increasing production efficiency.

One more example: An assessment of the state of human resources in the regional agro-industrial complex based on the levels of professional training, including initial, was carried out, which allowed us to conclude that there is a serious lag in the professional training of agricultural personnel, an underestimation in the region of the problems of professional education in

agricultural personnel policy, the reasons for the low retention rate of graduates of agricultural educational institutions, and the inconsistency of the quality of training of specialists with modern requirements. Here, the author of the dissertation claims as a novelty a specific conclusion based on the results of the analysis, i.e. a conclusion about a serious lag.

The main directions of the modern strategy for organizing the social development of rural communities have been formulated, which, unlike traditional ones, are oriented towards improving the quality of life of the population through the development of scientific, informational and innovative potential, entrepreneurship, and effective socio-economic planning, which ensure the inflow of funds to the territory sufficient for the implementation of social programs at the expense of available internal resources.

This formula of novelty indicates a rejection of the traditional view of how to solve the problem and a turn to a different orientation (concept) when developing a strategy for socio-economic development – an orientation towards improving the quality of life of the population.

An example: A methodical approach to the formation of a strategy for the development of the economic potential of an enterprise has been developed, the distinctive feature of which is the conduct of diagnostics and justification of priorities based on the method of fuzzy modeling. Here, the applicant, in fact, clarifies the methodology for forming a strategy, supplementing it with a new, in his opinion, action – conducting diagnostics ... taking into account the method of fuzzy modeling.

Another example: A classification of reserves has been developed, a distinctive feature of which is the introduction of the classification feature "according to technological operations" and the deepening of the feature "based on the scale of occurrence"; a method for assessing the competitiveness of the economic potential of an enterprise has been developed, which, unlike known approaches, is based on criteria that characterize the potential of an enterprise according to the stages of the life cycle. The formula of novelty here is similar to the methodology.

Task 2.1. Based on the studied material, construct a map of key concepts and issues on the topic "Scientific Method. Methodology of Scientific Research" in accordance with the rules and requirements specified in Appendix A.

Task 2.2. Scientific novelty of research results.

Work out the formulation of scientific novelty from the following fragments of PhD dissertations. Using the text of the abstract, formulate the formulas of novelty in the form in which they should appear in the text of the Introduction to the dissertation.

A fragment of the annotation:

Dyuk O. M. The influence of corporate culture on the choice of management technologies at industrial enterprises. Qualification scientific work in the form of a manuscript. *Dissertation for the degree of Doctor of Philosophy in Management in specialty 073 "Management". Ivano-Frankivsk National Technical University of Oil and Gas, Ivano-Frankivsk, 2021.*

"The work investigates the content and functional components of corporate culture at industrial enterprises, defines the concept of management technologies and characterizes the theoretical and methodological foundations of the influence of corporate culture on the choice of management technologies at these enterprises, substantiates the methods of assessing the state of corporate culture at enterprises and the prerequisites for applying the results of such an assessment in managing the activities of the enterprise.

Taking into account the sources studied, conceptual principles for the formation and development of corporate culture at an industrial enterprise are proposed. The conceptual model as a basic approach to the study of corporate culture takes into account such components of the formation of the internal environment of the enterprise as principles, values, functions, elements of corporate culture (rituals, traditions, history, morality) and the external environment – based on the study of the image, reputation, and loyalty of consumers to the enterprise and its products or services. The application of this concept for the development of corporate culture at industrial enterprises will allow a better understanding of the ideology of corporate culture, the content of its elements, the importance and relevance of studying their impact on the main types and results of the activity of an industrial enterprise.

Taking into account the views of Ukrainian and foreign scholars on the definition and approaches to interpreting the content of corporate culture, the work improves the definition of the concept of corporate culture as a special activity carried out by management entities and associated with the formation

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of an enterprise's operating environment, favorable for stimulating and involving enterprise employees in performing production tasks, innovative development, and change management based on the development and application of such basic corporate culture tools as values, rituals, traditions, attributes, legends, and image, which, unlike the existing ones, not only takes into account the specified elements of corporate culture, but also does so on the basis of highlighting the characteristics of individual and collective values of the enterprise's personnel, which are decisive for the development of the attributes of the enterprise's corporate culture, in particular, establishing communications, forming principles of behavior, ensuring flexibility and adaptation, creativity and responsibility of personnel, and a caring attitude of the enterprise and its employees to the environment. The improved definition of corporate culture takes into account the peculiarities of modern development, in particular, of industrial enterprises.

Taking into account that the elements of corporate culture are of great importance in the activities of each enterprise in various forms and ways of influencing it, the work improves the classification of the corporate culture of the enterprise, which is based on the allocation of individual and collective values as components of corporate culture, which are determined on the basis of grouping values according to the four levels of formation and development of corporate culture defined in the work, which, unlike the existing one, makes it possible to determine the potential of the corporate culture system at the enterprise by taking into account the individual characteristics of each employee in relation to the formed values and their collective interaction skills in maintaining corporate traditions, rituals and creating appropriate conditions for the development and maintenance of collective values, the combination of which will contribute to the improvement of interaction, establishing partnerships and cooperation in achieving effective work not only of an individual employee, unit, but also of the enterprise as a whole.

The approaches to defining the concept of management technology are considered and the positioning of management technologies at the four levels of corporate culture formation at the enterprise is carried out. In order to diversify modern management technologies that take into account the elements of the corporate culture of the enterprise, the classification of management technologies has been improved, which are grouped depending on the interests of employees and the enterprise, are based on their needs

and determine the values of both an individual employee, a team, and the entire enterprise, which is the basis of the philosophy of its activities, an indicator in decision-making and the implementation of tasks for personnel, their development and career growth.

The work investigates the impact of corporate culture on the activities of domestic industrial enterprises based on the analysis of the prerequisites and research of their development trends in the languages of modern challenges; international experience in studying the impact of corporate culture on the formation of such attributes as image and reputation; analysis of the state of corporate culture at domestic industrial enterprises and the formation of their corporate culture profile, which allows us to generalize the best practices for the development of corporate culture and forms an information basis for the selection and implementation of management technologies relevant to the situation at each enterprise.

Based on the diagnostics of the environment for the formation of corporate culture at the enterprise, in particular such system-forming criteria of industrial development as the dynamics of industrial production, innovative activity of industrial enterprises, dynamics of labor productivity indicators, the state of labor protection and safety at the enterprise, the presence of a system of corporate values, the reputation and image of enterprises, factors that influence the formation of elements of corporate culture were summarized.

An analysis of the characteristics of the attributes of the corporate culture of industrial enterprises was carried out as a result of studying and summarizing relevant information and materials from Internet resources, as well as conducting a survey of the personnel of industrial enterprises, which made it possible to assess its condition based on the allocation of the levels of formation and development of corporate culture at the enterprise considered in the work.

The paper improves the methodological approach to assessing the corporate culture of industrial enterprises. The proposed methodology is based on the identification of four levels of corporate culture assessment, taking into account which survey criteria are defined and the individual and collective levels of formation and development of corporate culture at the enterprise are summarized. Processing the results of the survey made it possible to assess the specified levels and determine the level of balancing of individual and collective values of employees by calculating the balance

indicator. It is substantiated that such an approach to assessing the survey results allows us to determine which values are decisive for the employee of the enterprise in the process of performing the tasks set. It is noted that the optimal condition for the state of corporate culture is the balancing of values, and their predominance in the direction of individual or collective interests makes it possible to take into account such differences in the choice of management technologies that ensure effective management of the enterprise and the achievement of expected performance results.

Using the method of hierarchy analysis, a hierarchical model was built to determine the priorities of the impact of the selected criteria for assessing corporate culture on the formation of the profile of the corporate culture of an industrial enterprise. The correlation of the assessments of the individual and collective components of the corporate culture of an industrial enterprise became the basis for determining such indicators of assessing corporate culture as the coefficient of formation of the potential of corporate culture and the indicator of balancing collective interests. The determination of the first indicator is carried out on the basis of the correlation of the values of individual and collective values of the company's personnel, and determining the second indicator by comparing collective values with individual ones.

The paper proposes is to consider the process of selecting management technologies taking into account the peculiarities of the formation and development of corporate culture at different stages of the life cycle of an industrial enterprise. It is substantiated that the state of corporate culture corresponds to the state of the enterprise's life cycle and vice versa, and therefore the process of developing elements of corporate culture requires taking into account changes in the enterprise's life and management attention to the state of corporate culture as an indicator of readiness for necessary changes, a means of overcoming resistance to change, a tool for developing adaptability to new conditions and work environment, if such a need arises.

Based on the proposed conceptual model of corporate culture, a model of the influence of corporate culture on the choice of management technologies at industrial enterprises was built. The proposed model identifies such management determinants as power and needs, under the influence of which influence is exerted on employees, teams and the enterprise as a whole on the basis of studying their values and determining the methods of their formation and implementation with the use of power mechanisms to

satisfy the needs and interests of internal and external stakeholders of the enterprise, taking into account the connection "individual values – individual needs – interests – collective needs – collective values", namely, the fact that individual needs, determined by individual values, determine the interests of a person, whose satisfaction forms collective needs in involvement, interaction, trust, partnership, requires the adoption of the corresponding collective values.

Having studied the content and connection of such concepts as needs, interests and values, the work has developed a value-oriented approach to the formation of resource support for the choice of management technologies at industrial enterprises. The basis of this method is the process of transforming the personal values of each employee of the enterprise into interests that motivate each person to perform a certain job. As a result, the employee acquires values that are formed at the enterprise and that reflect the beliefs of the founders, managers, stakeholders and employees of the enterprise regarding their behavior, interaction, therefore, the development of corporate culture is achieved, in particular through the harmonization of individual and collective values of the enterprise. It is substantiated that the final indicator of the value–oriented approach to the choice of management technologies is the return on investment–an indicator that summarizes the results of the enterprise's work not only as an internal result of enterprise management, but also as an external reputational factor, which, in our opinion, should be considered as a factor of the attractiveness of investment in the development of the enterprise.

The paper proposes a decision map for the choice of management technologies, the construction of which is based on the application of the methodology for determining the continuum of harmonization of individual and collective interests of the enterprise's personnel and the use of the results of a survey of the personnel of the studied industrial enterprises. This methodology is applied to enterprises for which the significance of the influence of corporate culture, according to the survey findings, on the economic result of the studied enterprises is mathematically substantiated.

Based on the study of domestic and foreign experience in the formation and development of corporate culture, methodological principles for choosing management technologies taking into account the balancing of individual and corporate values of enterprise employees have been substantiated. Such technologies are based on personnel management technologies, the application of information technologies based on the study of corporate culture at

industrial enterprises. The results of the research conducted in the dissertation have been used in the activities of industrial enterprises, in particular, LLC "Pamibro" – to determine technologies for balancing individual and collective values of employees by calculating the balance indicator; LLC "PromtekhmontazhPNO" – to substantiate the effectiveness of the application of management technologies at industrial enterprises by applying a value-oriented approach; LLC "Karpatneftekhim" – to improve "human resource management subsystems through the use of modern corporate culture tools in order to harmonize individual and collective interests of personnel".

A fragment of the introduction to the dissertation.

Dyuk O. M. The influence of corporate culture on the choice of management technologies at industrial enterprises. Qualification scientific work in the form of a manuscript. *Dissertation for the degree of Doctor of Philosophy in Management in specialty 073 "Management". Ivano-Frankivsk National Technical University of Oil and Gas, Ivano-Frankivsk, 2021.*

"**The scientific novelty of the obtained results** lies in the generalization of theoretical foundations and the development of methodological approaches to the selection of management technologies based on the study of corporate culture at industrial enterprises.

First:

a conceptual two-vector model of the influence of corporate culture on the choice of management technologies is proposed, which is based on the application of such determinants of influence as power and needs, which have a targeted effect on employees, teams and the enterprise as a whole; it identifies individual and collective values of corporate culture, which take into account the challenges of modern development and the needs of the enterprise, ensure the profitability of its activities and form criteria for the selection of management technologies based on the application of subject – subject management, which, unlike subject – object management, takes into account the needs, interests and values of the subjects of such management and ways of harmonizing and satisfying them.

What has been improved:

definition of corporate culture, which is based on the formation of an enterprise's operating environment, favorable for stimulating and involving enterprise employees in performing production tasks, innovative development, change management based on the development and application of such basic corporate culture tools as values, rituals, traditions, attributes, legends,

image, which, unlike the existing ones, does not only take into account the specified elements of corporate culture, but also the allocation of characteristics that reflect the individual and collective values of enterprise employees, which are decisive for the development of attributes for the development of corporate culture at the enterprise, in particular communications, management style, principles of behavior, flexibility and adaptation; classification of corporate culture of the enterprise, which takes into account individual and collective values as components of corporate culture, which makes it possible to determine the potential for the development of corporate culture at the enterprise by forming values and skills of collective interaction regarding the development, dissemination, maintenance of corporate traditions, rituals and effective communications to maintain effective work;

classification of management technologies, which are grouped depending on the action of power mechanisms and the interests of employees and the enterprise, which are based on their needs and determine the values of both an individual employee, a team, and the enterprise as a whole.

What has been developed further:

the concept of the influence of corporate culture on the choice of management technologies through the identification of such management determinants as power and needs, which is based on the study of the mechanisms of application of these tools in the choice of management technologies;

a methodology for assessing corporate culture through the allocation of levels of its formation, which, unlike existing ones, makes it possible to determine the degree of balance of individual and collective values of employees by calculating their balance indicator and taking it into account in the process of choosing management technologies;

a value-oriented approach to justifying the effectiveness of the application of management technologies at industrial enterprises, which is based on the application of the foresight methodology, which, in the process of determining the future state of the enterprise, takes into account the potential economic results of its activities and the possibility of increasing the interest and involvement of enterprise employees and other stakeholders in achieving its goals and solving the tasks set".

A structural model of the subject area. This is essentially a mental map of the research area where a scientist can, by understanding the cause-and-effect relationships known to him between the object and the subject of the research, compactly display them in the form of a structural diagram.

Task 2.3. Using the cause-and-effect relationships between the object and the subject of your scientific topic of dissertation research that you currently know, compactly display them in the form of a structural diagram (network structural model of the subject area of research).

Topic 3. Empirical research methods and tools for processing empirical research data

Basic concepts of measurement theory. Observation as a method of cognition. Experiment as a special form of scientific cognition. Empirical research methods. General and special methods of scientific research. Characteristics and functions of research methods. Methods of expert evaluation. Tools for processing empirical research data.

Study the theoretical material on the topic provided in the textbook [2, p. 180–243], as well as Appendix B.

Task 3.1. Based on the studied material, build a map of key concepts and questions on the topic "Methods of empirical research".

Task 3.2. Construct a regression model of the dependence between the effective feature and the set of explanatory variables that characterize the phenomena of the subject area of your dissertation research that you are studying. According to the conditions of the task, it is necessary to construct a simple regression model of the dependence of the effective feature on the set of explanatory variables using the least squares (LS) method:

● present a table of intermediate and final calculation results;

● present a formalized form of the regression equation (with defined coefficients and permissible error);

● construct graphs of the dependence of the resulting characteristic on the set of explanatory variables according to the simple regression equation obtained as a result of applying OLS;

● based on the constructed graph and the value of the model's standard error, evaluate the quality of the resulting regression equation;

● using the MS Excel spreadsheet editor, it is necessary to approximate the results of the experiment by adding a trend line to the corresponding graph, choosing its type by yourself (the degree of smoothing should be at least 5). Display the trend equation and the value of the approximation reliability in the figure.

Task 3.3. Create a sample experiment for the experimental part of your dissertation. It can be a passive or active experiment, a technological or sociometric experiment. To conduct an experiment of any type you need to develop a hypothesis that will be tested; create pilot programs; determine ways and methods of intervention in the object of research.

Review questions

1. What does the concept of method mean?
2. Explain the main content of empirical research methods.
3. Describe the measurement scales used in science.
4. What is the essence of expert evaluation methods?
5. How is the consistency of expert opinions measured?
6. What methods of processing empirical data do you know?
7. Define and characterize correlation analysis.
8. Give the analytical form of the definition of the correlation coefficient.
9. Define and characterize regression analysis.
10. Give the general form of a linear regression function.
11. Explain the essence of the factor analysis method.
12. Explain the essence of cluster analysis.
13. Describe the main problems of measurement theory.
14. Indicate the limitations on the use of regression models within scientific research.
15. How does an experiment manifest itself as a special form of scientific knowledge?
16. What types of experiments are distinguished according to the goals of the experiment?
17. What is the difference between a natural experiment and an artificial experiment?
18. What types of experiments are distinguished depending on the way they are organized?

Topic 4. Theoretical research methods

Principles as tools of cognition. Abstraction and idealization. Methods of analysis, synthesis, classification and theory building. Deduction. Induction. Analogy. Idealization. Abstraction. Ranking. Logical method. Hypothetical method. Axiomatic method, mathematical methods. Theoretical research methods. Scientific laws, regularity and randomness. Methods of establishing causal relationships. Features of the use of theoretical methods in economics.

Study the theoretical material on the topic provided in the textbook [2, p. 244–313].

Task 4.1. Based on the studied material, build a map of key concepts and questions on the topic "Theoretical research methods".

An example of a description in a dissertation of the use of research methods.

To achieve the goal and solve the tasks set, the following research methods were used:

● **morphological analysis** – to generalize theoretical approaches to determining the essence and content of the conceptual and categorical apparatus of the subject area of managing the integration development of enterprises;

● **a dialectical method of cognition and comparative analysis** – to determine and systematize the factors of complex formation, identify opportunities and limitations for enterprises when integrating them to create a tourist product (TP) with certain parameters;

● **systemic and program-targeted approaches, as well as the laws of organization theory, synergy and benchmarking methods** – when systematizing the composition and substantive characteristics of nature management imperatives and building an enlarged structural model for ensuring sustainable recreational and tourist development;

● **general scientific methods of abstraction, analysis and synthesis** – to establish the structure and typology of the tourism market, as well as to determine the economic nature and components of the multifunctional structure of the tourism market;

● **functional and logical analysis** – when determining the patterns of formation and reflection of the subordination of the components of the institutional support for the integration of the national tourism market into the global system of tourist flows;

● **formalization** – to develop a methodological approach to assessing the tourist attractiveness of territories and objects of the natural and recreational sphere;

● **expert assessment method** – to determine priorities for managing the development of the complex;

● **forecasting methods** – for predicting the likely consequences of deepening the level of economic integration of the national economy into the globalized market environment;

● **classification** – to systematize the types of competitive advantages of tourism enterprises;

● **factor analysis** – for a comprehensive assessment of the quality of tourist services;

● **general equilibrium computational models (Computable General Equilibrium)** – for modeling the choice of the form of integration interaction of enterprises;

● **rating and reflective management** – for selecting network participants;

● **organizational and architectural standardization** – to create a formalized description of the product creation processes and the subordination relationships that arise between representatives of the complex;

● **Petri nets** – for dynamic reflection of the provisions of the proposed concept of enterprise development;

● **matrix methods** – for structuring the formed mechanism according to the levels of hierarchical representation of the cluster and formalizing strategic guidelines for the development of the complex;

● **the principal components method** – for assessing the cluster structuring of enterprises in the complex.

Task 4.2. Conduct an analytical study on the state and prospects for the development of one of the following phenomena and processes in the subject area of your dissertation research.

The content of an analytical study on a chosen (or independently formulated) topic should include:

● setting the main tasks to be solved as a result of the research (for example, analysis of the state of the research object, trends and directions of its spread in the industry, conditions necessary for its implementation and benefits that occur as a result of this, etc.);

● collection and analysis of secondary information from local to global networks to solve the tasks;

● collection and analysis of primary information to solve the tasks by observing real processes and phenomena in the industry;

● synthesis and comparison of information obtained to solve the tasks in different ways;

● formulation of the main critical conclusions based on the results of solving the research tasks.

Review questions

1. Explain the meaning of abstraction and idealization as the beginning of theoretical research.

2. List the principles of processing and generalization of scientific facts.

3. Describe the process of formulating, constructing, and testing scientific hypotheses as a stage of theoretical research.

4. Define scientific laws, regularity, and randomness.

5. Describe the methods of analysis, classification, and theory building.

6. Under what conditions are the methods of deduction and induction used?

7. Give examples of the use of the analogy method in economic research.

8. Reveal the essence of the methods of idealization, abstraction, and ranking.

9. What is the purpose of using the aggregation method?

10. Define and characterize the formalization method, the axiomatic method, and mathematical methods.

11. What are the features of the methodology of economic research?

12. How do economic concepts and theories develop?

Topic 5. The systematic method of research. Methodology of research of complex systems

Systematic method. Systematic approach and system analysis. Self-organisation of systems and synergetics. Synergetic analysis of complex organised systems. Methodology of research of complex systems. Formation of the systematic method of research. Specificity of the system method and classification of systems. Modern methods of mathematical description of complex systems (phase space, chaos theory, attractors, fractals).

Study the theoretical material on the topic provided in the textbook [2, p. 313–395].

Task 5.1. Based on the material studied, build a map of key concepts and issues of the topic "The systematic research method. Methodology for studying complex systems".

Principles of systemic thinking.

1. Well-developed visualisation.

One of the main requirements of systems thinking is a well-developed ability to visualise.

Aristotle: "The thinker thinks of forms in images, and in what images he becomes clear, ... As if looking with his eyes, he justifies and makes decisions ...".

Through the eyes of the mind, Mozart saw his completed works as "paintings" and "sculptures".

2. Creating multiple connections between the senses.

Even if vision remains the central element, all the other senses should be used and synesthesia should be formed between them.

In this sense, Mozart is the best example – he felt, saw and even tasted music. Disney also had an outstanding ability to superimpose the senses, as evidenced by "Fantasia" and his other works. Aristotle coined the term "general properties" to describe the ability of the different senses to perceive information together.

3. Use of multiple perspectives.

One of the characteristic features of systems thinking is the ability to view a particular phenomenon or process from more perspectives than is typical of ordinary people, and to identify perspectives that are overlooked by others.

Aristotle, for example, saw several different types of "causes" in his analysis, and tested assumptions and syllogisms with different verbal "appeals". In his conclusions and summaries, Holmes proceeded not only from his knowledge of the general cultural background and external events, but also, to some extent, from esoteric knowledge known only to him. Disney invariably used different perspectives, such as a "second look" at his scripts and plans. At each stage of his creative process, Mozart resorted to different feelings and metaphors.

4. A highly developed ability to constantly switch from one position of perception to another.

In addition to the ability to accept different points of view, systemic thinking involves the ability to switch to different positions of perception, i.e. the first (own), second (other's) and third (outside observers) positions.

Disney, for example, could not describe the behaviour of his cartoon characters without transforming into them and portraying them in the game. He also had the opportunity to deviate from his own position of perception and look at the world through the eyes of his audience. In the course of his investigations, Holmes tended to put himself in the position of perception of his "subjects". The most commonly known characteristic of this kind is the ability to identify (i.e. take a second position) with any object they work with, even if it is an inanimate object. People called computer geniuses claim to be able to see the world through the eyes of a computer.

Michelangelo could take the position of the stone he was about to work with. He said: "I am not creating a statue. The statue is already there, in a piece of marble, and is just waiting for me to free it from there. And I work tirelessly until it is set free".

Mozart claimed that after reaching a certain limit, his symphonies were written as if by themselves.

5. The ability to move freely between breakdowns of different scales and move from one level of thinking to another.

Systems thinking leads to the ability to easily move from a broad view of things to the narrower components and actions needed to recreate and demonstrate the bigger picture. It is necessary to develop the ability to work with small things without drowning in details; to see the whole picture without losing sight of its smallest components.

Aristotle, Holmes, Disney and Mozart seemed to have a unique ability to find a balance between the big and the small. For example, Aristotle and

Holmes started with "rather coherent" arrays of information, which they first broke down into more concrete details and components. Then, by reversing the combination of individual parts, they obtained or recreated a "larger picture". Mozart and Disney, on the other hand, combined separate "fragments" of experience, which initially developed through synesthesia between different senses, until they could "see clearly in their minds how to represent a particular fragment". After that, they would again break down this enlarged picture into details.

6. Maintain feedback between the abstract and the concrete.

Systems thinking is characterised by the ability to move freely from abstract models and concepts to their concrete expression. You must discover higher-level principles and qualities ("general properties") in the concrete examples you encounter in your work and translate abstract relationships into concrete examples.

This creates a kind of feedback loop that allows you to develop ideas and theories on the axis of feedback from the real world and at the same time improve the material fruits of your work through feedback from abstract principles.

7. Balancing mental functions: Dreamer, Realist and Critic.

In systems thinking, dreams are also manifested, as well as the ability and skill to translate your dreams into concrete forms and to be critical of your ideas. The ability to think critically is just as important as the ability to dream.

The main thing is not to let criticism completely suppress your dreams. The distinctive ability of a right-thinking person is to create something that embodies these dreams and ideas. A brilliant action always ends in some kind of external reflection.

Aristotle put his ideas on paper. Holmes directed all the power of his mind to solve the problems and mysteries of the world around him. Disney's main strength was his ability to turn dreams into externally tangible forms. Mozart wrote down his musical reveries in the form of notes. If they had just kept their ideas in their heads, the world would never have known about their genius.

8. Asking fundamental questions.

Systems thinking tends to place more emphasis on questions than on answers. As a rule, you should not hesitate to discuss questions, but you should not talk much about your answers. A characteristic that supports this quality is unbridled curiosity and enthusiasm. Instead of sticking to your

previous knowledge and trying to strengthen it further, you should look for gaps in it.

In addition, one should develop the ability to perceive one's own failures not as bad luck, but as feedback that indicates an area for further search.

Aristotle, for example, identified four fundamental questions that he constantly asked and the process by which he tested his hypotheses and assumptions. Holmes warned against the tendency to "distort facts by trying to fit them into a theory, instead of bringing the theory into line with the facts". Disney put it this way: "I have to explore and experiment ... I am annoyed by the limitations of my own imagination". Mozart's music is the result of his constant preoccupation with whether it is really "two notes in love with each other".

9. Use of metaphors and analogies.

Systems thinking constantly uses metaphors and lateral or non-linear thinking strategies. Indeed, a metaphor or analogy is at the heart of every successful action.

Aristotle constantly gave examples and analogies to illustrate his thoughts. Holmes claimed that his method was based on "a mixture of imagination and reality". Mozart used metaphors and analogies, thinking, for example, about how to "use this or that tidbit to make a glorious dish" and comparing his music to a "canvas" or "sculpture" when describing his creative process. Disney's business was all about creating metaphors. It may seem that the use of metaphors allows us to focus on the "general properties" and deeper principles of both the external and internal world, and to avoid the danger of being too dependent on real content or the limitations imposed by reality.

10. The purpose beyond your own identity.

Perceive your work as something that comes from something and serves something greater than the researcher.

Aristotle searched for the "first principle" in all manifestations of existence. Holmes wanted to use the links in the "great chain of existence". Disney spoke about his work: "This is not just the 'field of animation'. We can conquer entire worlds. Whatever the human mind can invent, animation can explain it". Mozart claimed that writing music "sets his soul on fire" and thanked the "Heavenly Creator" for the gift of creativity.

Task 5.2. Study the above principles of systemic thinking and examples of implementation of these principles. Formulate the ways in which the

principles of systemic thinking are implemented in your own life. Think about the directions of their development in your scientific activity.

Task 5.3. Objectives of the task:

● to get acquainted with the role of system analysis methods in scientific research;

● to acquire skills in applying the method of morphological analysis in research work;

● to learn to conduct qualitative and quantitative analysis of the goal tree.

1. Using the method of morphological analysis, form alternative options for any economic system on the topic of your research work. Choose one of the alternative system options as the best one.

2. Build a goal tree for the creation of the economic system designed as a result of task 1. Conduct a quantitative analysis of the goal tree.

3. Decompose the objective of your research work. Conduct a quantitative analysis of the resulting goal tree and determine the degree of achievement of the research goal at the current time.

Control questions

1. What processes determined the formation of the systematic research method?

2. Specificity of the systematic method and classification of systems.

3. What is the specificity of the systematic approach in research?

4. Name the main stages of system analysis.

5. Describe the most commonly used aspects of the system approach in system analysis.

6. Formulate the principles of system thinking.

7. How is the degree of understanding of the system related to the integration of the data obtained about it. Describe the stages that the researcher goes through.

8. How is the method of morphological analysis used in applied research?

9. When is it advisable to use the goal tree method?

10. What effective thinking techniques are used in system analysis?

11. What is the self-organisation of systems?

12. Describe the synergistic analysis of complex organised systems.

13. What is the place of the systematic method in the modern scientific worldview?

14. What are the main functions of forecasting as a special type of prediction?

Topic 6. Models and modelling method in scientific research

The concept of a model. Classification of models. Quality of models and evaluation of quality. Adequacy of models. Truth and models. Dynamics of models. Method of modelling. Computer modelling.

The main tool for cognition of objects and processes of the subject area of research and a means of achieving its goals are models, because they allow replacing the original object (subject) in the case when it is inaccessible, complex and uncontrollable.

In solving research problems, various models can be built, the entire set of which is ordered according to the following criteria: modelling tools, modelling objectives, ability to take into account the time factor and random factors, completeness of the description of the internal structure of the original, etc.

The construction of any model, i.e. the process of modelling, along with the reflection of the essential properties and relations of the original, involves a certain degree of abstraction and idealisation of its non-essential (from the point of view of the modelling purposes) aspects, connections and relations. The truth of the model obtained as a result of modelling depends on the correct identification and consideration of the essential properties of the original and the degree of abstraction from its other characteristics. The truth of the model means that it fully corresponds to the original and indicates the legitimacy of its further use.

Study the theoretical material on the topic provided in the textbook [2, p. 396–489].

Task 6.1. Based on the material studied, build a map of the key concepts and issues of the topic "Models and modelling methods in scientific research".

Task 6.2. Select for each task of your dissertation research from the section "Basic models of knowledge" those basic models that currently seem to you to be the most adequate to these tasks. Justify, why these models can help you solve your research problems.

Control questions

1. Explain the essence of the concept of model.

2. Give a classification of models.

3. What are the features of cognitive and pragmatic models?

4. In what cases are static and dynamic models of economic objects and processes used?

5. What are abstract models and languages?

6. How is the quality of models determined and evaluated?

7. What is the basis for establishing the similarity between the model and the original?

8. What does the concept of model adequacy reflect? How are truth and models related?

9. What does the concept of model dynamics mean?

10. Describe the conditions for the construction and use of mathematical models.

11. Explain the essence of the modelling method.

12. What features should be considered when modelling in economic research?

13. What is the essence of computer modelling?

14. Describe the linguistic expression of the content of knowledge for different cultures. What is their fundamental difference?

15**.** Give examples of basic models of knowledge representation.

Content module 2
Technology and organisation of scientific research

Topic 7. Organisation of scientific activity and research

Scientific activity, its types. Subjects of scientific activity. Forms of organisation of scientific activity. Contract for scientific activity. Technology of scientific research. Preparation of applications for state budget research topics. Planning of scientific research. Expertise of scientific achievements.

Work out the theoretical material of the topic provided in the textbook [2, p. 490–540].

Task 7.1. Based on the material studied, build a map of the key concepts and issues of the topic "Organisation of scientific activity and research".

Task 7.2. Solve the task. Identify and formulate the scientific results of your own dissertation research, which are of the greatest practical importance for the economy (technology, pedagogy) of the country as a whole or individual business entities.

Task 7.3. Draw up terms of reference for a research and development (R&D) project: state budget or commercial contract, indicating in it:

general data:

name, date and number of the document that provides funding;

names of directions and sections according to the Law of Ukraine "On Priority Areas of Science and Technology Development" of 12.10.2010 No. 2519-17 "Fundamental scientific research on the most important problems of development of scientific, technical, socio-economic, socio-political, human potential to ensure Ukraine's competitiveness in the world and sustainable development of society and the state".

Task 7.4. Study the following excerpt from an article on the prospects for the development of universities and related issues of science development in Ukrainian universities. Outline possible options (strategies) for the development of the field in which you conduct research, as well as mechanisms for deeper integration of such research into world science.

"... Ukraine ranks 74th out of 189 countries in the human development index, and 111st out of 185 countries in terms of GDP per capita. At the same time, Ukraine ranks 47th out of 189 countries in the education index, 39th out of 197 countries in the science and technology activity ranking, and 45th out of 131 countries in the global innovation index. Thus, our country has sufficient educational, scientific and innovative potential, but it is not being used to the fullest extent to ensure Ukraine's socio-economic development. There are many different factors behind this.

One of them is the inconsistency of the chain between educational, research and innovation activities and the real sector of the economy. It should be noted that, in general, the transition to a modern mode of social reproduction and the spread of the knowledge economy have significantly changed the vector of the global economy and determined its innovative orientation. International best practice shows that innovation activity peaks at the point where the interests of the state, the business community, research

and education institutions intersect. Today, higher education institutions are the generators of innovation processes in developed countries, while the state and the business community act as customers, consumers and co-investors of innovative developments [3]. Today, there are various forms of interaction between education, science and business, but, as the experience of the world's leading countries shows, the university remains the basic one. At the same time, modern universities are undergoing revolutionary changes towards transformation in line with the requirements of today.

Well-known classical universities in the UK, such as Cambridge, the University of York, etc., not only generate scientific research, but also actively implement business education, promote entrepreneurial practice, commercialise research developments, and contribute to the development of the country's economy. About 235 US universities are so-called research universities, which conduct approximately 2/3 of all basic and applied research. An example of active cooperation between educational institutions, the state and business is Sweden, which, with the help of state funding, as well as attracting investments and orders from large private companies, is implementing a course of implementation and commercialisation of scientific developments.

This approach has allowed Swedish universities to become a kind of core of the largest technology parks, for example, the Ideon Technology Park based at Lund University, which develops and implements knowledge-intensive and high-tech products, etc. Thus, the need to expand the forms of interaction between research and education institutions and business has contributed to the formation of a new type of university – entrepreneurial universities and universities of the future.

Today, scientists have identified different models of universities and shaped their evolution. Thus, a model 1.0 university is an educational centre whose main purpose is knowledge transfer; a model 2.0 university is a research university – a centre of scientific and technological progress; a model 3.0 university is an entrepreneurial university based on the Triple Helix concept and aimed at commercialising scientific results; a model 4.0 university is outward-looking, deeply connected to industry and built on the principles of digitalisation of processes A comparison of these university models according to their main features is presented in Table 3.

Table 3

Comparison of conceptual models of universities

(compiled by the authors)

University 1.0	University 2.0	University 3.0	University 4.0	University of the future
1	2	3	4	5
Type	Educational university	Research university	Entrepreneurial university	The need to anticipate and solve global and local problems (resource, environmental, epidemics, etc.)
The need of society	The need for teachers, doctors, lawyers, etc.	The need for educated citizens	The need for economic development and innovation	The state, communities (formal and informal), transnational organisations, individuals
"Customer"	City	State	State, production sector	Development of the noosphere and individual ecosystems of society
Objective	Reproduction of the elite	Creation of civil society, national idea	Creation of innovations and development of technologies	Model of multiple intelligence
Axiological basis	Cultural model	Academic model	Competence model	Education, science, creativity, eco-system, business
Key category	Education	Training, research are key categories	Education, science, business	Creativity

Table 3 (the end)

1	2	3	4	5
External referee	Culture	Truth	Quality	Links between university, state, industry and society. Physical and virtual (cloud) existence, network organisation
Features of the organisation	A corporation of students and teachers	Linking the university and the state	Links between university, state and business (production)	Formation of individuality
Features of the educational process	Scholastic system of teaching	Learning through research	Learning through core competences	Self-construction
Form of learning	Monological	Dialogue or "Socratic" communication	Group (network) interaction	Creation of a viable product, contribution to the development of the society's ecosystem
Criterion at the "output"	Compliance with the culture of the corporation (including professional)	Knowledge of the classics in the original and the ability to hypothetical and deductive thinking	Compliance with the expected competences	

This situation requires an immediate search for ways to improve modern national higher education, to form universities of the future in accordance with possible scenarios and trends in the development of the educational process.

Research on higher education development scenarios is receiving considerable attention in developed countries. Thus, according to the options for the development of higher education, which were developed within the framework of OECD research, in 2004, the scenarios presented in Table 4 were identified.

Table 4

Scenarios of higher education development according to the OECD study (2004)

Scenario name	Brief description
1	2
Scenario 1. Traditional university	Universities are largely similar to modern universities, serving a relatively small proportion of young people for employment purposes. Universities conduct both teaching and research without excessive reliance on or involvement with the private sector. The government continues to play an important role in funding, regulating and governing universities. Lifelong learning and e-learning develop largely outside the university sphere
Scenario 2. Entrepreneurial universities	Universities are characterised by autonomy. There is a mixed model of public-private funding. Research is seen as a very important and profitable activity. Universities use a market-based approach to their activities without losing their basic academic values. Lifelong learning takes place in a university setting, but in lower status institutions. The three missions of the university – teaching, research and community service – are well balanced. Commercial approaches to international markets and e-learning are important
Scenario 3. Free market for universities	Market forces are the main drivers of higher education development. It is regulated by private companies in terms of quality assurance and accreditation, and is largely financed through market mechanisms. Market forces give rise to institutions that become specialised in terms of function (teaching, research), field (business, humanities, etc.), audience (young students, part-time students, distance education, adult education, lifelong learning), while business firms provide corporate training for their employees. Competition between universities is growing. The importance of developing technologies for learning is increasing. Research is transferred to public research centres and corporate R&D departments

Table 4 (the end)

1	2
Scenario 4. Lifelong learning and open education	Universities are a universal vehicle for education at any age. The knowledge economy is booming, and higher education is becoming a source of continuous professional development, funded by companies, individuals seeking recognised professional development, and the state. Universities are becoming more student- and demand-driven, more focused on short courses, and increasing distance and e-learning. Most research is carried out outside the higher education system, and the best researchers move to private companies and specialised institutes. All university education follows the model of a professional school
Scenario 5. A global network of educational and research institutions	The following main innovations are envisaged: 1) students choose their own course of study from all available courses in the global post-secondary network and manage their own educational trajectory; 2) higher education institutions increasingly cooperate, including industry. The influence of e-learning is growing. Educational content is becoming more standardised. The market for lifelong learning is growing. Most research is conducted outside the higher education system. There is a strong polarisation in the status of the academic community: academic superstars and developers of 'learning tools' gain high status, while average teaching staff become less qualified and receive lower status. Programmes and courses are more important than institutions
Scenario 6. Diversity of recognised learning – disappearance of universities	The formal higher education sector disappears. People learn throughout their lives, at work, at home, for personal and professional reasons, increasingly on their own and by sharing their experiences with others interested in the same field. New technologies are driving the spread of information and knowledge. The global Internet is important and goes beyond institutions. The knowledge and experience gained in all life situations is confirmed through formal competence assessments conducted by specialised assessment bodies. Research that requires large investments is carried out in public research centres and in corporate research departments

Based on the results of the analysis of the state and trends in the development of the national scientific and educational sphere, as well as the prospects for socio-economic development of the country and global scenarios of higher education development, we believe that the following scenarios for the future of Ukrainian universities can be distinguished.

Scenario 1. Stagnation of higher education and science in the context of the implementation of the "raw material" model of socio-economic development: reduced demand for research, innovation, quality education, outflow of highly qualified personnel from the country and other negative trends.

Scenario 2. The higher education sector loses competition with foreign universities, corporate research centres, corporate universities, short-term courses in the field of research, innovation, and training of qualified personnel, which is accompanied by the loss of the relevant status and role, and resources by domestic universities.

Scenario 3. Consumers of higher education, dominated by adults, change significantly, and the demand for retraining increases. Educational programmes, education technologies and higher education staff do not meet the requirements of the time, a network of alternative educational centres using modern digital and distance technologies is formed, and higher education loses its status and resources.

Scenario 4. Modernisation of higher education and science, introduction of new technologies and restructuring of the educational and research process to ensure socio-economic development are limited to a few large cities (Kyiv, Kharkiv, Lviv, Odesa, etc.). The gap and inequality in the quality of educational and research activities in the regions is growing.

Thus, in order to ensure the development of higher education in Ukraine in line with current global trends and challenges, the problem of developing and implementing an effective socio-economic mechanism for integrating science, education and the business sector, based on modern technologies of educational and research processes, is becoming more urgent and will contribute to the sustainable development of our country. Otherwise, there is a significant threat of the final loss of the national higher education status, reduction of the scientific potential and national security of the country."

Control questions

1 Describe the essence of the concept of scientific activity and its types.

2. Who are the subjects of scientific activity?

3. What forms of organisation of scientific activity are used in the practice of domestic and foreign science?

4. What types of activities fall under the concept of scientific activity?

5. In what forms is the organisation of scientific research carried out?

6. Which organisation is the highest scientific organisation in Ukraine?

7. What are the forms of research funding in Ukraine?

8. What is economic contractual research and development (R&D)?

9. How do research firms work?

10. Explain the content of the schemes of involving specialists in the implementation of research topics.

11. How and why are temporary creative teams created?

12. What sections does a research contract contain?

13. How are applications for state budget research topics prepared? Planning of scientific research.

14. What are the types of effects from the implementation of research and development?

15. What criteria are used to evaluate the effectiveness of research work?

16. What criteria are used to assess the effectiveness of a researcher?

17. What criteria are used to assess the effectiveness of a research organisation?

18. What is the difference between the previous, expected and actual effectiveness of research and development?

19. Which of them is the most reliable?

20. What measures are used to improve the effectiveness of R&D?

21. What are the criteria for the examination of research projects and studies (articles, abstracts, dissertations, reports)?

Topic 8. Information support for research

Information space of a scientist. National system of scientific and technical information. Technology of working with information sources. Electronic resources. Theory and practice of dynamic reading and rational work with scientific literature. Publication of research results. Scientometric

databases of publications. Impact factor. Principles and rules of scientific integrity in research.

Study the theoretical material on the topic provided in the textbook [2, p. 541–656].

Task 8.1. Based on the material you have studied, create a map of the key concepts and issues of the topic "Information support of scientific research".

Sample formatting and stylistic requirements for the content/experimental scientific article

An abstract is a brief bibliographic reference, a description of the content of the article.

Relevance of the problem. Through critical analysis and comparison with known solutions to the problem or scientific task (review of facts from the scientific literature), the relevance and expediency of the work for the development of the relevant field of science or industry are substantiated. The connection of the chosen direction, research with the plans of the organisation where the work was performed, as well as with sectoral or state plans and programmes, is briefly described.

The purpose and objectives of the research. The purpose of the work and the tasks that need to be solved to achieve the goal are formulated. The purpose should not be formulated as "Research ..." or "Study ...", because the words indicate the means of achieving the goal and not the goal itself. The definition of the purpose and objectives of the study should be directly related to the definition of the object and subject of the study.

Research methods. A list of research methods used to achieve the goal of the study is given. They should not be listed in isolation from the content of the work, but briefly and meaningfully, defining what exactly was studied by this or that method.

Study of the results obtained (presentation of the main material). In this section, the results of the author's own research should be presented with comprehensive information. The author should give an assessment of the completeness of the solution of the tasks set, an assessment of the reliability of the results obtained (characteristics, parameters), and a comparison with similar results of domestic and foreign works. The presentation of the material should be subordinated to one leading idea clearly defined by the author.

Conclusions. The most important scientific and practical results of the study are presented; they should contain a formulation of the solved scientific problem. The scientific novelty of the results obtained and their practical significance, as well as the prospects for the development of the study are determined.

A list of references. A list of references is attached in accordance with the requirements of citation.

An example of references:

1. Modeling of packaging processes : a textbook for students of higher educational institutions / A. I. Sokolenko [et al.] ; ed. A. I. Sokolenko. – Vinnytsia : Nova Knyha, 2004. – 271 p. : fig., tab. – Bibliography: 258 p.

2. Osyka V. A. World market of paper packaging materials / V. A. Osyka, V. O. Komakha, O. S. Shulga // Goods and Markets. – 2019. – No. 2. – P. 5–17.

Task 8.2. Work with libraries. Find in digital libraries two PhD dissertations related to your topic (or at least those within your speciality). For each of these dissertations, provide: their email address, source data (in accordance with the requirements for referencing), research questions (tasks) formulated in the dissertation and the scientific novelty obtained for each of these questions (tasks).

This result should be presented in the original language and in Ukrainian in translation. You can search for the materials you need in the libraries listed below:

Dissertations can be found in foreign collections that are available on the Internet in open access:

DART-Europe.

This contains full texts of over 500,000 dissertations in English and other European languages. The DART-Europe database represents the work of researchers from 600 universities in 28 European countries. Find out more.

Dialnet.

This regularly updated database contains more than 40,000 doctoral dissertations and scientific articles from leading Spanish universities in Spanish and other European languages. Dissertations are grouped according to university. Find out more.

HAL.

The electronic archive contains more than a million publications, including more than 350,000 full-text dissertations and scientific articles from French research and educational institutions in open access. The archive has more than 48,000 abstracts, presented mainly in English and French. Find out more.

OATD (Open Access Theses and Dissertations).

This international database provides access to 2,800,000 theses and dissertations from more than 1,000 research institutes, universities and colleges. More than half of the works are in English. Find out more.

PQDT Open.

Full texts of dissertations in the UMI database of the ProQuest Dissertation Publishing House, whose authors have agreed to place their works in open access. Currently, the database provides open access to 27,000 works, and their number is constantly growing. Learn more.

dissertations. se

A collection of Swedish dissertations containing more than 54,000 full-text doctoral dissertations in various European and Eastern languages. About half of the works are presented in open access. Learn more.

theses. fr.

A database created within the framework of the Higher Education Information Support Project with the support of the French Ministry of Education. It includes more than 30,000 full texts of dissertations defended at French universities, mainly in French and English. Read more.

CiNii Dissertations.

An information resource that provides both bibliographic information on dissertations and open access to full-text doctoral dissertations from universities and institutes in Japan in Japanese and English: about 600,000 bibliographic references, more than 130,000 full-text dissertations from the National National Diet Library and about 130,000 from universities. Find out more.

NDLTD.

The information system maintained by the international organisation Networked Digital Library of Theses and Dissertations (NDLTD) provides a

search for full-text open access dissertations or information about restricted dissertations. Find out more.

It is recommended to start with the two most "comfortable" collections (good interface and most works in English): **NDLTD** and **DART-Europe E-theses Portal**. Below are screenshots of their home pages (Fig. 4, 5).
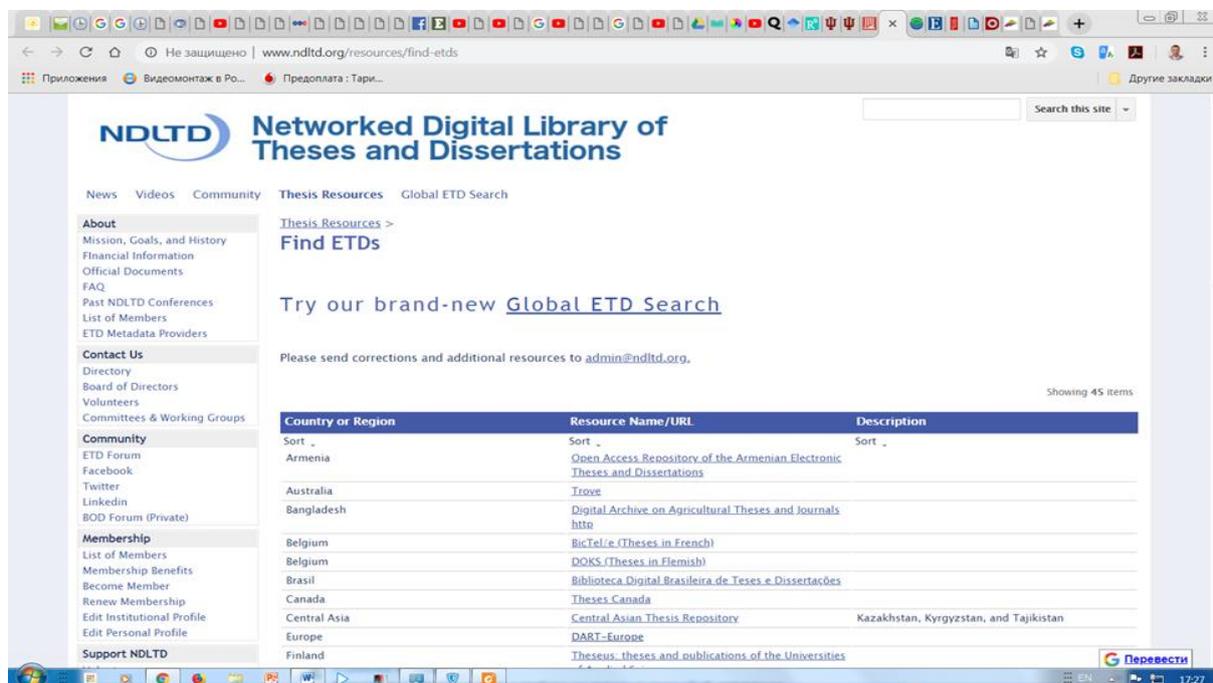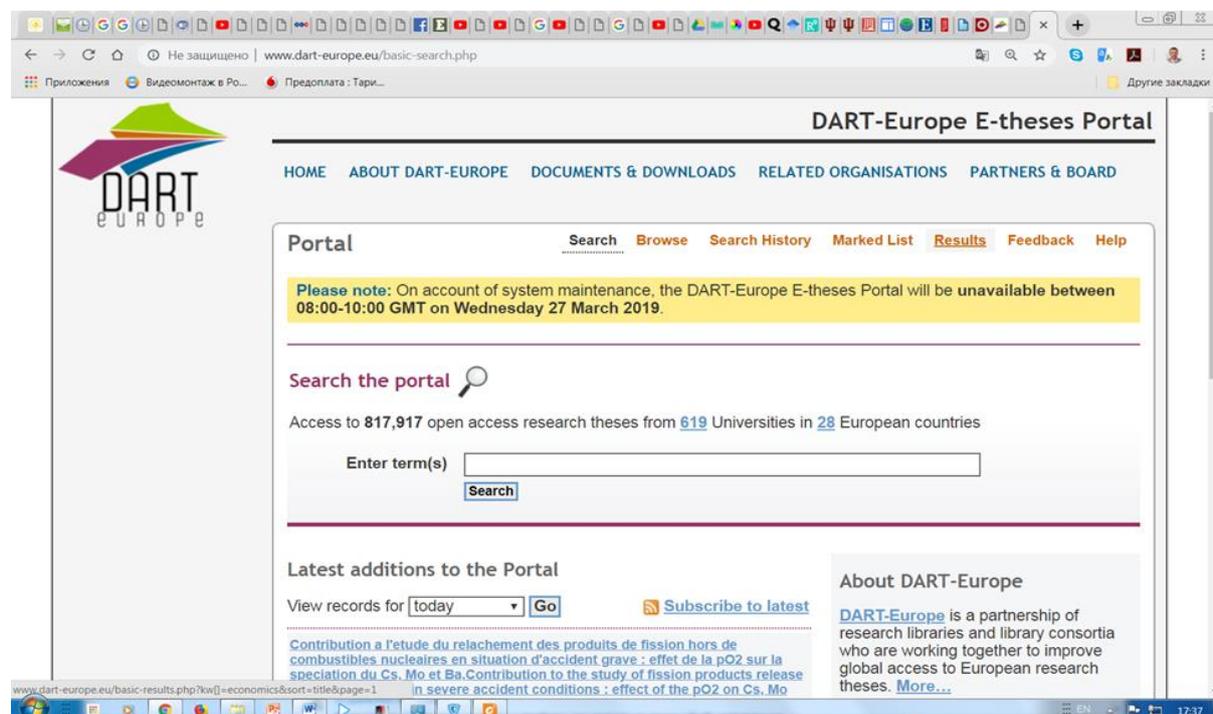

Fig. 4. **The NDLTD home page**

Fig. 5. **The DART-Europe E-theses Portal**

Google search commands.

When you search using Google commands and operators, the search results may vary depending on your browser settings, IP address, and the Google you choose. For example, **google.com** is a global search engine, and its results will differ from **google.ua,** which is a local search engine for the Ukrainian audience.

You can also use the operator before or after the keyword query. To get more accurate results, you can combine and group commands.

Language and query technology in Google.

Many browsers support the ability to type a search query directly into the address bar, including Firefox, Opera, Chrome, and the latest versions of Internet Explorer. You can type a question instead of a web address, and which search engine will be used to find the answer depends on your settings. For example, in the case of Chrome, Firefox and Opera, the default search engine is Google, while Internet Explorer sends users to the search site www.bing.com, developed by Microsoft.

All operators of Google search queries.

Get acquainted with the main and secondary search operators.

● **Site search (site :).**

This is a popular and favourite command for many webmasters to search for a query on a specific resource.

The formula for success is simple: enter the query, then the syntax (site :) and url. As a result, you will get all the texts about your query on the site.

Important! You do not need to put a space between the colon (:) and the link.

● **Exact match ("").**

The operator shows pages that contain the exact match to your key – the words in quotation marks ("") are in the same order.

This command will be useful for those who are looking for information about rare products with long article numbers. It will also help you quickly find thieves of your news and other information.

To increase the targeted search area, add quotation marks to one part of the query and leave the other part of the query broad.

● **Files (file :).**

The special character searches the Web for documents of a specified format, saving the user time and nerves. For example, if you want to study

the legendary work of marketing founder Philip Kotler in a "PDF", you need to enter the following query into the search engine: "Kotler marketing filetype: pdf". The book will start downloading immediately after you click on the website address.

- **Plus words (+).**

These AdWords matching operators find the full set of listed words within the same sentence. The main thing is to put a plus (+) between them.

- **Minus words (–).**

They are useful in cases where you need to exclude unwanted words from the query. All you need to do is put a minus (–) without a space in front of the unwanted fragment.

If you type in Google "how to optimise an online store", you will be able to see sites with all the information about an online store (opening, niches, design choices) except for its optimisation.

- **Or (OR).**

Shows resources where at least one of the specified words and phrases occurs.

- **operator *.**

This is a universal command in Windows designed to find an exact match, where * replaces any number of words. By typing "order * inexpensively", you will receive information about everything that can be ordered inexpensively on a particular online platform: a website, an essay, a dress.

- **Special character.**

An ideal solution if you need data with a digital range (like 1.15). It refines the query with a specific location in mind. **The define operator** allows you to instantly find the definition of a term from an authoritative source, such as Wikipedia.

- **Date symbol.**

Searches for information that appeared in the index during a certain period. For example, a person who types "social media promotion date: 6" in the search bar will receive data that was added within the last six months.

- **Refine the source query.**

This feature is intended for Google News and is designed to narrow down the search circle according to the selected source. For example, with a news magazine.

- **Allinurl matching operator.**

An extremely useful feature that shows websites with words mentioned in the url after the command itself. To expand the search area, it is better to use Latin or transliteration. For example, "allinurl: marketing".

- **The special character inurl.**

In this case, the system will limit the results to a single word. Do you want to find an answer to the query "tips", the address of which contains "seo"? Then feel free to type "tips inurl: seo" in the search.

- **The allintext command.**

It comes to mind when you need a complete query based solely on the content of the page.

- **Additional intext syntax.**

If you specify "seo intext: humour" in the search, it will give you data on the word "humour" that contains materials with the inclusion of "seo".

- **Allintitle operator.**

Searches for the full occurrence of the specified query in the title of pages.

- **The intitle function.**

It is similar to the previous special character, but with the difference that its search is limited to the first word specified in the query.

- **Cache :).**

After entering "cache:site", you will see the latest copy of the Google cache page of the analysed website. A similar manipulation can be done with any portal on the Internet.

- **Information (info :).**

This displays all information about the specified page. This method allows you to check whether a page is indexed in the search engine.

- **Allinanchor command.**

This command is used to search for projects with keywords in the description of the links to which they are referring.

Search operators for setting up contextual advertising.

Additional syntax will save not only your time but also money. With the help of a few simple special characters, the user will significantly narrow down the search and find what they are looking for in a matter of minutes.

Using special characters for search engines is the best way to solve this problem. They will weed out non-targeted queries, so that only the interested

audience will see your advertising content. The result of this will be the same as when you increase the budget for Direct, but you will do without additional costs.

Do you want to know which clarifying characters you should choose in this or that case, how exactly they will help your business? Then read on!

How do Google AdWords operators work?

The service allows you to work with broad, phrase and exact match, as well as use minus words and the broad match modifier.

All keywords specified without special characters are perceived by the search engine in a broad match. In this case, the ad is shown in response to queries with relevant keyword phrases and word forms. Among them:

● synonyms;

● variants that are close in topic;

● words that are similar in meaning.

Please note: If there are no relevant Google search operators, the word order in the keyword phrase is not taken into account.

Google AdWords by default supports the "Close variants" feature that can be disabled. This means that it will show analogues in the singular and plural, with different cases, word forms, declensions, and typos.

For broad matching, a modifier is provided to display phrases with the mandatory presence of the specified key. This is a plus sign (+). For example, the query "+ buy a ticket + Tahiti" will be seen by every user who is looking for holidays and tours to Tahiti and wants to buy them. The words "Tahiti" and "buy" should definitely appear in the query, but instead of "voucher", there can be "vacation", "tour" or "rest".

Exact and phrase matching.

To get only the entered words with any case, declension, and number, as well as their synonyms without any additions, you need to use the syntax in the form of square brackets.

As for phrase matching, it is intended to find passages with the specified word or phrase (it must be enclosed in quotation marks ""). In this case, there are usually additional words before and after such a key. There are also minus words that exclude irrelevant phrases – the minus (–) symbol was invented for this purpose. By the way, use it to speed up the process.

Attention: The search engine does not take into account service words, conjunctions, and prepositions by default. For example, the answers to the query "tickets in Kyiv" will be "ticket to Kyiv" and "ticket Kyiv".

To exclude a large number of untargeted queries and achieve high conversion rates, use the special character of quotation marks (""). In this case, the ad will be shown only to queries with a specific keyword and its word forms.

Do you want to force a fixed word order? Use square brackets. This command is especially relevant when selling tickets. For example, an advert posted on Yandex that says "[ticket Samara-Kaliningrad]" will be displayed to those users who need to travel from Samara to Kaliningrad. Those wishing to book a ticket from Kaliningrad to Samara will not see it at all. And everyone knows that the more specific an offer is, the more effective it is.

Minus and plus words.

The plus (+) match operator is used to take into account conjunctions and prepositions, which, as already mentioned, are ignored by the search engine. Thanks to it, you will create a more relevant headline and, accordingly, increase sales. The phrase "+ how to buy a ready-made online store" is suitable for users who need additional information about the purchase, and "+ where to buy a ready-made online store" is suitable for those who are interested in the place of purchase.

If you need to "freeze" the current number and case of a word, use the exclamation point "!". For example, "! Looking for investor" or "! Searching for investors". For maximum effect, you can group commands with exact matches, i.e. with quotation marks.

Search basics and the Google search engine query language.

The easiest way to search on Google is to type one or more search terms (words or phrases that best describe the information you need) in the search box and press 'Enter'. Google will return a search results page: a list of web pages that match your search terms. The pages that best match your search terms are displayed at the top of the list. It is clear that choosing the right search terms is the key to finding the information you need.

You can start with the obvious – if you're looking for general information about Lviv, try entering just "Lviv". But it's usually better to use several words: if you're planning a tour of Lviv, you'll get better results for the query "Lviv

tour" than for the separate queries "Lviv" and "tour". And the query "Lviv city centre tour" can give you even better (or worse, depending on where you are going) results.

You may wonder if your search terms are specific enough. Of course, in this sense, it's better to search for "good coffee shop downtown" than "coffee shops in the city". But you need to be careful and choose your terms carefully, because Google is looking for exactly what you are asking for. Therefore, a good coffee shop in the city centre is likely to give a better result than a really good place to relax during a city centre tour.

The Google search engine is NOT case sensitive. All letters, no matter how you enter them, are automatically translated into lower case (become small). Therefore, for example, the search results for the queries "Kyiv National University" and kyiv national university will be the same. By default, Google only returns pages that include all of your search terms. Therefore, there is no need to insert "and" between terms. But keep in mind that the order of the words in your query can affect the search results. Sometimes you only need results that include a phrase (or phrase combination) in its entirety. In this case, you just need to enclose your search terms in quotation marks. Phrase searching is most effective if you are looking for proper names ("Taras Shevchenko"), phrases from poems or songs ("Why do you appear to me in my dreams"), or other famous sayings ("of all losses, the loss of time is the most difficult").

Search for "+".

Google ignores very commonly used words and symbols such as "where", "how", "the", as well as some single numbers and single letters, because they tend to slow down the search without improving the results. If one of your search terms is ignored, you can find out about it right away on the search results page.

However, it may be that this very commonly used word is important for getting the results you need. In this case, you can include it in your query by adding a "+" sign in front of the word. (Remember to leave a space before the "+" sign!) Another way is to use phrase search. In phrase search, commonly used words (for example, "where are you") are not excluded. For example, to search for Star Wars, Episode I, you can use Star Wars Episode +I OR "Star Wars Episode I".

Word Shape Change Google uses word shape change technology. So, when it's appropriate, it looks not only for the search terms you enter, but also

for words that are similar to all or some of your search terms. If you set your search parameters as pet lemur dietary needs, Google will also look for results for pet lemur dietary needs and other possible variations of your search terms. Any variations of your search terms that have been searched for are highlighted in the text that accompanies each search result.

Exclude search terms.

If your search term has more than one meaning (for example, ocean can refer to a geographical location, a large volume of something, or part of the name of the popular band Ocean 2 Elsa), you can focus your search by placing a "-" before the words associated with the meaning you're not interested in. For example, to find information about the ocean as such, but not about the musical group, you can use the following search parameters: ocean -elzy.

Note: If you include a negative search term in your search, remember to leave a space before the "-" sign.

I'm Feeling Lucky.

After you have entered your search terms in the search form, you can try clicking the "I'm Feeling Lucky" button, which immediately redirects your browser to the web page that best matches your search terms (according to Google). In this case, you will bypass the search results page. If you use the regular Google Search button, then the link that matches the "I'm lucky" option will be the first in the list of search results. For example, if you are searching for the website of Taras Shevchenko National University of Kyiv, you can enter KNU in the search form and click "I'm lucky" instead of the "Google Search" button. Google will automatically redirect your browser to http://www.univ.kiev.ua/ua/.

Search settings.

You can change the default search settings by following the link Preferences (http://www.google.com/preferences?hl=en for the English version, http://www.google.com.ua/preferences?hl=uk for the Ukrainian version).

It is possible to set the language of the pages included in the search results. This search method cannot be considered universal, as it covers only a part of the web, so Google usually offers search in all languages by default. However, selecting a specific language can be useful if it is a fundamental condition for your search. Please note that by default, if you are using the Ukrainian version of Google, you can easily choose to see results in

Ukrainian only (this option is offered on the search results page), but you can choose any language from the general settings page. You can also choose the interface language for Google on the settings page.

By default, search results are displayed on a page of 10. This value guarantees the fastest response. However, you can change this value to 20, 30, 50, or 100 if you prefer.

When you search for information using Google and click on one of the search result links, a new page replaces the search results page. If you prefer to keep your search results in an open window, select the Show search results in a new window option.

By the way, did you know that Google has an online translator (http://translate.google.com)? It's a shame that it doesn't yet support Ukrainian, but you can already translate from a dozen other languages into Russian.

Advanced search.

Advanced search allows you to configure a number of options to make your search more precise and the results more useful. You can access this page by clicking the Advanced Search link from the Google home page.

Advanced Search allows you to do much more than just list search terms. You can search only for pages:

- that contain ALL of your search terms;
- that contain the exact phrase you entered;
- that contain at least one of the words you entered;
- that do NOT contain any of the words you entered;
- created in the specified language;
- created in the specified file format;
- those that have been updated within a specified period of time;
- that keep numbers within a given range;
- located within a given domain or website;
- that do not contain "adult" material.

You can improve your search results by adding "operators" to your search terms in the regular Google search form or by selecting them on the Advanced Search page. Google supports a number of advanced search operators (special operators), which are essentially query words that have a specific meaning to Google. Typically, these operators change the search rules in a certain way or define a completely different type of search. Most of the special operators are available from the Advanced Search page, but not all of them.

Some of the more commonly used operators are specified by punctuation marks rather than words, or do not require a colon after them. These operators include: OR (the OR operator), "" (the quotation mark operator), – (the minus operator), and + (the plus operator).

The most popular Google special operators are:

cache: The [cache:] **query** displays the version of a web page that is stored in Google's cache. (A search engine cache is a version of a web page that is recorded during indexing. Since the page can change after indexing, the text stored in the cache sometimes differs from the text on the actual page). For example, cache:www.google.com will return the Google cache for the Google homepage. Note that there must be no space between the "cache:" operator and the web page address.

If you include other words in your search, Google will highlight those words in the cached document. For example, cache:www.google.com web will show the cached content with the word "web" highlighted. You can get a similar result by clicking on the "Cached" link on the main Google search results page.

link: The [link:] **query** displays a list of web pages that contain a link to the specified web page. For example, link:www.google.com will display a list of web pages that contain a link to the Google home page. Note that there must be no space between the "link:" operator and the web page address! A similar result can be obtained from a complex search page via **Page Specific Search > Links (Page Specific Search > Links).**

related: The [related:] **query** returns a list of web pages that are "related" to the specified web page. For example, related:www.google.com will list web pages that are similar to the Google home page (i.e., the home pages of other search engines). Note that there must be no space between the "related:" operator and the web page address! You can get a similar result from a complex search page using **Page Specific Search > Similar (Page Info Search > Similar).**

info: The **[info:] query** will return information that Google has about the specified web page. For example, info:www.google.com will return information about the Google home page. Note that there must be no space between the "info:" operator and the web page address! The same result can be obtained by explicitly typing the web page address in the Google search form.

define: The **[define:] query** will return definitions of the word entered after the operator, taken from various online sources. The definition will be displayed for the entire phrase you entered (i.e., it will include all the words in the order you entered them).

site: If you include the [site:] operator in your query, Google will limit the possible search results to sites within the specified domain. For example, help site:www.google.com will search for help pages within www.google.com. And help site:com will search for help pages on sites located in the .com domain. Note that there must be no space between the "site:" operator and the specified domain! A similar result can be obtained from the **Advanced Web Search** page **> Domains (Advanced Search > Domain)**.

allintitle: If you start your query with the [allintitle:] operator, Google will limit the search results to those that contain all the search terms you entered in the page title (the title is actually the title of the window in your browser when the page is open). For example, allintitle: google search will return only documents that contain both words: "google" and "search" in the title. A similar result can be obtained from the **Advanced Web Search** page **> Occurrences (Advanced Search > Occurrences)**.

intitle: If you include the [intitle:] operator in your query, Google will limit the search results to those that contain the specified search term in the page title (the title is actually the title of the window in your browser when the specified page is open). For example, intitle:google 4 search will return a list of documents that contain the word "google" in the title and the word "search" anywhere in the document (this can be in the title or outside the title). Note that there must be no space between the "intitle:" operator and the next word! If you insert [intitle:] before each search term in your query, the result is the same as if you precede the entire query with **[allintitle:]: intitle:google intitle:search** works the same as **allintitle:google search**.

allinurl: If you start your query with the [allinurl:] operator, Google will limit the search results to those that contain all the search terms you entered in the page's address (url). For example, allinurl: google search will only return documents that contain both words: "google" and "search" in the url. Note that the [allinurl:] operator operates on words, not on parts of the url. In particular, it ignores punctuation. Accordingly, allinurl: foo/bar will limit the search results to those containing the words "foo" and "bar" in the url, but it does NOT mean that these words must be separated by a slash within the url, that they must be next to each other, or that they must be in that order. So

far, there is no way to specify such a complex search criterion. A result similar to the action of the [allinurl:] operator can be obtained from the **Advanced Web Search** page **> Occurrences (Advanced Search > Occurrences)**.

inurl: If you include the [inurl:] operator in your query, Google will limit the search results to those that contain all the words specified after this operator in the page address (url). For example, **inurl:google search** will return documents that contain the word "google" in the page address (url) and the word "search" anywhere in the document (this can be either in the page address or outside it). Note that there must be no space between the "inurl:" operator and the next word! If you insert [inurl:] before each search term in your query, the result will be the same as if you precede the entire query with [allinurl:]: inurl:google inurl:search works the same way as **allinurl: google search**.

Search for synonyms.

If you want to search not only for the search terms you specify, but also for their synonyms, you need to put a tilde sign ("~") directly before the corresponding search term. For example, to find information about food facts and cooking information (in English), you can search for ~food ~ facts (This option does not seem to be available in Ukrainian yet).

OR search.

To find pages that contain either of two search terms, you need to insert OR (in capital letters!) between these terms in your query. For example, you can search for information about holidays in London or Paris as follows: **holiday London OR Paris**.

Search for numbers within a specified range.

Need to find something related to numbers? Use two numbers separated by two periods without spaces as your search term. You can use this to search for any number-related value, from dates (Willie Mays 1950…1960) to measurements (500…1000 mm length). But don't forget to specify a unit of measurement or some other indicator of what these numbers represent. For example, to search for a DVD player with a price from $50 to $100, you can specify the following: DVD player $50...$100.

Task 8.3. Based on the material you have studied, build a search query (definition of concepts, trends, models, methods, etc.) for your research topic. Perform the search.

Control questions

1. Describe the role of information in research.

2. How is the National System of Scientific and Technical Information organised?

3. What are the types, sources of information and modes of access to it?

4. Where is economic information searched in documents and in the system of bibliographic resources of Ukraine?

5. Give a general description of the technology of working with information sources.

6. Name the main journals in economics.

7. Describe the main Internet services and the main types of search for scientific information.

8. What are the features of the use of information retrieval systems of the Internet?

9. What are the rules for forming queries to search for information on the Internet?

10. Electronic resources: domestic and foreign databases, electronic libraries on the Internet.

11. What is the practice of dynamic reading and rational work with scientific literature?

12. What are the requirements for publishing research results in articles, monographs, reports, conference papers?

13. What is the purpose of scientometric databases of publications?

14. What are the features of using the Impact Factor?

Topic 9. Project-based forms of research

Forms of financing research activities. Methods of project management in research management. Preparation of grant applications.

Study the theoretical material on the topic provided in the textbook [2, p. 657–722].

Task 9.1. On the basis of the material studied, build a map of the key concepts and issues of the topic "Project-based forms of research" (Fig. 6).
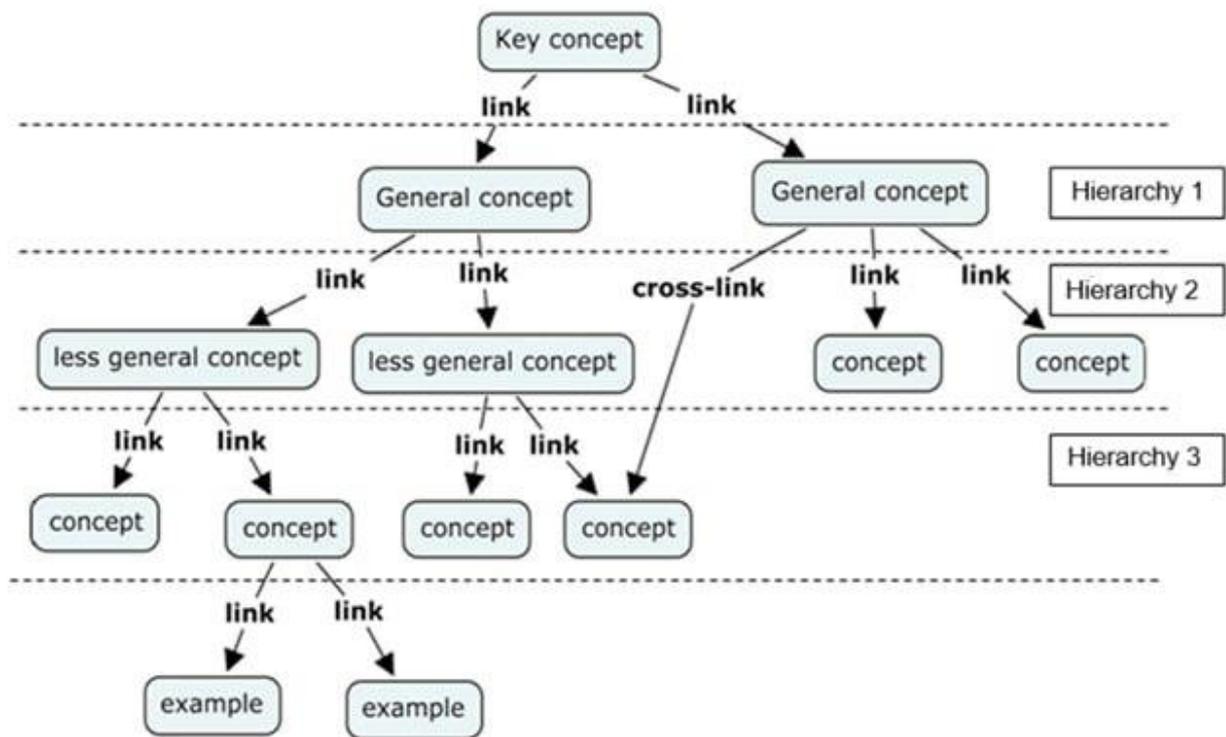
Fig. 6. **Project-based forms of research**

Also work through the additional methodological material below and complete the relevant tasks for independent work (Task 9.2 and Task 9.3).

Groups of project management processes typically include:

● initiation;

● planning or development;

● operation or execution;

● monitoring and control;

● termination.

After the initiation stage, the project is planned with the required level of detail (see Fig. 6). The main task is to plan time, costs and resources in order to adequately estimate the work to be done and effectively manage risks during the project implementation. Similar to the initiation process group, an insufficiently developed plan significantly reduces the chances of a project successfully completing its tasks.

Project planning generally consists of:

● determining "how to plan?" (e.g., according to the level of detail or implementation stages);

● developing a document that defines the content and scope of the project;

● identifying a group of people who will plan the project;

● defining the project results and creating a work breakdown structure;

● identifying the tasks that need to be completed to achieve the project goals and the logical sequential combination of such tasks;

● assessment of resource requirements to ensure the completion of tasks;

● estimating the time and cost of tasks;

● developing a calendar plan and schedule;

● developing a budget;

● risk planning;

● obtaining formal approval to start work.

Additional processes, such as planning communications, defining roles and responsibilities, project procurement, and holding a preliminary meeting of project participants (Kick-off meeting) are generally recommended. The place of planning processes in the overall project life cycle is illustrated by the IT project management structure (Fig. 7, 8).
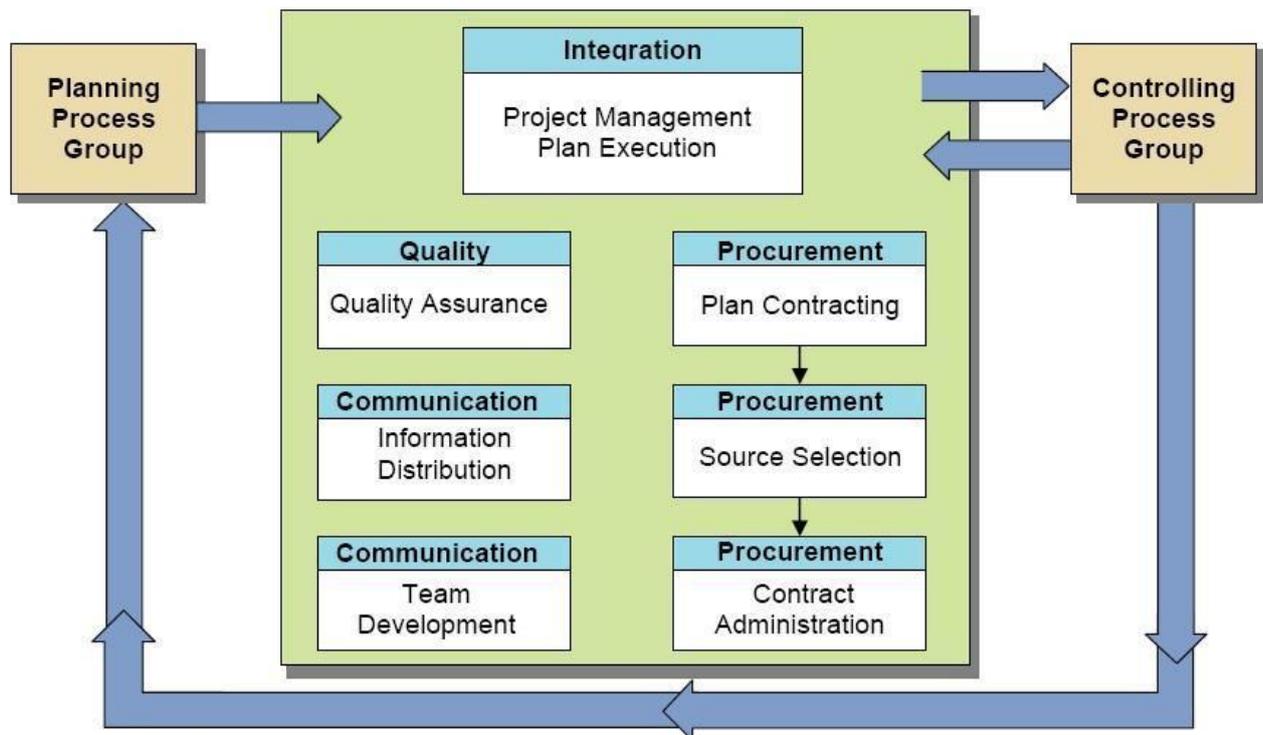
Fig. 7. **Planning process group**
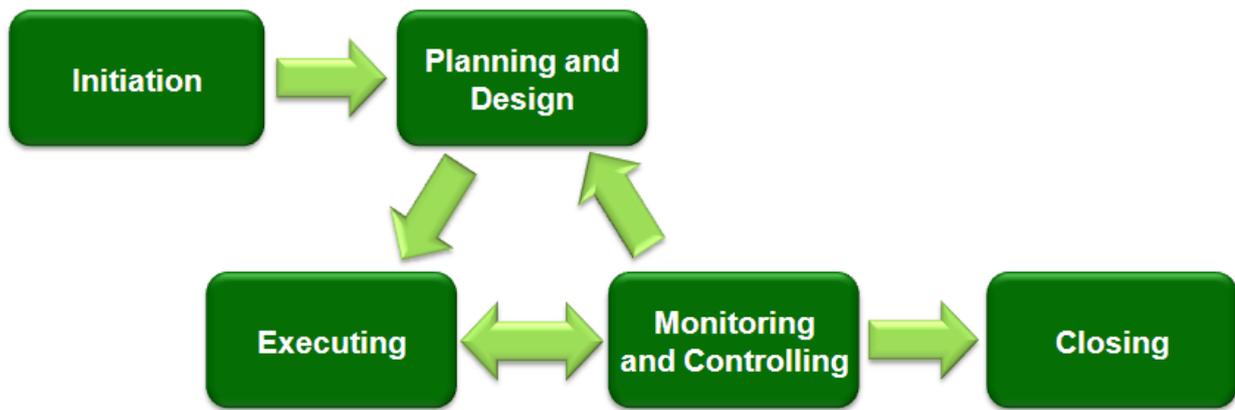
Fig. 8. **An example of an IT project management structure**

For new product development projects, product conceptualisation can be carried out in conjunction with planning activities, which can help the planning team by informing them of the defined project deliverables and planned tasks.

A huge database of grants, scholarships and investments for scientists, students, educators, cultural workers, media, business, etc. has been launched in Ukraine – KickYour.Tech.

Founded by Ukrainians, the database currently contains information about 6,000 grant programmes and 50 – 60 items are added daily.

To search, you need to choose your field of research and geography of coverage (you can go even further, such as the amount of funding or the country of the initiator), and the system will automatically select the right options. The search result is a selection of grants ranging from the US or UK governments to the Fulbright Foundation in Ukraine, USAID, various ministries, etc. The website of the KickYour.Tech platform is https://kickyour.tech/uk.

Task 9.2. Consider your dissertation research as a project, where you are the project team. Perform a generalised project planning based on the material presented above and Fig. 7. Based on the example of the project management structure (Fig. 8), formulate the activities for your dissertation project.

Task 9.3. Go to the website of the database of grants, scholarships and investments for scientists, students, educators, cultural, media and business workers KickYour.Tech. Based on the results of Task 9.2, find potential

grants, potential investors and potential partners. Perhaps this search will be not only educational, but also lead you to serious financial and information resources. We wish you every success.

Control questions

1. What forms of research funding are available in Ukraine?

2. What is economic contractual research and development (R&D)?

3. What project management methods are used in research management?

4. What is the specificity of the grant form of research funding?

5. What are the conditions for preparing grant applications?

6. What are the principles of writing a grant application?

7. Explain the main content of the logical framework for the project.

8. What is the general structure of a grant proposal?

9. Describe the process of developing a grant application and security documents.

10. What types of activities fall under the concept of scientific activity?

11. In what forms is the organisation of scientific research carried out?

12. What are the objects of copyright?

13. How is an electronic application for an intellectual property right prepared and what are its mandatory details?

Topic 10. Technology of working on a dissertation. Presentation, defence and implementation of research results

Organisation of work on the dissertation. The system of certification of scientific personnel. Choosing a research topic. Drawing up a dissertation plan. Basic requirements for dissertations. Development of a presentation of scientific research. Content and structure of the report. Implementation of the results of completed research. Effectiveness of research results: criteria, calculation. Defence of the dissertation. Implementation of research results in the curriculum of academic disciplines.

Work out the theoretical material on the topic provided in the textbook – [2, p. 723–766].

Task 10.1. Based on the material studied, build a map of the key concepts and issues of the topic "Technology of working on a dissertation. Presentation, defence and implementation of research results".

Task 10.2. Write an introduction to your dissertation using the traditional requirements for its structure and content.

Task 10.3. Create the structure of the main part of the dissertation. (See subsection 10.2.1. of the Guidelines [3]).

The design of the main part of the dissertation indicates which sections and subsections should be provided, how they can be interconnected.

There are 5 main types of thesis body structure:

● systemic and problematic;

● theoretical and applied;

● software;

● theoretical and methodological;

● time-historical periodisation.

In the systemic-problem design, the entire structure of the dissertation is "strung" on a scientific problem: The essence of the problem and its formulation → Proposed ways to solve the problem → Confirmation and practical significance of the problem.

The theoretical and applied design of the main part of the dissertation consists in its division into component parts according to the principle: Theoretical foundations of the research topic → Applied aspects of the research problem → Practical recommendations. The researcher moves from theory to practice and solves an applied problem through the creative application of theory.

The programmatic design of the main part of the dissertation is aimed at works of clear applied orientation: Goals → Ways → Means.

The theoretical and methodological design provides for the construction of the work according to the principle: Theory → Methodology → Technique → Technology.

The construction of the time-historical periodisation is based on the following scheme: Period 1 → Period 2 → Period 3 (study of stages of development of events or scientific ideas).

Control questions

1. What scientific degrees are awarded in the system of certification of scientific personnel in Ukraine?

2. What are the structural components of the system of certification of scientific personnel in Ukraine?

3. Give a definition of thesis.

4. What are the main features of working on a dissertation in comparison with other types of research work?

5. Name the main sections of the content of the dissertation.

6. List the main requirements for thesis design.

7. On the basis of what criteria is the research topic chosen?

8. What indicators are used to analyse the structural adequacy of a dissertation?

9. What is the purpose of a dissertation abstract?

10. What are the requirements for the presentation of research, content and structure of the report?

11. What types of work are involved in planning for the defence of a dissertation?

12. Describe the procedure for defending a dissertation.

13. Where is the preliminary examination of dissertations carried out?

14. What stages precede the defence of a dissertation in a specialised academic council?

15. What is the procedure for defending a dissertation?

16. What activities are carried out by specialised academic councils? In which organisations are they established?

Topic 11. Technology and psychology of scientific creativity. Development of abilities for scientific activity

Principles of system thinking in scientific creativity. Techniques for stimulating scientific creativity. Self-organization of scientific work. Abilities for scientific activity and their development. Factors determining the solution of a scientific problem. Obstacles to creative thinking. Discussion as a form of scientific communication. Strategy and tactics of polemics. Methods of argumentation in scientific discussion. International communications and internships as a tool for the development of a scientist.

Task 11.1. Study topic 11 of the textbook [2, p. 783–848]. Build a mind map of the topic according to the rules given in Appendix A.

Self-organization of scientific work is a set of sociological and psychophysiological measures taken by the scientist himself to ensure system and order in his work. Due to the fact that the study of economic processes involves the processing of large amounts of digital information, the researcher must develop such character traits as concentration, attentiveness, and analytical thinking, which allow for a critical evaluation of the results of the calculations performed.

The main elements of self-organization of work are the organization of the workplace and work area, working hours, consistency, sequence, work discipline, the use of means of mechanization and automation of auxiliary operations, independence, self-training, self-planning and self-regulation, self-control, self-accounting, self-restraint, self-criticism, and self-monitoring [17].

Task 11.2. Consider the elements of self-organization in your work and describe its elements: independence (in what actions?), self-training (for what and how?), self-planning and self-regulation (which components of loyalty and how), self-regulation (of what?), self-accounting (of what actions and results?), self-restraint (in what?), self-criticism (of what?), self-control (of what processes, thoughts, actions?).

Task 11.3. Self-assess your creative abilities and formulate ways and directions for developing those abilities that need your attention.

Task 11.4. Study the presentation "Opportunities for postgraduate students of S. Kuznets Kharkiv National University of Economics to participate in international projects and academic mobility programs" prepared by the head of the International Relations Department of S. Kuznets Kharkiv National University of Economics, Y. B. Dobroskok, which is included in Appendix B of the guidelines.

Task 11.5. Study the description of the "EU Erasmus+ Program: Support for the educational, professional, and personal development of EU citizens and beyond, in the fields of education, youth, and sports" [16]. A short excerpt from the Erasmus+ Guidance Document with a translation into Ukrainian can be found on the website of Simon Kuznets Kharkiv National University of Economics.

Task 11.6. Familiarize yourself with the terms and conditions of internship programs and internship grants at the links provided in the presentation, as well as at the links for specific countries listed below. Find

the program that best suits your needs and capabilities and submit an application for it in accordance with the requirements specified on the website. We wish you success.

Links to internship programs for graduate students:

China: http://iczu.zju.edu.cn/english/redir.php?catalog_id=22232.

France: https://www.ukraine.campusfrance.org/stipendii-uryadu-francii-magistratura-ta-doktorantura-aspirantura; https://institutfrancais-ukraine.com/etudier/bourses/bgf; https://www.fmsh.fr/en/international/atlas-2022-call-for-applications-ukraine-france.

Canada: http://www.mitacsua.org/mitacs-globalink-research-internship/#hto-mozhe-stati-uchasnikom.

Germany: https://mobilnist.kpi.ua/diploms/swp/; https://www.bundestag.de/en/europe/international/exchange/ips/ips-201258; https://www.humboldt-foundation.de/web/georg-forster-fellowship.html?fbclid=IwAR0dbGNF2HHhF4XAjgmZKhtkERhOdSYS1f3tNLHlOLIH05WhXF4m1dNWbyc.

Visegrad Group: https://www.visegradfund.org/apply/mobilities/visegrad-scholarship/; https://scholarship-positions.com/international-visegrad-fund-research-grant-programme-2022/2021/10/01/.

Sweden: http://www.swedishcollegium.se/subfolders/Fellowships/generalfellowships.html.

Slovakia: https://www.scholarships.sk/en/.

Austria: https://oead.at/en/to-austria/grants-and-scholarships/ernst-mach-grant/faq-ernst-mach-grant-worldwide/.

Review questions

1. Formulate the principles of systems thinking in scientific creativity.

2. What are the characteristics and differences between various types of thinking: scientific, practical, everyday, vertical, lateral?

3. Describe techniques for stimulating scientific creativity.

4. How are intuition and creativity related?

5. What is the essence of the art of creative thinking?

6. Explain the essence and describe the principles of organizing scientific work.

7. How are scientific abilities developed?

8. Describe the factors and stages of creative thinking.

9. What are the mechanisms, properties, and characteristics of a scientist's thinking?

10. Subjective representations of scientific problems.

11. What factors determine the solution of a scientific problem?

12. What can hinder creative thinking?

13. Describe discussion as a form of scientific communication. Strategy and tactics of polemics.

14. Identify methods of correct and incorrect approaches to seeking the truth.

15. What methods of argumentation are used in scientific discussion?

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Appendices

Construction rules and recommendations for developing memory maps (mind maps, mental maps)

The essence of the mind mapping technique is that the main concept is highlighted, from which tasks, ideas, individual thoughts and steps necessary for the implementation of a particular project or idea are then branched off. Just like the main one, smaller branches can be divided into several more sub-branches.

It turns out that a mental map reflects associative connections in the brain of its creator. Therefore, further work with such mental maps will be interesting and productive.

This technique is based on the principle of radiant thinking, associated with associative mental processes. The starting point in such a process is the central object (thought, idea, task).

Another advantage of the mental maps method is that it is a method of holistic thinking. As is known, the left hemisphere of the brain is responsible for logical thinking. Therefore, when making classic linear notes, it will be activated. But the right hemisphere, which is responsible for creativity and imaginative thinking, will rest. But the mind mapping method allows you to use both hemispheres simultaneously. This means the integrity of thinking.

A mind map is a special type of diagram, presented in the form of a tree diagram. It depicts words, tasks, and other concepts that are connected by branches that extend from a central branch. The central branch represents the main idea or concept.

In the center of the screen (sheet), you should place the central idea, thought, concept. It is better to decorate it or make it in the form of a drawing. Next, you should draw lines to the corners of the sheet. They should be "marked", that is, signed with key words, nouns or verbs. Not all words will be suitable. You need to use words that are eloquent enough to make you create or restore an associative chain, recall certain images or thoughts. These are the main branches.

Further splitting into branches will display more and more fine details.

In order for the scheme to be perceived as effectively as possible, it is better to use different colors, special symbols, icons, pictures. Play with letters, their shape and size. It is also necessary to avoid repetitions that may arise when you go headlong into the creative process. The result of such creativity is not a linear, but a radial configuration.

It is important to remember that the basis of building a mental map is not structuring, but association.

A map can be considered complete if it looks solid. This means that its compiler has understood the topic or problem. If this did not work out, then it makes sense to continue the analysis and the associative series. Sometimes for this it is necessary to pay more attention to some single branch, which did not turn out very beautiful, and therefore is a weak link.

So, the basic rules and recommendations for building memory maps are as follows.

Style: your own. Don't try to imitate someone else. Every person has their own style of thinking. And since the maps reflect a person's style of thinking, they should be different from each other! Find your own style!

Exaggerate. If something is exaggerated, it is better remembered. Feel free to draw a person who is taller than a tree. Use the words: "super", "hyper", "mega". It is not necessary to be close to reality. You can safely exaggerate this reality.

Not serious. Humor is a great power. If your map makes you smile or even laugh, then it evokes an emotion that makes the map more memorable. Add a little light humor to the map! It will benefit it.

Beautiful. A beautiful map is a beautiful map. It attracts the eye more. It makes you want to study it more. It is better remembered. It evokes the right emotions and associations more strongly!

Landscape orientation. The map tends to grow sideways. Left and right. This means there should be more space there. Accordingly, we have a horizontal map.

Central image: in the center of the screen (sheet). Although a common option is when it is drawn from the left in the center and the branches extend to the right.

Bright: memorable. The image should attract attention, remain in memory, evoke the desired emotion, provoke the work of thoughts in a certain direction. To do this, make it bright!

Color (> 3 colors). A color image is better remembered, so we create it with at least three colors.

Structure: radial. We adhere to the principle of hierarchy. Closer to the center, more important concepts should be placed. Further from the center, less important concepts should be given. Thanks to this radial distribution, it is easier for us to work with the map.

Understandable. To improve the clarity of the map, we use the following elements.

Order. Number the branches with numbers "1", "2", "3" ... indicating in which order they should be viewed.

3–4 branches. Remember the law of perception: "7 ± 2". We try to build the structure so that a maximum of 3–4 branches extend from each branch.

Halos. We use halos to make the map easier to understand.

Associative. Any two elements are linked by an association. This allows us to reconstruct the map even if we remember only 20 – 30 % of the maps.

Words: key. We write only key words. As a result, we have 20 – 30 words on the map, and these 20 – 30 words sometimes store information from 20 – 30 pages of text. But from each page of text we took only 1 key word, which allows us to restore information from the text in memory.

1–2 words. There is always a temptation to write down a whole sentence! Don't do that. You should write down 1–2 key words. This is usually enough!

In one line. If we have a multi-story structure, then the eyes are forced to make several movements left and right. If everything is in one line, it's easier!

Colors: the more the better. A person is able to distinguish small shades of colors, so it is worth using this resource to the maximum! But you should not exaggerate too much either. 4 – 8 colors are usually enough for most maps. If there are more colors, then their diversity begins to rub against the eyes, and the colors cease to carry the necessary semantic load.

Meaning. Colors can carry some meaning. For example, we have a project in which Ivanov, Petrov and Sidorov are participating. If they draw a similar map together, where they distinguish themselves with different colors, it will be easy for them to understand who is performing which front of work. And the colors will carry an important semantic meaning.

Show connections. Lines also perform such an important function as showing connections between different elements of the map. An important note: it is desirable to have no more than 3 – 5 arrow lines on the map. If there are more, then these lines do not help, but on the contrary, make the map even more confusing.

Pictures: use wherever possible. Pictures, drawings, visual images are remembered 10 times better than words! Therefore, wherever possible, we try to illustrate our keywords with pictures that are well suited to them!

Three-dimensional (3D). We add volume to our drawings. In this case, the images will attract more attention and remain in the memory.

Symbols. You can use your own or commonly accepted symbols.

Programs for building mind maps. TOP 10 programs for building mind maps. Best Free Mind Map Software in 2024:

GitMind (Web, iOS, Android);

Mindmeister (Web, iOS, Android);

Coggle (Web, Android, iOS);

Canva (Web, Android, iOS);

MindMup (Web);

XMind (Windows, macOS, Linux, Android and iOS);

Cacoo (Web, Windows, macOS);

Mindomo (Web, Windows, macOS, Android and iOS);

SmartDraw (Web, Windows, macOS);

Ayoa (Web, Windows, macOS, Android and iOS).

Mind maps, or mental maps, are a reflection of an effective way to think, remember, recall, and solve creative problems, as well as the ability to present and visually express your internal information processing processes, make changes to them, and improve them.

Mind maps are a tool that allows you to:

● work easier with information: remember, understand, and restore logic;

● conveniently present material and clearly explain your position to your interlocutors;

● easier make decisions, create plans, and develop projects.

We offer a fresh selection of 8 excellent programs for creating mind maps. We are sure that these programs will help you use mind-mapping technology 100 %. In the collection, you will find many free applications and you can easily choose the best option for yourself (Fig. A.1 – A.6).

1. Google – www.coggle.it.
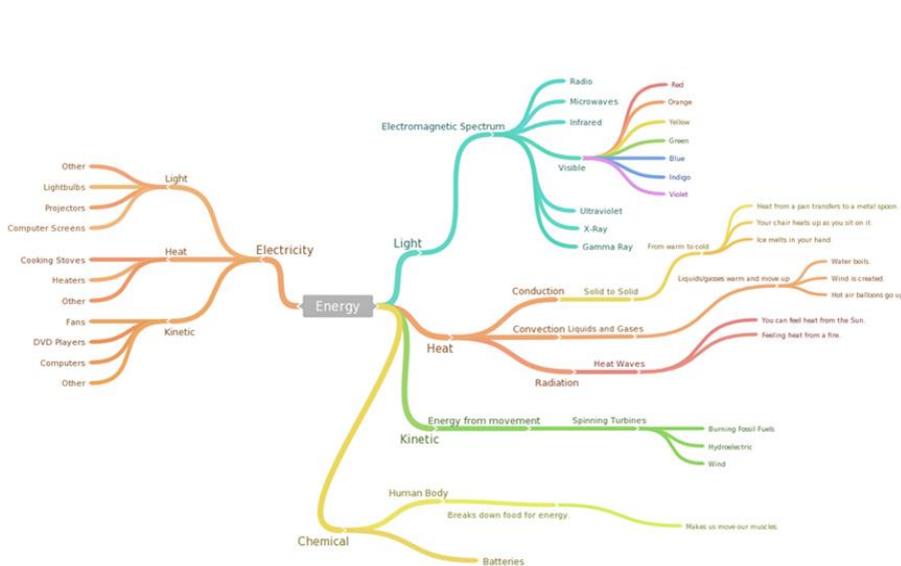
Fig. A.1. **Mind-mapping technology Google**

Coggle is a free online application that supports collaborative work on projects. In this program, you can develop convenient, beautiful mind maps. The program interface is simple, but at the same time it has many features that make the process of creating a mind map incredibly easy. The program supports the use of images, individual color schemes and the ability to view the history of the document. Saving the history of changes allows you to return to previous versions of the created map if you get stuck in the current version. Mind maps created in Coggle can be exported in PNG or PDF format.

2. Xmind – www.xmind.net.
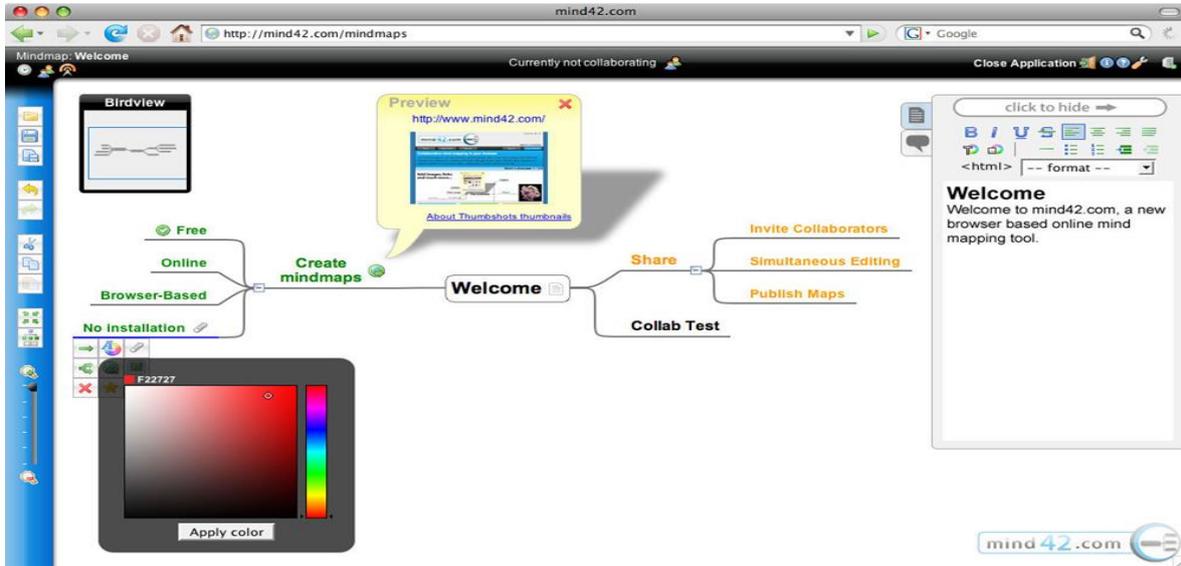
Fig. A.2. **Mind-mapping technology Xmind**

3. Freemind.
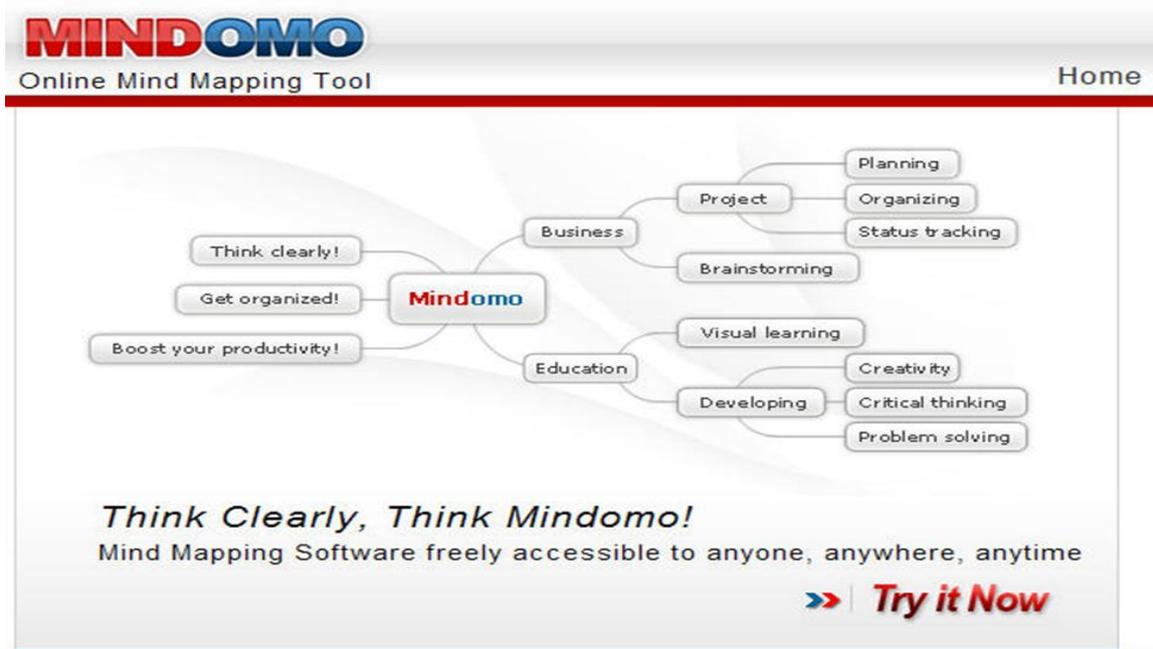
Fig. A.3. **Mind-mapping technology Freemind**

Freemind is an open source, free application that runs on any platform that supports Java. Overall, the program has the full set of features needed to create high-quality mind maps. The only downside of the program is the outdated design of the intelligence maps.

4. BubblUs – www.bubbl.us.
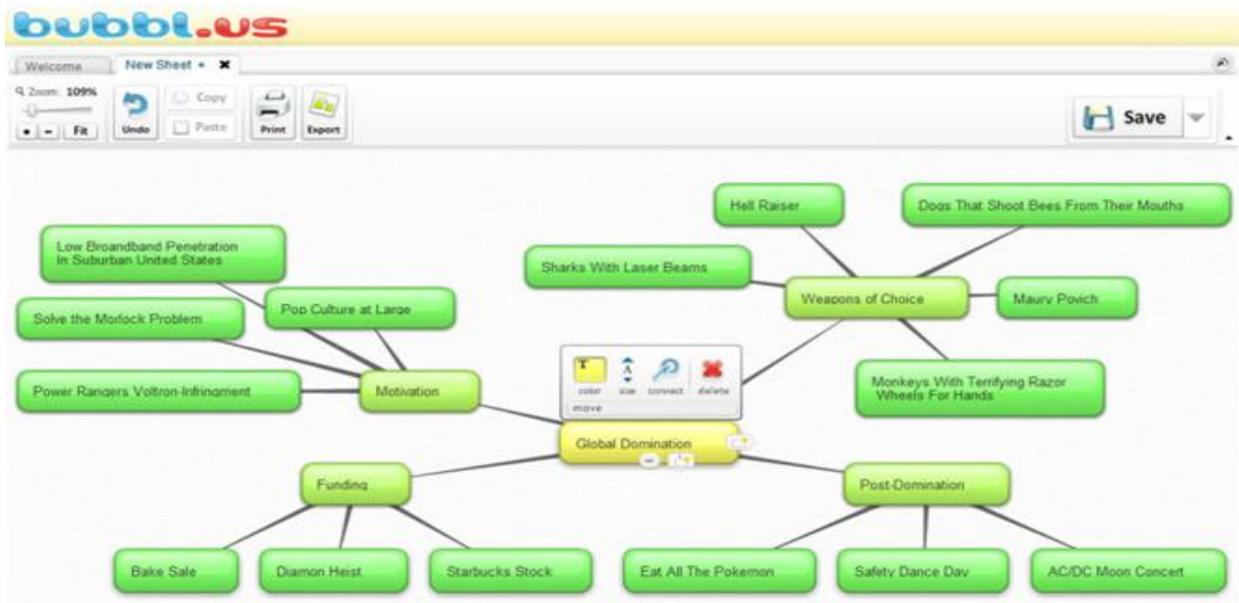
Fig. A.4. **Mind-mapping technology BuublUs**

Bubble.us is a free web application for creating mind maps online. The application allows you to create simple mind maps and export them in image format. The functionality of the program compared to simple solutions MindNode and Coggle seems a bit sophisticated, but still the program solves the task and creates good mind maps. The program runs on flash and will not work on smartphones.

5. WiseMapping – www.wisemapping.com.
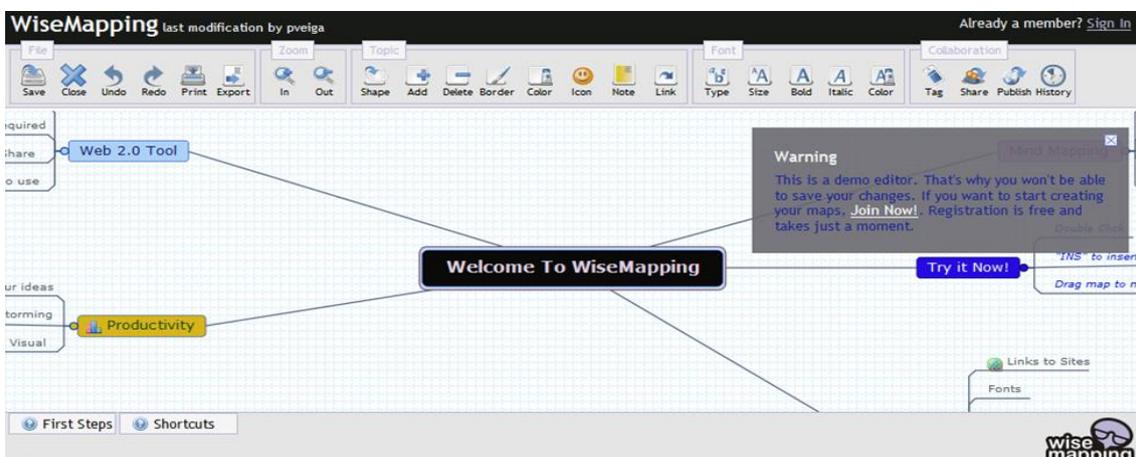
Fig. A.5. **Mind-mapping technology WiseMapping**

WiseMapping is a free online mind mapping application that uses open source HTML5. You can use the application directly from the developer's website, or you can download the open source code and install it on your own web server. The application has a full set of features for working with mind mapping technology.

6. Mind42 – www.mind42.com.
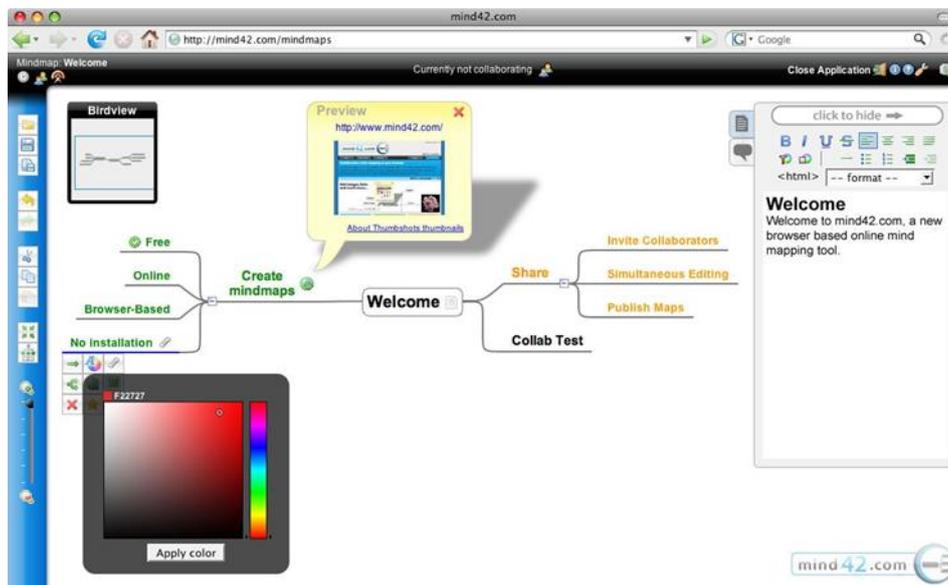
Fig. A.6. **Mind-mapping technology Mind42**

Free On-line program (Beta). Paid access is also available advantages:

- multiple people can work on the map at the same time;
- it is possible to import maps from other extensions: Mind42.com (*.m42), Freemind (*.mm), MindManager (*.mmap; *.xml);
- integrated image search on Google, Yahoo, Flickr, it is available by clicking on the icon to add an image.

Features:

- registration is required before accessing the resource;
- it is not possible to add images from files, only as a link.

Methodological foundations of experimental research

The basis of the experiment is a scientifically sound experiment with precisely calculated and controlled conditions. The word "experiment" itself comes from the Latin "experimentutn" – test, experience. This concept includes the scientific formulation of experiments and observation of the phenomenon under study in precisely calculated conditions that allow you to monitor the course of phenomena and reproduce it each time these conditions are repeated. The main purpose of the experiment is to identify the properties of the objects under study, to verify the validity of previously put forward hypotheses within the framework of the topic of scientific research. The formulation and organization of the experiment are determined by its purpose. Experiments conducted in various branches of science are technical, chemical, biological, physical, psychological, pedagogical, psychological social, etc.

Experiments in any field of science are different depending on:

how conditions are formed (natural and artificial);

research goals (transformational, explanatory, controlling, exploratory, decisive);

the organization of the study (laboratory, full-scale, field, production, etc.);

the structure of the objects and phenomena being studied (simple, complex);

the nature of external influences on the object of study (material, energy, information);

the nature of the interaction of the experimental research tool with the research object (conventional and model);

the type of models studied in the experiment (material and mental);

controlled values (passive and active); the number of variable factors (single-factor and multifactor);

the nature of the objects or phenomena under study (technological, sociometric, etc.).

These features are most often used to determine the specificity of particular experiments, but other features can also be used to classify them.

From these features, *a natural experiment* involves conducting experiments in the natural conditions of the existence of the object of research (most often it is used in biological, social, pedagogical, and psychological sciences).

An artificial experiment involves the formation of artificial conditions (widely used in natural and technical sciences). A transformational (creative) experiment involves an active change in the structure and functions of the object of research in accordance with the hypothesis put forward, the formation of new connections and relationships between the components of the object or between the object under study and other objects. The researcher, in accordance with the identified trends in the development of the object of research, deliberately creates conditions that should contribute to the formation of new properties and qualities of the object.

An exploratory experiment is used to test certain assumptions. In the process of this experiment, the presence of a certain relationship between the impact on the object of research and the result is revealed, the presence of certain facts is revealed.

A control experiment is reduced to monitoring the results of external influences on the object of study, taking into account its condition, the nature of the influence, and the expected effect.

An exploratory experiment is conducted if it is difficult to classify the factors influencing the phenomenon under study due to the lack of sufficient prior (a priori) data.

A decisive experiment is designed to test the validity of the main propositions of fundamental theories, when two or more hypotheses are equally consistent with many phenomena. This leads to difficulties – which hypothesis is considered correct. A decisive experiment provides facts that are consistent with one of the hypotheses and contradict the other.

An example of a decisive experiment is the dispute between Ptolemy and Copernicus about the motion of the Earth. Foucault's decisive pendulum experiment finally settled the dispute in favor of the Copernican theory.

A laboratory experiment is conducted in laboratory conditions using standard instruments, special model installations, stands, equipment, etc. Most often, in a laboratory experiment, not the object itself is studied, but its sample. This experiment allows you to study the effect of some characteristics with different characteristics in a good quality, with the necessary repetition, to obtain good scientific information with minimal time and resources. It simulates the real course of the process under study, therefore there is a need to conduct a full-scale experiment.

A full-scale experiment is conducted in natural conditions and on real objects. which will work later on the object that you create. Therefore, the central tasks of a full-scale experiment are: studying the features of the impact of the environment on the object under study; identifying statistical and dynamic parameters of the object; assessing the effectiveness of the object and checking it for compliance with the specified requirements.

Experiments can be open and closed, and they are widespread in psychology, sociology, and pedagogy.

In *an open experiment*, its tasks are openly explained to the subject, while in a closed experiment, in order to obtain objective data, these tasks are hidden from the subject. Any form of an open experiment influences (often activates) the subjective side of the behavior of the subjects. In this regard, the experiment is advisable only when there is an opportunity and sufficient confidence that it will be possible to force the subject to live participation and subjective support of the planned work.

A closed experiment is characterized by being carefully masked; the subject is unaware of the experiment, and the work takes place outside in natural conditions. Such an experiment does not cause the subjects to be hypervigilant and demonstrate excessive self-control, or want to behave differently than usual.

A simple experiment is used to study objects that do not have a branched structure, with a small number of interconnected and interacting elements that perform the simplest functions.

In *a complex experiment*, phenomena or objects with a branched structure (hierarchical levels can be divided) and a large number of interconnected and interacting elements that perform complex functions are studied. A researcher sets several different goals. But it is still possible to describe the specific state of a complex object. In a very complex experiment, an object is studied whose state is due to one or another. The reasons still cannot be described in detail and accurately.

An information experiment is used to study the influence of certain (different in form and content) information on the object of research (most often an information experiment is used in biology, psychology, sociology, cybernetics, etc.). With the help of this experiment, a change in the state of the object of research under the influence of the information transmitted to it is studied.

A material experiment involves studying the influence of various material factors on the state of the object of study. For example, the influence of various additives on the quality of steel, etc.

An energy experiment is used to study the effects of different types of energy (electromagnetic, mechanical, thermal, etc.) on a research object. This type of experiment is widely used in the natural sciences.

A conventional (or classical) experiment involves an experimenter as the knowing subject; an object or subject of experimental research; and the means (tools, devices, experimental setups) with which the experiment is conducted. In a conventional experiment, the experimental means interact directly with the object of research.

A model experiment, unlike a conventional one, deals with a model of the object under study. The model is part of the experimental setup, replacing not only the object of study, but often the conditions in which a certain object is studied. In addition, extrapolation of the results of studying the behavior of the model to the simulated object requires additional time and theoretical justification of the legitimacy of such extrapolation.

The tools *of a mental (psychological) experiment* are well-thought-out models of the objects or phenomena under study (sensory images, models of figurative signs, sign models). Idealized terms or an imaginary experiment are sometimes used to denote a thought experiment. The structure of a thought experiment includes: building a mental model of the object of study, idealized experimental conditions and influence on the object; conscious and planned changes, a combination of experimental conditions and influence on the object; conscious and precise application of the objective laws of science at all stages of the experiment, thereby excluding absolute arbitrariness. As a result of such an experiment, conclusions are formed.

A material experiment has a similar structure. However, a material experiment uses material, not ideal objects of study. The main difference between a material experiment and a mental experiment is that a real experiment is a form of objective material connection of consciousness with the outside world, while a mental experiment is a specific form of theoretical activity of the subject.

Thought experiment is an important point of all creative activity. Thought experiment is used not only by scientists, but also by writers, artists, teachers, doctors. Thought experiments are clearly manifested in the thinking of chess players. The role of thought experiment in technical design and invention is enormous. The results of thought experiment are reflected in formulas, drawings, graphs, sketches, etc.

A passive experiment involves measuring only selected indicators (parameters, variables) as a result of observing an object without artificial intervention in its functioning. Examples of a passive experiment are observations of intensity, composition, speed of transport flows; the number of diseases in general or any specific disease; indicators that change with age. A passive experiment is essentially an observation accompanied by instrumental measurement of selected indicators of the state of the object of study.

An active experiment is associated with the selection of special input signals (factors) and controls the input and output of the system under study.

A single-factor experiment involves isolating the necessary factors; stabilizing interfering factors; and alternative variations of the factors of interest to the researcher.

The strategy of *a multivariate experiment* is that all variables are changed at once, and each effect is evaluated based on the results of all experiments conducted in that series of experiments.

A technological experiment is aimed at studying elements of a technological process (products, equipment, employee activities, etc.) or the process as a whole.

A sociometric experiment is used to measure existing interpersonal socio-psychological relationships in small groups with the aim of further changing them.

As already noted, the above classification of experimental research cannot be considered complete, since with the expansion of scientific knowledge, the scope of application of the experimental method also expands. In addition, depending on the objectives of the experiment, its various types can be combined to form a complex or combined experiment.

To conduct any type of experiment, you need:

1) to develop a hypothesis that will be tested;

2) to create pilot programs;

3) to determine ways and methods of intervention in the research object;

4) to provide conditions for carrying out the experimental work procedure;

5) to develop methods and techniques for recording experimental results;

6) to prepare the means of the experiment (devices, installations, models, etc.);

7) to provide the experiment with the necessary service personnel.

Of particular importance is the correct development of experimental techniques.

When developing a methodology for conducting an experiment, it is necessary to provide for:

1) conducting targeted preliminary observation of the object or phenomenon under study in order to determine the initial data (hypothesis, selection of variable factors);

2) creating conditions in which experiments are possible (selection of objects for experimental influence, elimination of the influence of random factors);

3) determination of measurement limits;

4) systematic observation of the development of the phenomenon under study and an accurate description of the facts;

5) systematic recording of measurements and assessments of facts by various means and methods;

6) creating recurring situations, changing the nature of conditions and cross-effects;

7) creating difficult situations in order to confirm or refute previously obtained data;

8) transition from empirical research to logical generalizations, to analysis and theoretical processing of the obtained factual material.

A properly developed method of experimental research determines its value. Therefore, the development, selection, and definition of the methodology should be carried out especially carefully. It is advisable to check the possibility of using methods used in related problems and sciences.

Having chosen an experimental method, the researcher must make sure of its practical applicability. This must be done even if the method has long been proven in practice in other laboratories, as it may be unacceptable or difficult due to the specific characteristics of the climate, premises, laboratory equipment, personnel, research object, etc.

Before each experiment, a plan (program) is drawn up, which includes:

1) the purpose and objectives of the experiment;

2) selection of various factors;

3) justification of the scope of the experiment, the number of experiments;

4) the procedure for conducting experiments;

5) determining the sequence of changes in factors;

6) choosing the step of changing factors, setting intervals between future experimental points;

7) justification of measuring equipment; description of the experiment;

8) justification of processing methods and analysis of experimental results.

The application of the mathematical theory of experimentation makes it possible to optimize the scope of experimental research in a certain way and increase their accuracy in planning.

An important stage of preparation for an experiment is determining its goals and objectives. The number of tasks for a particular experiment should not be too large (preferably 3–4, maximum 8 – 10).

Before the experiment, it is necessary to select variable factors, that is, to establish the main and secondary characteristics that affect the studied process, to analyze the calculated (theoretical) schemes of the process. Based on this analysis, all factors are classified and a descending series of importance for this experiment is formed from them. The correct selection of main and secondary factors plays an important role in the effectiveness of the experiment, since the experiment is reduced to finding relationships between these factors. Sometimes it is difficult to immediately determine the role of the

main and secondary factors. In such cases, it is necessary to perform a small amount of preliminary search experience.

The main principle of establishing the degree of importance of a characteristic is its role in the process under study. For this, the process is studied depending on one variable with other constants. This principle of conducting an experiment justifies itself only in cases where there are few such characteristics (1–3). If there are many variables, the principle of multifactor analysis, discussed below, is appropriate.

It is also necessary to justify the set of measuring instruments (devices) of other equipment, machines and devices. In this regard, the experimenter must be well acquainted with the measuring equipment produced in the country (using the annually published catalogs, according to which certain measuring instruments produced by domestic devices can be ordered). Naturally, first of all, standard, mass-produced machines and devices should be used, the work on which is regulated by instructions, GOST and other official documents.

In some cases, there is a need to create unique devices, installations, stands, machines for developing the topic. In this case, the development and design of devices and other means must be carefully substantiated by theoretical calculations and practical considerations about the possibility of manufacturing equipment. When creating new devices, it is desirable to use ready-made components of manufactured devices or reconstruct existing devices.

A crucial point in implementing an experimental program is establishing the accuracy of measurements and errors.

Measurement methods must be based on the laws of a special science – metrology, which studies the means and methods of measurement.

When experimentally studying the same process (observations and measurements), repeated calculations on devices are usually not the same. Deviations are explained by various reasons – the heterogeneity of the properties of the body under study (material, design, etc.), the inflexibility of devices and their accuracy classes, the subjective characteristics of the experimenter, etc. The more random factors that affect the experience, the greater the discrepancy of the figures obtained during measurements, that is, the greater the deviation of individual measurements from the average value.

This requires repeated measurements, which means, it is necessary to know their minimum number. The required minimum number of measurements is understood as such a number of measurements that in this experiment a stable average value of the measured value is ensured, which satisfies the given degree of accuracy. Setting the required minimum number of measurements is of great importance, as it provides the most objective results with minimal time and money.

The methodology develops in detail the process of conducting the experiment, draws up a sequence (order) of measuring and observation operations, describes in detail each operation separately, taking into account the selected means for conducting the experiment, justifies methods of quality control of operations that ensure high reliability and specified accuracy with a minimum (previously established) number of measurements.

Log forms are developed to record the results of observations and measurements. An important section of the methodology is the choice of methods for processing and analyzing experimental data. Data processing is reduced to the systematization of all figures, classification, and analysis.

The results of experiments should be summarized in readable forms of recording – tables, graphs, formulas, nomograms, which allow you to quickly and qualitatively compare the results obtained and analyze the results. All variables should be evaluated in a single system of units of physical quantities.

Particular attention in the methodology should be paid to mathematical methods of processing and analyzing experimental data, for example, establishing empirical dependencies, approximating relationships between various characteristics, establishing criteria and confidence intervals, etc. The range of sensitivity (insensitivity) of the criteria should be stabilized (explored).

The results of experiments must meet three statistical requirements:

the requirement for the efficiency of estimates, i.e. minimum variance of the deviation with respect to the unknown parameter;

the requirement for consistency of estimates, i.e. with an increase in the number of observations, the estimate of the parameter should tend to its true value;

the requirement for biased estimates is the absence of systematic errors in the process of calculating parameters.

Appendix B (the end)

The most important problem in conducting and processing an experiment is the compatibility of these three requirements.

After the development and approval of the methodology, the volume and complexity of experimental research are established, which depend on the depth of theoretical developments and the degree of accuracy of the adopted measuring instruments (the more clearly the theoretical part of the study is formulated, the smaller the volume of the experiment).

Depending on the previous theoretical training, three cases of the experiment are possible:

1) if an analytical dependence is theoretically obtained that uniquely determines the process under study (for example, r = 3e2x), then the volume of the experiment to confirm this dependence is minimal, since the function is uniquely determined by experimental data;

2) if only the nature of the relationship (for example, y – aehx) is theoretically established, that is, the family of curves is specified, then it is necessary to experimentally determine both a and k and, therefore, the scope of the experiment increases;

3) if theoretically it was not possible to obtain any dependencies and only assumptions about the qualitative laws of the process were developed, then a search experiment is advisable, in which the volume of experimental work increases sharply. In such cases, it is appropriate to apply the method of mathematical planning of the experiment.

The type of experiment significantly affects the volume and complexity of experimental work. For example, field experiments, as a rule, are always very labor-intensive, which should be taken into account when planning.

After determining the scope of experimental work, a list of necessary measuring equipment, the amount of materials, a list of performers, a calendar plan, and an estimate of costs are compiled.

Contents

Подано основні положення щодо організації та виконання самостійної роботи. Наведено методичні рекомендації щодо виконання самостійної роботи відповідно до програми навчальної дисципліни, опис структури дисципліни, тематичний план, кваліфікаційні вимоги до здобувачів вищої освіти, опис технології виконання завдань для самостійної роботи, список літератури та додатки, що містять довідкову інформацію.

Для здобувачів вищої освіти третього (освітньо-наукового) рівня всіх спеціальностей.