



THE SUBJECT OF MODERN CARTOGRAPHY AND ITS SCIENTIFIC RESEARCH METHODOLOGY: PROBLEMS AND SOLUTIONS

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-----ABSTRACT-----

The article highlights some of its theoretical problems through a modern approach to the science of cartography and makes relevant recommendations. The content and essence of the research methodology, which is the fundamental basis of the science of cartography, is revealed.

KEYWORDS: *cartography, science, research, methodology, method, systematization, problem, solution, recommendation.*

INTRODUCTION

Section 1 of the resolution of the Cabinet of Ministers of the Republic of Uzbekistan dated march 15, 2018 “On the development and publication of the National atlas of Uzbekistan” №.204-f provides a fundamental scientific and lexical work the question of creation is raised. In order to carry out the National atlas at the level of modern requirements, which is accepted as a state symbol, it is necessary to conduct appropriate scientific research. Scientific research, on the other hand, encourages clarification of the methodological aspects of the science of geography, including cartography. After all, it is the main problem of the theory of all geographical sciences [1, pp. 106-110].

Before commenting on the science of cartography, it is necessary to know what “science” is. The philosophical scientific literature states that “Science is a system of knowledge about the world, one of the forms of social consciousness” [2, p. 16]. But the knowledge of the world is realized not only through science, but also in a non-scientific way (para-scientific, doctrinal, quasi-scientific, anti-scientific, and pseudo-scientific) [3, pp. 21-27]. Therefore, it is expedient to use the term “scientific knowledge” in the concept of science. In our view, **science** is a system of scientific knowledge of a social nature. Exactly the system, because in science every situation, event and process is studied from simple to complex, from close to far, from big to small, or vice versa, in the hierarchy of units or parts placed in an integral vertical.

THE MAIN FINDINGS AND RESULTS

“Science” is a word, not a designation. The name of any subject in it can mean the name of a field of science or the name of a training module (course). For example, the term “cartography” refers to both a science and a course or module. The same applies to designation [4, p. 113] or terms [5, p. 73] such as “Geography”, “Geoecology”, “Climatology”.

Generally, if these terms are used as the subject of research of the subject (researcher), they are accepted as a field of science. If they are viewed from the point of view of the subject (learner) learning - they are accepted as a training course or module. A course or module with science does not mean the same thing. For example, “Fundamentals of cartography”, “General cartography” is not a subject, but a course or module that provides generalized or substantiated knowledge, skills and competencies of these disciplines. In the textbooks,

curricula and programs, unfortunately, it is not logical to refer to a course or module as a “subject of study” [6, pp. 451-455].

This begs the pertinent question of how to understand the **science of cartography**. “**Cartography** is a science that teaches how to describe the location of events and phenomena in nature and society and their interrelationships, as well as their characteristics, changes over time, by mathematical means of special image – illustrative character models in a plane as a small scale generalization and use it as a resource on the basis of a research method” described the great Uzbek cartographer, Professor T. Mirzaliev [7, p. 6]. This definition is very complicated; it contains the phrase “interdependence, characteristics and change of events and phenomena in nature and society”. But Cartography may not always reflect the unity, location, interdependence, characteristics, and change of nature and society. For example, the content of the map “Timur's Empire and its marches” (Fig. 1).



Figure 1. Amir Timur's Empire and a map of its marches

reflects only the **sociological** situation, that is, the events and happenings specific to human activity, and the hydrographic state, which belongs to the **natural sciences**. The unity, location, connection, **feature**, and change between them may not be reflected. Because the boundaries of the Timurid empire or their marches in the conquest of new lands were not attached to any natural boundaries or objects. But the hydrographic nature and the territorial position of the empire in a particular period are on this map. Thus, the science of cartography studies not only the unity of nature and society, the events and happenings in it, but also their separate or interrelated state.

The popular dictionary on the Internet, Wikipedia, says that **Cartography** is the study of natural and social phenomena, modeling and reflecting their location across the field, the adaptation and interrelationship of objects [8].

In this relatively brief and more precise definition, first, the word situation is dropped, and events, happenings, and processes are not reflected at all. Second, modern electronic maps can reflect not only the “location in the field” but also the dynamic state and process of change in space or time, location (going deep into the lithosphere [9, 1982] and rising towards the atmosphere shown in Fig. 2).

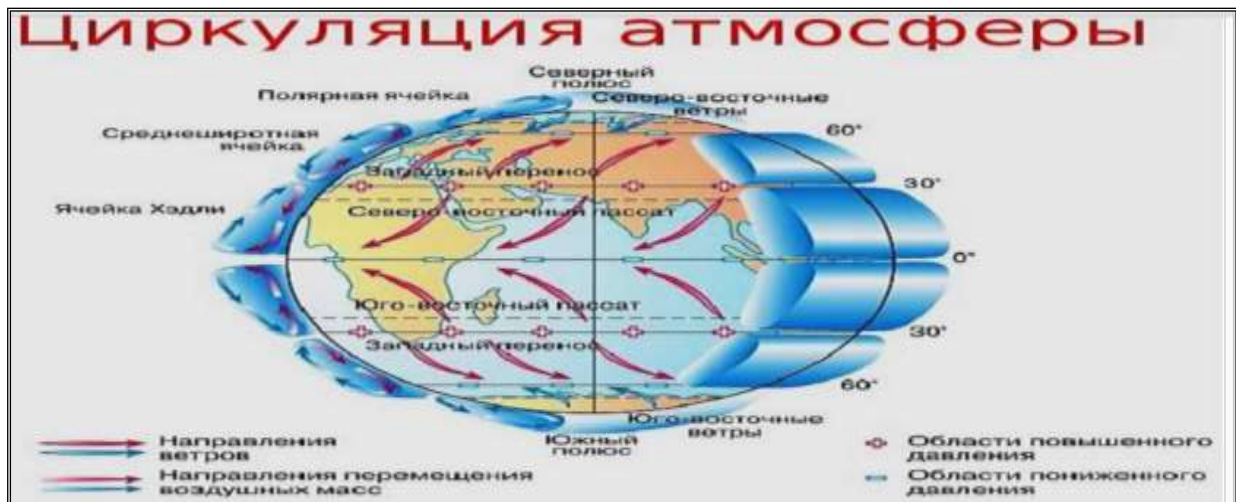


Figure 2. An offline map showing wind movement in the atmosphere

Third, maps are not only a model [10] (science - a condensed object that reflects the main features of a particular object or system for research purposes) but also schematic (science - a schematic map of the components of a particular object and the relationship between them on the basis of symbols, drawings or images) - A.N.) is also reflected in the view. Fourth, the rapid development of information and communication technologies is leading to the emergence of new modern maps not only “offline” but also “online” (Figures 3 and 4).

MATERIALS AND METHODS

Thus, the modern science of cartography is concerned with the design, creation, reproduction, transmission, modification, implementation of maps depicting nature, society, community and the state, situation, event, event and process between them offline or online, scientific knowledge system. In a simplified

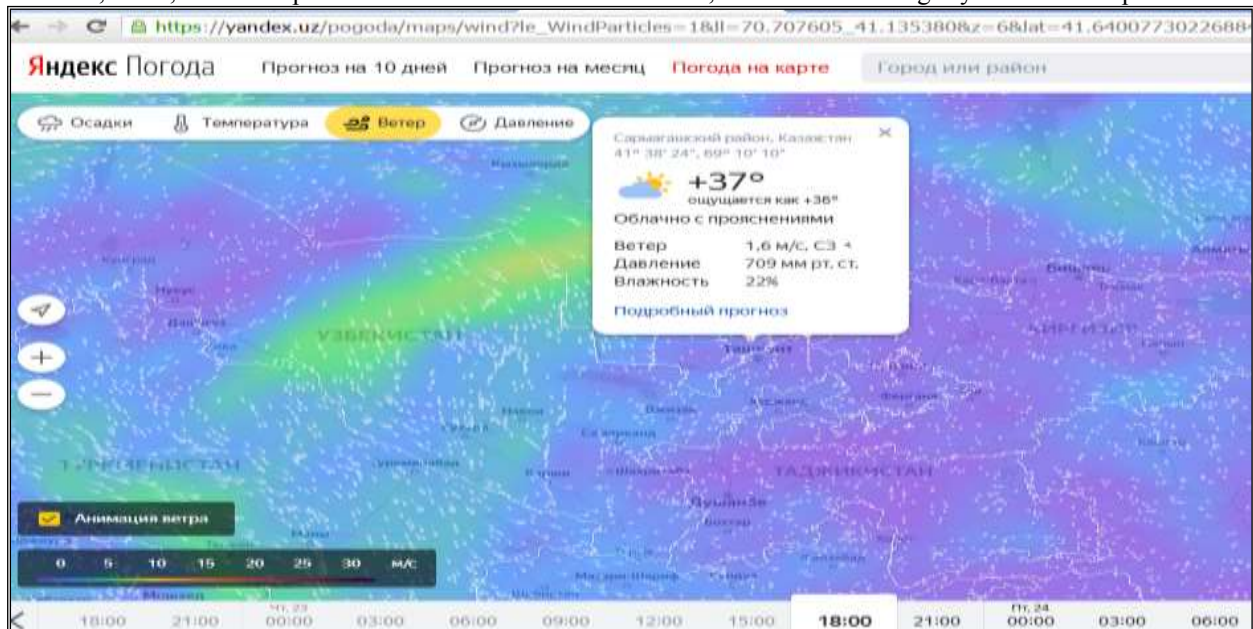


Figure 3. Atmospheric air circulation on the planet Earth "online" map

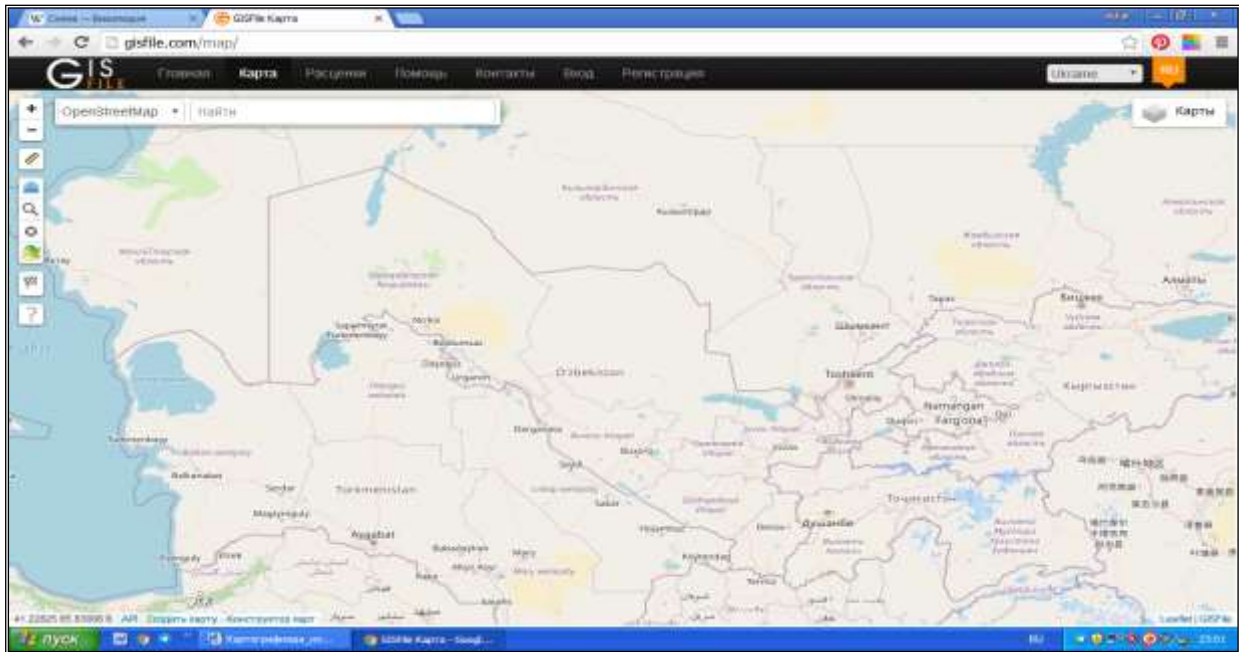


Figure 4. World map in "online" form at <http://gisfile.com/map>

way, the **science of cartography** is a system of scientific knowledge about maps of a social nature.

In the concept of the science of cartography, we have not dwelled on the type, shape, scale, type of dynamic maps, nor is it necessary in the interpretation of science. Because the word "map" in Uzbek, which needs a theoretical basis, which is widely used in recent times, is a separate object of scientific debate.

Now as for the **cartographic science**. The explanatory dictionary of the Uzbek language gives 3 different definitions of the word "science" [11, p. 195]. But in science, its 1st variant, that is, the definition of **knowledge**, skills, information that is achieved through study, research, analysis, comes closer to science. Closer to why, the phrase "man acquires information" given in later versions of the zero dictionary does not mean that he has yet become a scholar. S.I. Ojegov's dictionary, which is the most popular in Russian, says that **science** is the understanding of being through consciousness [12, p.299]. The free encyclopedia Wikipedia is the result of scientific activity or the acquisition of information by an individual to find a solution to a problem [13].

RESULTS AND DISCUSSION

In general, the word "science" is reflected differently in different literatures. In our view, it belongs to the human community in the social geographical sciences, and to the individual in the humanities, and **science** is the conscious understanding, knowledge, and understanding of being.

Based on the above concepts, **cartographic science** is the ability of people to understand, know and comprehend the science of cartography. It also has a social category. Because science is also a process or state that belongs to human society. The words used in cartographic science can be described as follows from the explanatory dictionary of the Uzbek language [14, pp. 83, 263 and 221]:

- ✓ **Comprehension** - to understand the importance of the science of cartography in the development of man, society and society;
- ✓ **Knowing** - to reach the content and essence of cartographic science;
- ✓ **Understanding** - to correctly assess the theoretical and practical significance of the science of cartography.

In the explanatory dictionary of the Uzbek language, research is used in two different senses [15, p. 637]. The first is research work, verification, study. The second is seen as the result of scientific research. Unfortunately, this dictionary does not reveal the true meaning of the word research. That is why we once again look at S.I. Ojegov's dictionary [16, p. 329].

In it, research is seen as scientific study and observation. But observation is a method or method of learning. In Wikipedia, **research** [17] is, in a broad sense, the systematization of research in order to seek new knowledge or to identify facts (facts). In the narrow sense, it is called a scientific method of studying something. There is no certainty in this either, as not everyone pays attention to or understands the "systematization" in identifying zero facts or facts. Nor can it be called the 'scientific method' given in the definition in the narrow



sense. Oral research is not a method to analyze (analyze) and synthesize (generalize) any facts. This will require the use of various research methods. The methods chosen can be either scientifically based or non-scientifically applied. For example, when preschoolers study the world around us, they cannot even imagine that there is no method and that a systematic approach is needed.

If we look at the word "research" from a philosophical point of view - it is the study, discovery, discovery of any situation, event, phenomenon, process by people. Research is also a process that is specific to a social category, a human society. Exact process. It can be either scientific or non-scientific. **Scientific research** is the process of studying, discovering, discovering, and describing a situation, event, phenomenon, and process by humans using clearly systemized methods. That is why the methods of scientific knowledge systematized in science are called methodology.

Cartographic research is the process of studying, discovering, discovering, and describing in writing the situations, events, and processes that are or should be reflected in maps by people using clearly structured methods. This situation can be described by the words used in cartographic research, using many scientific literature and dictionaries [18, pp. 338, 163 and 166]:

- ✓ **systematization** - the process of breaking down a situation, event, event and process for the purpose of a specific cartographic research and placing them on a hierarchical hierarchy, in a strict vertical sequence;
- ✓ **Method** - empirical (practical) and theoretical (logical) methods of cartographic research;
- ✓ **Learning** - mastering and mastering cartographic research.
- ✓ **Discovery** - the creation of any innovation, invention and finding a solution to a problem or an innovative approach to a problem through cartographic research;
- ✓ **Disclosure** - the discovery of a particular law or laws through cartographic research;
- ✓ **Written statement** - a written statement or statement of the results obtained through cartographic research.

Now for the term "Methodology". Belarusian pedagogical scientists consider methodology as a system of principles and tools for the organization and placement of theoretical and practical activities [19, pp. 24-37]. The Russian expert G.A. Fedotova [20, p. 4] says that "Methodology is a science about the general principles of understanding and processing the objective being, the direction and methods of the processes that take place in it". The most authoritative national encyclopedic dictionary in Uzbekistan defines it as "Methodology - a system of principles and methods of organization, theoretical and practical activities of the researcher and the doctrine of such a system" or a method of teaching or general knowledge [21, p. 614]. In this literature, methodology teaches how to approach methods and reality in general. It includes "Metaphysics" to the methodology of studying a particular part of reality, a certain aspect of its development, "Dialectics" to a methodology that reflects the linear development of reality, the process of change and the interrelationships between its constituent elements, abrupt catastrophic changes in reality, nonlinear development. An example of the methodology used in the study of processes is "Synergetic". It is said that methodology can also be viewed as an algorithm of scientific knowledge, understanding and changing reality.

The great Austrian philosopher P. Feuerbend argues that "Methodology" gives rise to new ideas only if it is free from any pressure (like religious beliefs), separate from public policy and has a free approach to the subject [22]. However, P. Feyerbend did not take into account the fact that "Methodology - the doctrine of methods", he can give a methodological approach to the issue, which is considered by each researcher in a given period of public policy, social status, economic opportunity and institutional situation. Otherwise, such a methodology will remain on paper and will not find its place in practice.

Derived from the foreign and national literature analyzed above, it should be noted that the concept of "Methodology" uses dozens of words such as: reality, objective being, process, principle, tool, method, doctrine, principle, theory, practice, organization. This does not allow it to be put into practice and easily understood by students. For example, in the general education block of all 1st stage master's curriculum of higher education institutions of the Republic of Uzbekistan there is a 36-hour training module "Scientific Research Methodology". However, when studying masters for this subject by the method of "Questionnaire", the level of mastery of this course did not increase by 15-20% (Fig.5.). Because the textbook "Methodology of Scientific Research" [23, p. 512], published by Professor of the National University of Uzbekistan N. Shermuhamedova, contains theoretical knowledge in the relevant national and international textbooks. But it does not give a single generalization and clear conclusions that will serve as a program-practice for future masters.

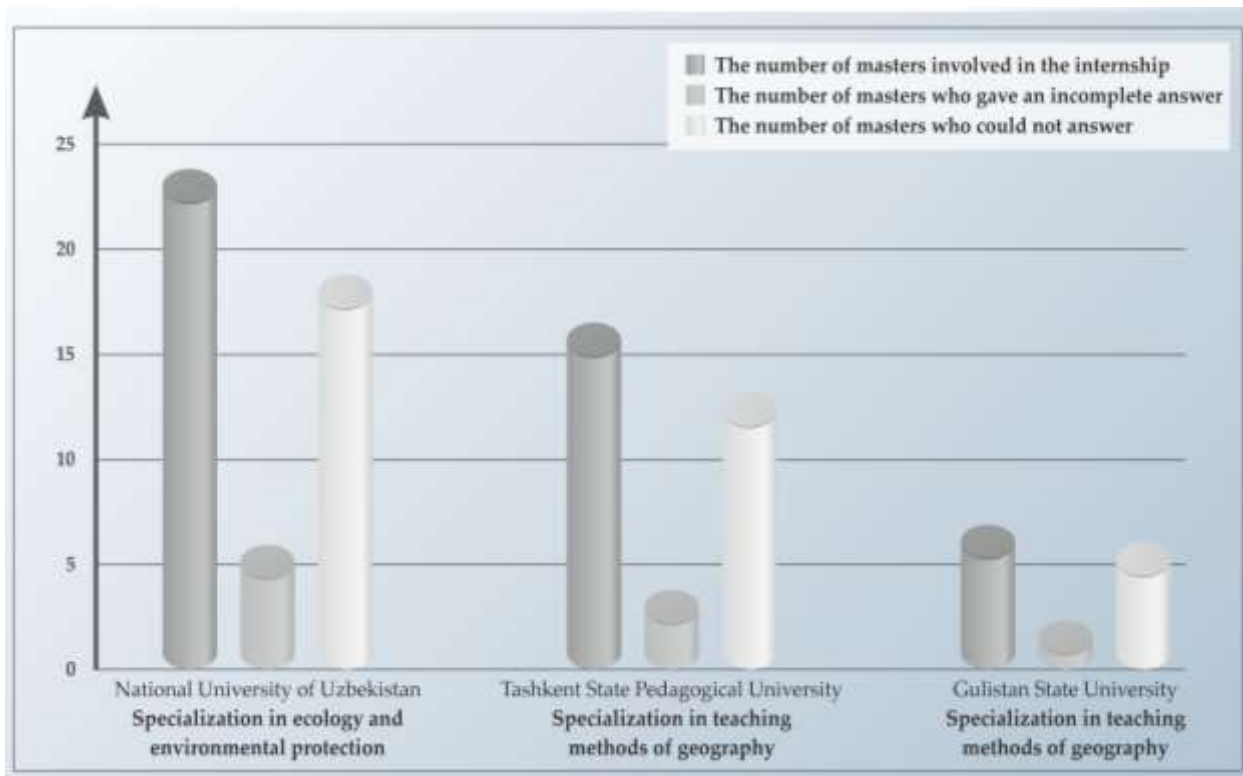


Figure 5. Indicators of mastering the course "Scientific research methodology" by masters of higher education institutions

Therefore, in order to assess the future implementation of the subject "Scientific Research Methodology" in the curriculum of the master's degree in "Geodesy and Cartography" in higher education, it is advisable to conduct a sociological survey among masters through the following questions and assignments:

- What do you mean by "cartography"?
- Explain the general and specific aspects of "Cartography" and "Cartography"!
- What do you mean by "cartographic research"?
- Explain the research methodology and its place in cartographic research!
- Systematize cartographic research methods from a methodological point of view!
- Give a scientific definition of the term "methodology"?
- Explain the content and essence of the research methodology in cartography!
- Are you satisfied with teaching the subject "Research Methodology" in the general methodological block of the master's degree?
 - Your suggestion on how to teach the subject "Methodology of Scientific Research" in the master's degree!
 - What would you like to know about this course?

The "questionnaire" method shows us how many masters who are taking their first steps in research are being passed on as a basic fundamental theoretical basis and a "road map". For example, the role of cartography in the rational use of alternative energy sources is invaluable. But a reasonable question arises as to what methodological basis lies in it. This is probably why the geographer, and especially the cartographers, are at the center of the debate.

Methodology is an abbreviation of the Greek word "metodos" - to know or study "logos" - doctrine. In general, it can be called **Methodology** in science - a set of teachings on scientific methods of knowledge, or rather a system here. This is because the parts of the methodology listed below, the division of research methods into parts or grouping for a specific purpose are systematized in a specific sequence and hierarchy.

Cartographic methodology is not a method and, in contrast, changes in an evolutionary or non-evolutionary way, depending on conditions and time. The method does not change, new ones are created, and they are used in cartographic scientific knowledge instead of the old ones. The systematization of cartographic methods stems from a particular social, political, economic, institutional situation. For example, in the former



Soviet Union, the methodology of almost all geographical sciences [24, p. 192], including cartography [25, p. 252], was adapted to a political system based on the idea of Marxism-Leninism to build a utopian communism.

The planned socialist economy, the utopia of achieving equal social security for all, the economic attitude of not lagging behind the United States at the expense of natural resources, the methodology of spiritual and enlightenment propaganda reflecting the idea of a single nation are clear examples of this.

After the collapse of the former Soviet Union and the emergence of independent states, a reasonable question arises as to what methodological basis scientific research was armed with. In the independent states, each of which has entered its own path of development, there is a "methodological vacuum - a gap" in the science of cartography in Uzbekistan. Because we cannot say that the cartographers of Uzbekistan, freed from the pressure of the Union, conducted in-depth research on theoretical and methodological issues of science. Islam Karimov, the first President of the Republic of Uzbekistan, once said: "We must not allow a vacuum to appear in politics, social life and science. That is, if you do not have your own idea, an idea from abroad will come and dominate your country. In this sense, if we do not have independent-minded people, if we do not restore the history of our state, our people, our nation, if we do not write it objectively, others will write it differently. If it is limited to writing, it will try to guide us, the younger generation, and even our scientists [26, 1998]. Therefore, it is important to create a methodological basis in the science of cartography.

A broad-based **cartographic methodology** that summarizes the above ideas is the selection, fragmentation and systematization of cartographic methods based on the existing political situation, social conditions, economic opportunities, institutional situation in the conduct of cartographic research. **Methodology** in the narrow sense is a system of teachings on cartographic methods of scientific knowledge.

Thus, **the methodology of scientific research in cartography** is a category that belongs to the social, that is, the society of the individual, which consists of concepts in a set of 2 words and 1 term:

✓ **Cartographic science** - people's ability to understand, know and comprehend the science of cartography;

✓ **Cartographic research** - the process of studying, discovering, discovering and describing in writing the situation, event, event and process reflected in the maps by people using clearly structured methods;

✓ **Cartographic methodology** - the selection, fragmentation and systematization of cartographic methods based on the current political situation, social conditions, economic opportunities, institutional situation in the conduct of cartographic research.

Summarizing all three concepts, the methodology of scientific research in cartography - to understand, know, comprehend, choose cartographic methods based on the existing political situation, social conditions, economic opportunities, institutional situation for the study, discovery, disclosure and written description of cartographic research, disassemble and systematize them.

It is advisable for each cartographer to follow the following systematic approach in conducting research methodology (Fig.6):

In considering the political situation in the methodology of cartographic research, it is very important to emphasize the perspective-oriented sources of international law, law, concept, program, plan, strategy or road map of the society, state, international community on the chosen topic. For example, the Law of the Republic of Uzbekistan "On Geodesy and Cartography", adopted on July 2, 2020, and the concepts given in Article 3, to apply in the research process or to express your attitude to it, ie to make proposals and scientifically substantiate.

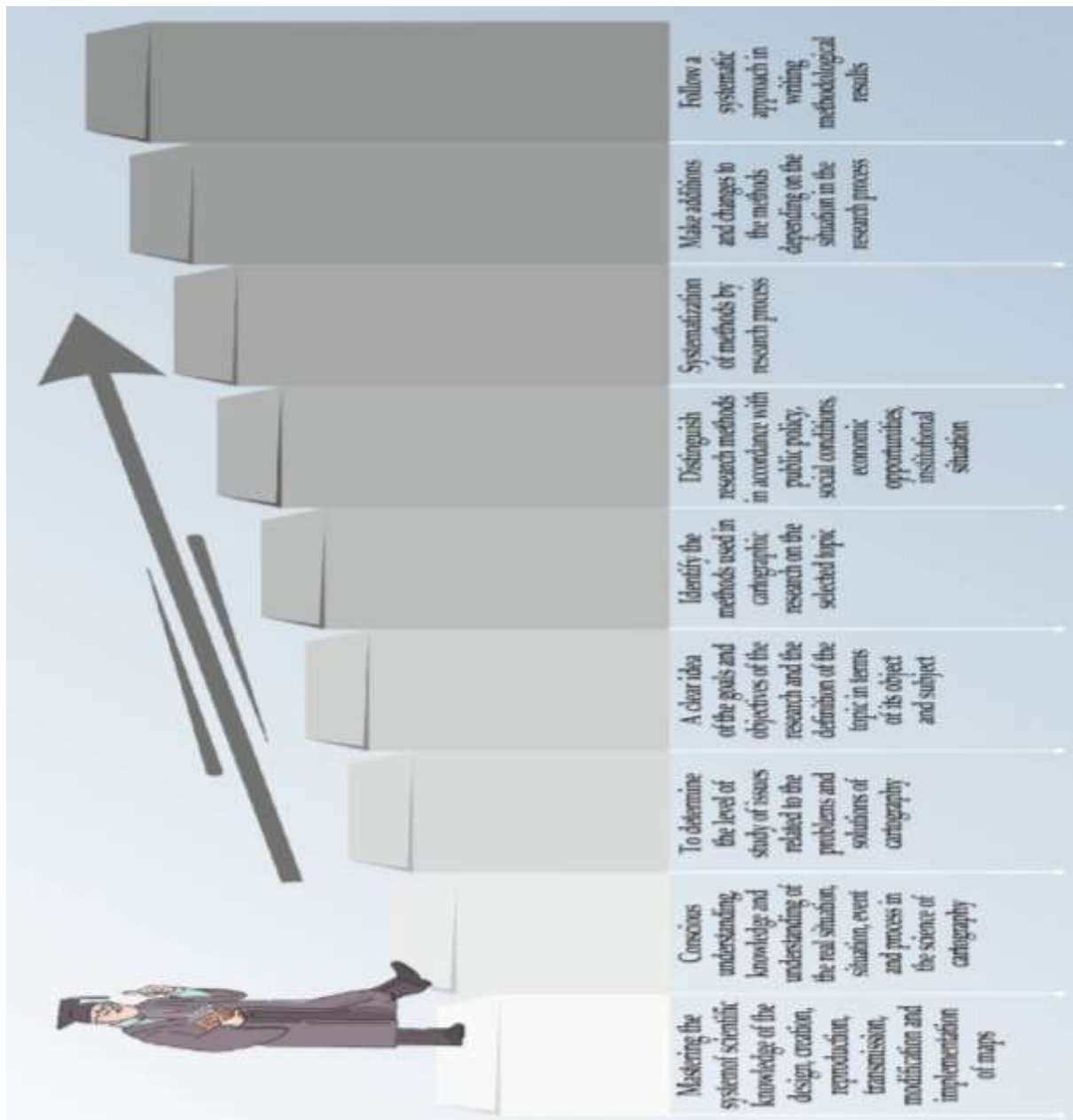


Figure 6. Systematic approach to conducting research methodology in cartography

In his Petition to the Oliy Majlis on January 24, 2020, the President of the Republic of Uzbekistan Sh.M. Mirziyoev said: “The greatest wealth is intelligence and knowledge, the greatest heritage is a good upbringing, the greatest poverty is ignorance! That is why the acquisition of modern knowledge, true enlightenment and high culture should become a constant vital need for all of us. It is necessary and necessary for us to acquire digital knowledge and modern information technologies in order to achieve development”, [27] he said. It is a very important state policy of every cartographer operating in the country to conduct their research in their research methodology by choosing methods related to the digital economy and GIS (geographic information system).

In choosing the methods of cartographic research, it is necessary to take into account the **social conditions**, that is, whether society needs it, the possibility of mastering the system of knowledge, norms and values [28, pp. 140-146]. This means that "Philosophy" is based on scientific knowledge, "Sociology" on the development of social associations (for example, the development of peoples and countries according to their social conditions), "Psychology" on the mental state of people, "History" on the periodic change, "Ethnography"



the laws and regulations in the life of the local people should not be overlooked. Otherwise, the research methodology may not yield positive results and practical effectiveness. For example, in the selection of methods for a cartographic object, one of the most effective tools is the quantitative and qualitative assessment of the social situation within it [29, pp. 39–42].

In the process of methodological approach to cartographic research, consideration of **economic opportunity** is reflected in its positive results. However, at a time when market relations are becoming increasingly pronounced, it is important to know whether the researcher and his or her research institution have the opportunity to use selected research methods. Let's say you don't have enough financial and material resources to buy, run, and use them. In this case, it is better to abandon the choice of this method. For example, in cartography, you chose methods for the digital economy. **The digital economy** is the economic activity based on digital technologies, the development of digital goods and services related to e-business and commerce [30]. Nicholas Negroponete, a professor at the Massachusetts Institute of Technology in the United States, suggested that it is logically correct to express goods in numbers, not in terms of physical condition and dimensions of movement [31]. However, the author keeps the innovative methods secret. As long as you do not have the opportunity to purchase these technologies, you will have to temporarily abandon their use in research methodology.

Another issue is to take into account the **institutional situation** in scientific research methodology, i.e. the researcher has to "sustainably unite" with practitioners, scientists and experts to apply cartographic methods on their own. In doing so, it is important to find an answer to the pertinent question of which a sustainable merger should be with and what methods will work for you. Taking into account the institutional situation and applying it throughout the research will undoubtedly yield effective results.

Conducting a research methodology and **expressing it in writing** requires a systematic approach [32, pp. 398, 399] - hypothesizing > creating a concept > developing a framework (program and plan) > developing a theoretical basis > applying a certain hierarchy of methods of practical application.

CONCLUSION

To conclude:

- ✓ the rise of cartographic practice to a new online stage requires a reconsideration of its scientific and theoretical foundations;
- ✓ the science of cartography can be defined as a system of scientific knowledge related to the design, creation, reproduction, transmission, modification, implementation of maps that reflect nature, society, community and the state, situation, event, event and process between them offline or online ;
- ✓ cartographic science is the ability of people to understand, know and comprehend the science of cartography;
- ✓ cartographic research - the process of studying, discovering, discovering and describing in writing the situation, event, event and process reflected in the maps by people using clearly structured methods;
- ✓ cartographic methodology - selection, division and systematization of cartographic methods based on the current political situation, social conditions, economic opportunities, institutional situation in the conduct of cartographic research;
- ✓ in general, the methodology of scientific research in cartography - the ability to understand, know, comprehend, select, disassemble cartographic methods based on the existing political situation, social conditions, economic opportunities, institutional situation for the study, discovery, disclosure and written description of cartographic research and is to systematize them;
- ✓ the hierarchical pathway of the cartographer conducting any research, which consists of 9 stages in the conduct of scientific research methodology, dramatically increases the effectiveness of the results.

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