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THE USE OF GEOGRAPHIC INFORMATION SYSTEMS IN MODERN CARTOGRAPHY

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Abstract
This article is devoted to the problem of using geographic information systems in cartography. The essence of the concept of geographic information systems, their undeniable advantages, and opportunities in the educational space revealed.

Keywords: geoinformation systems, GIS technologies, educational activities, educational space, maps, geoinformatics.

INTRODUCTION

Currently, the process of increasing the amount of geographical information in the educational space is accelerating both at the regional and local levels (at the level of individual educational institutions). A lot of information is spatial. It consists of maps, atlases, space and aerial photographs, diagrams of objects such as cities, addresses of buildings, and much more. This kind of information is increasingly presented in digital form. It should be noted the increasing prevalence of geographic information systems in the practice of the domestic educational process. This technology is one of the most popular and useful tools, including in the educational process.

One of the significant developments in the field of information systems over the past few decades has been geographic information systems, or GIS for short. They are systems with the ability to collect, process and analyze data that are distributed in space, along with their graphical representation. The possibilities of geoinformation systems technology are very extensive, because, in fact, they represent a completely new view of the world. Geographic information systems contribute to the formation of people's views, provides a better understanding of the relationships between the components of the world. A cardinal shift of time layers has taken place in society, our world is now shrouded in the World Wide Web, information technologies are increasingly being introduced into all areas, and such a sphere as education is no exception. For example, paper maps have been replaced by electronic GIS, which have undeniable advantages over traditional maps.

The relevance of GIS is also due to the fact that there is a gradual decrease in the cost of equipment that is necessary to use these technologies, all this together determines their very promising use for the education system.

MAIN PARTS

First of all, let's try to get into the essence of the GIS concept itself. GIS is an integrated system. It presents visual and interactive modeling. Thus, GIS can be defined as a universal tool that finds its practical application in various disciplines. GIS has been developing recently in order to acquire the possibility of using it in various areas of social activity, such as ecology, nature management, urban planning, management of municipal services, etc. According to pedagogical practice, the use of GIS in educational activities is justified and effective in view of several aspects.

First, GIS combines traditional database operations (query, statistical analysis) with the full visualization and spatial analysis benefits that a geographic map provides. These capabilities distinguish GIS from other information systems, which ensures their application in a wide range of tasks related to the analysis and forecasting of the phenomena of events in the surrounding world, with understanding and highlighting cause-and-effect relationships in the natural and social environment.

Secondly, GIS can be considered as a good example of a modern integrated information technology, the use of which significantly increases the efficiency of solving a large number of different applied problems. These include environmental monitoring of urban areas, geo-ecological zoning, valuation of land and buildings, creation of electronic maps for municipal services, selection of territories for new construction, assessment of mineral reserves, etc. As a rule, GIS are able to study not so much the essence of objects and processes of our environment, how much information is discovered through such methods of study as observation and measurement in various scientific fields. The connecting artery of GIS and educational space is that the information provided by GIS is included in the structure of most educational disciplines and academic lessons in various educational institutions.

However, here we run into a difficulty. After all, the mere possession of information is not an expected and idealized result. In turn, we need a tool that will ensure its full use. With such a universal tool, GIS technology is identified. Its versatility is its main advantage.

GIS has different interpretations [2], but in general they can be divided into three types:

1. GIS is an information system that provides the collection, storage, processing, display and distribution of spatially coordinated data in the form of their digital representations;
2. GIS (GIS software) is a software product that implements the functionality of a geographic information system. It is supported by software, hardware, information, legal, personnel and organizational support.
3. GIS is an integrated computer system managed by analysts that collects, stores, manipulates, analyzes, models and displays spatially correlated data.

GIS is a specialized information system designed to work on an integrated basis with geospatial and semantic data of various content. In this definition, semantic data refers to a set of qualitative characteristics of an object (for example: height, depth, number of inhabitants, name of a settlement, drawing color, etc.). GIS is designed for input, storage, processing and output of geospatial information at the request of users and is a complex integrated system that obeys all the principles of system analysis. It contains data about spatial objects in the form of their digital representations (vector, raster, and other forms).

Currently, GIS is becoming a tool and technology for the dissemination and use of geospatial information, which makes it possible to study the processes and phenomena occurring on the Earth. GIS integration technologies are manifested in separate operations for processing various types of data based on information and space technologies.

The geography of GIS distribution is very wide, starting from geosciences and ending with socio-political and economic sciences. In every industrialized country, GIS is the basic platform for solving state and priority tasks of managing and developing territory and resources. GIS technologies combine cartographic materials, data from remote sensing and environmental studies, statistical departmental data, field expedition materials, etc.

The main distinguishing features of geoinformation mapping and GIS are contained in systems for storing, processing and displaying information. They are primarily related to the content of the database and a set of specialized programs for modeling, analyzing and displaying information. Digital cartographic information is organized into cartographic databases, which are a systematic set of digital maps. Such maps are digital models created by digitizing cartographic sources, photogrammetric processing of remote sensing data, digital recording of field survey data, or otherwise. Many processes for creating maps are presented in [3].

GIS technologies are a tool for managing any type of information in terms of its spatial location. It should also be noted the importance of methods of geographical indication

in complex geographical research. System geographic works and GIS have different themes, spatial scope and purpose. The general structure of GIS, individual blocks and layers of information largely repeats the structure of the obtained cartographic works. On the basis of geoinformation software packages, geoecological mapping is carried out, which is further used in assessing the state of geosystems and regional planning of nature management.

Geoinformation mapping is also developing in the direction of operational mapping. In practical situations, prompt production of maps becomes an important condition for completing the task. Such operational cartographic works are designed to solve a wide range of problems. First of all, to warn about unfavorable or dangerous processes, monitor their development, make forecasts, and also select control options [1]. Efficiency of making maps, technical capabilities of GIS, the need to visualize the results of monitoring the dynamics of processes or phenomena have become important factors in the development of methods for geoinformation mapping of the environment.

In [4], two effective methods for displaying the dynamics of geosystems are given: animation mapping and virtual images. The direction of process modeling remains important, the efficiency of which is very high, and is connected, first of all, with the need to create data banks. GIS technologies are a means of developing education.

Geoinformation mapping accumulates the achievements of remote sensing, space mapping, cartographic research method and mathematical-cartographic modeling. In its development, geoinformation mapping uses the experience of complex geographical research and systematic thematic mapping. As a result, at the end of the 20th century geoinformation mapping has become one of the main directions in the development of cartographic science and production

The current trend of geoinformation mapping is manifested in the use of GIS packages, as well as common graphic software packages, which eliminates the need to create specialized geoinformation mapping systems. More often this concept is used when the task is to create a computer map in the traditional form and the presence of such output devices. Geographic information systems with the development of Internet technologies are of great importance, both for personal use and for large-scale enterprises. At the same time, GIS are now provided with modern software. GIS systems have a number of advantages: a large analytical resource, many tools for processing and using data, significant savings in time and money, the study of geospatial information, and much more.

The basis of the GIS is the cartographic block, which provides the development, creation and use of maps, and consists of a number of subsystems (subsystems for

input, processing and output of information). The functionality of GIS is diverse, the main ones are: - input of digital data into a computer; - data processing, transformation of map projections, data conversion into various data formats; - data storage and management; - cartometric and computational-analytical operations, etc. Any GIS is based on working with raster and vector data models. Vector models use points, lines and polygons, raster models work with objects that have the property of continuity.

Currently, there are hundreds of domestic and foreign software developments that meet most of these criteria. Most of the software is not one of the subsystems in its purest form. Today there are a huge number of software products that are available on any hardware platform. These products can basically be divided into two "camps": high-end professional GIS (high-end) and desktop mapping packages with some GIS functionality. The first are distinguished by high power, a full functional set of tools. They provide all the features required by most applications. The latter make up the bulk of developments in the GIS software market in the past few years. These are so-called desktop GIS mapping packages that have few features and were originally developed for simple analysis and output of maps and graphs. One of the full-featured GIS systems that have perfect tools for creating maps is ESRI's ARCGIS [5] . This GIS software for any level allows you to use geographic information to conduct analysis, better understand data and make more informed decisions. ArcGIS is a complete system that allows you to collect, organize, manage, analyze, share, and distribute geographic information. The platform allows you to publish geographic information for access and use by any user. ArcGIS is also a framework for creating maps and geographic information available between user communities and on the Internet for public access. The ArcGIS product family is divided into desktop and server products. The main products of the desktop line are ArcView, ArcEditor, ArcInfo, where each subsequent one includes the functionality of the previous one. The main server product - ArcGIS for Server, is designed for multi-user geoinformation projects with centralized storage and an unlimited number of jobs, publishing interactive maps on the Internet. ArcGIS is used in a wide range of applications, including planning, analysis, asset management, familiarization with operations, and site work. The ArcGIS family of products is used for problem solving, data management, better decision making and planning, modeling and change management, and more.

ArcGIS makes it easy to create data, maps, globes, and models in desktop software, then publish and use them in desktop applications, web browsers, and in the field via mobile devices. For developers, ArcGIS gives you all the tools you need to create your own applications.

Around the world, ArcGIS tools are used to improve organizational workflows and solve a variety of problems: asset and data management, including integration of various systems, territory and service management, branch and customer base management; planning and analysis, such as forecasting and risk assessment; business applications for creating call centers / control rooms; monitoring and tracking; data collection in the field; bypasses, maintenance and operation of equipment; routing; situational centers for decision support and providing access to customer and public information.

GIS technologies have completely replaced the traditional approaches to the concept of "map", which has led to the emergence of dynamic methods of mapping. A map is a dynamically developing computer database of a territory. At present, the whole world has switched to electronic representation of maps, because. this is required by modern society and economy in the form of complex maps that would reflect all the most important and informative features of the territory. Through geoportal technologies in cartographic science, it becomes possible to accustom society to the use of electronic maps as everyday tools in the study of the territory. Another side of the geoinformation support for the management of the region is manifested in the use of Earth remote sensing methods as one of the ways to obtain information and new knowledge.

Since its inception, geoinformation systems have helped to solve various problems facing society. It is clear that government organizations are primarily involved in solving these problems, while a large proportion of these organizations among GIS users only emphasizes the role of this technology in solving socially significant problems. Geoinformation systems are multifunctional tools for analyzing combined tabular, textual and cartographic business data, demographic, statistical, land, municipal, address and other information. The main advantage of GIS over other information technologies lies in the set of tools for creating and combining databases with the capabilities of their geographic analysis and visual visualization in the form of different maps, graphs, diagrams, direct linking of all attributive and graphic data to each other.

GIS is more than simple electronic maps on a computer monitor. After all, it is GIS that contribute to the development, visual reproduction, as well as the collective analysis of all kinds of information: tabular, vector, raster, CAD and others. Meanwhile, the use of GIS allows you to find a solution to a specific problem visually or provide the results of classification and typing in a visual format. Moreover, various management processes cannot be conceived without the use and analysis of information from statistical data. GIS, in turn, makes available statistical data on

maps and provides the necessary tools for processing three-dimensional statistical information, taking into account its qualitative and quantitative features. Along with this, when using GIS, students have the opportunity to master the design of information systems based on GIS, as well as to form an information base in such information systems.

GIS allows the objects of the pedagogical process, thanks to universal tools and Internet browsing, to use maps as widely as with desktop and wall GIS, in the form of a specialized program downloaded to a computer for subsequent demonstration of the necessary kind of material to the wards. GIS contribute to the collection, storage, analysis, mapping of data on objects and processes of various formats, based on their spatial arrangement. This computerized technology integrates databases and operations on them, including their querying, statistical research, with powerful ways of presenting information, query results, samples and analytical calculations in a visual, easy-to-read cartographic form. Note that GIS is actively used in various research centers and laboratories in the implementation of research and applied work. University students also contribute to fundamental research using GIS technologies.

The advantages of GIS in cartography are: full support for the process of creating, analyzing and processing maps of varying degrees of complexity; saving time and money when processing information; allows you to quickly and efficiently link together several electronic charts from a wide variety of sources; GIS applications provide the ability to easily place any explanatory or descriptive text on a map; the ability to create a centralized corporate geodatabase and a single software environment for all operations; providing interactive and intuitive tools for editing and modifying maps; the possibility of using maps in scientific research and work; full automation of the main processes of building maps; accessible and fast navigation on the map and data layers; input and editing of metric information, etc.

Conclusions: In conclusion, I would like to emphasize that the current situation in the development of geoinformatics and the improvement of GIS contribute to the opening of new horizons in the name of implementing all kinds of information interactions through GIS. Therefore, we can argue that GIS is a comprehensive toolkit used in the educational space. Therefore, we have every reason to believe that the use of GIS in the educational process is promising, not only in the field of geoinformatics, but also in a fairly wide range of different academic subjects. Moreover, our highly informative society causes intensive implementation and use of information technologies in the educational process, which gives an impetus to bring teaching to a higher level, to combine knowledge in diverse subject areas, and students, in turn, helps to show their

subjectivity, to receive new knowledge, skills and abilities, being in continuous improvement of their personality.

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