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Modern Methods of Mapping and Analysis in A Virtual Environment

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Abstract: This article will consider in detail modern methods of mapping and analysis in a virtual environment. The focus is on geographic data systems (GMTs) and their role in the educational process, as well as the possibilities of visualizing and analyzing data using virtual maps. The interactivity of the Virtual environment, the ability to integrate multilayer data and the possibilities to respond to changes in real time, as well as the possibilities offered by various software and online platforms, as well as pedagogical approaches and methodologies are discussed. With the help of Virtual maps, the importance of students in the development of spatial knowledge, analytical thinking skills and creative approaches is especially recognized. The article reveals the importance of mapping and analysis methods in the educational process in the virtual environment and provides recommendations for the practical implementation of innovative approaches in this area.

Keywords: Virtual environment, mapping, analysis, modern methods, pedagogy, interactive teaching, digital technology, educational innovation.

Introduction: In the age of digital technology, methods of managing, presenting and analyzing geographic data are changing dramatically. In particular, modern tools, software platforms and methods for mapping, managing and analyzing it have appeared in the virtual environment. This resulted in the popularization of interactive, continuously updated, real-time digital maps capable of obtaining information rather than traditional printed maps.

Innovative approaches such as Geo-informational systems (GIT), cloud technologies, mobile applications, 3D modeling, augmented and virtual reality (AR/VR) are taking modern cartography to a new level. Today, virtual environments are mainly understood as online

platforms, digital software environments, various applications, 3D simulations and VR technologies created in remote collaboration over the internet, with controlled, continuous public use. The process of mapping and analysis is enriched in such an environment with opportunities such as higher interactivity, rapid information exchange, complex review of various objects and processes, work with thematic layers, integration of real-time geo-data.

Virtual cartography is the process of creating, editing, mass distribution, and real-time updating maps online based on digital technologies, the internet, cloud platforms, and various interactive software tools. On traditional printed maps, static, unchanging information was expressed. On Virtual maps, however:

• Data can be constantly updated.

• The ability to insert or remove different thematic layers is created.

• The user can control this map in interactive mode, enlarge the desired location, take measurements, leave comments or upload information.

• It is integrated into software platforms and updated in real time based on data coming from sensors or satellite. Virtual cartography is inextricably linked not only with GIT (GIS), but also with big data, remote sensing (remote sensing), simulation and animation techniques. Initially, special specialists (cartographers, GIS-analysts) managed this process, while now independent users have also become able to create, analyze and distribute their maps on various cloud-based GIT platforms [1].

Differences between Virtual cartography and traditional cartography. Traditional cartography (printed or static digital form): usually the information is not updated, it remains in printed form. Mapping and distribution is carried out in limited sources (printing, publishing house). The user can only read the map, interactive activity is practically non-existent. It is impossible or very limited to analyze information in depth, disable and activate different layers, zoom, put geotegs.

Virtual cartography (online, interactive): the map is constantly Interactive, can be updated, edited quickly.

With the help of cloud technologies, mass distribution is carried out on the internet, users themselves can also add or change information. Enters into a “dialogue”with the user, there are many dimensions, filters, search functions, such as distance, area, volume, volume, relative location. Multiple users can work on a single map or project in collaboration at the same time, put comments, mark (marker), import/export information.

It can be seen from this that virtual cartography is a form of cartography that develops side by side with information and communication technologies, very well suited to modern requirements, which serves to express spatial information quickly, conveniently and accurately [2].

Mapping platforms and technologies in a Virtual environment. Cloud GIT platforms. Modern virtual cartography is often done through cloud-based GIT platforms. Cloud software mainly provides services on remote servers over the internet, the user can perform work through the browser without having to install the program on his computer. The most popular are:

ArcGIS Online: is a major platform offered by ESRI corporation with functions of working with Vector and raster data, adding different layers, searching by specific addresses, diagrams, Web-app, story map creation [3].

QGIS Cloud: a cloud-based version of the Open Source Program QGIS. In this case, it will be possible to upload the QGIS project to the cloud and share it with others online. Users will have the functions of viewing the map, activating/disabling layers, leaving comments [4].

Mapbox: this platform allows users to make online maps, customize design settings, integrate with mobile applications, apply 3D effects. Mapbox GL JS is a JavaScript library convenient for creating interactive web maps.

Google My Maps and Google Earth Web: through Google services, it is possible to create online maps, draw dots/lines/polygons, add characters and images, enter geotegs, form several layers. While less functional, the style is extremely simple and popular. On cloud platforms, the workflow is interactive, designed for teamwork, with the ability to update and collaborate in real time. Therefore, it is very convenient in the educational process, in team projects, for corporate purposes.

Mobile applications are applications that can perform functions such as quick determination of the coordinate of a place through a smartphone or tablet with a GPS module and Internet, drawing, photographing, comment or conclusion input. Very important for cartographic projects. The most common are:

Collector for ArcGIS: collecting information in Desert (field) conditions, marking objects, uploading images, working offline, and sending information to the cloud later [5].

QField: a mobile application that runs integre with QGIS, allows you to export the QGIS project, which was originally created on the table (desktop), to a mobile device and collect data in the field.

SW Maps: open source, free app. Supports coordinate

recognition, Polygon and line drawing, photo and video storage with geoteg, Export/import to KML/GPX formats. These applications are convenient for GIS professionals, environmentalists, geodesists, urban planners, students doing field research. The information collected with them will then be uploaded to the cloud platform and displayed on an interactive map. When integrated with VR technologies, the user can wear VR glasses, “enter” the City, Mountain relief or other spatial scene on the map, “walk” in the area and view objects from all sides. It is very effective for conducting virtual tours, remote surveys in areas such as education, architecture, ecology, tourism.

Foreign experience. USA: Esri's ArcGIS Online Platform is widely used in stages from school to university, as well as by government agencies and the private sector (ESRI, 2022: 35). Online mapping, real – time sensor data integration, collective online projectors-all of which demonstrate advanced approaches to digital cartography.

European Union: in conjunction with the” Copernicus " program, open geo-data, satellite images and cloud platforms are being integrated and environmental monitoring, meteorological monitoring, climate change research is being carried out through virtual cartography.

Finland: at the school level, free tools such as QGIS Cloud and Google Earth are involved in the course of the lesson, and students are taught competencies such as creating virtual maps themselves in the form of a “geo-project”, data-summarizing, commenting.

Canada: Mobile GIS applications as well as 3D cartography are popular in urban planning, environmental processes, transportation planning. In agriculture, Earth productivity is monitored in real time through drones and sensors and analyzed on a virtual map platform [6].

CONCLUSION

The theoretical considerations described above, Foreign experiments, as well as experimental and test work carried out in Uzbekistan put forward the following main conclusions:

1. Virtual cartography is a form of cartography that is radically different from traditional printed maps, integrated with digital technologies, interactive and continuously updated. The main role in it is played by such methods as online platforms, 3D modeling, mobile GIS applications, VR/AR.

2. Cloud GIT platforms (ArcGIS Online, QGIS Cloud, Mapbox, Google Earth, etc.k.) provides convenient mechanisms for mapping and analysis in a virtual environment. Users can exchange information in real time, publish team projects, work with thematic layers in different areas.

3. Spatial analysis methods (buffer, intersect, union, heatmap, 3D analysis) are conducted quickly and accurately by means of virtual cartography, which simplifies decision-making processes.

4. The use of these techniques in the educational process enhances student motivation, digital literacy, interdisciplinary integration, and creativity. Experiments have shown that groups engaged in mapping in a virtual environment demonstrate high efficiency and creative approach to groups relying on traditional methods (Murodova, 2020: 64-65).

5. Certain difficulties – internet speed, technical base, teacher qualifications, software license issues-can negatively affect the final result. But it is possible to overcome these problems by using open-source and free platforms, establishing advanced training courses, developing public private cooperation.

6. Development prospects-the importance and capabilities of virtual cartography are expected to expand further through future integration with technologies such as AR (augmented reality), AI (artificial intelligence), remote universe surveillance, metaverse.

Thus,” modern methods of mapping and analysis in a Virtual environment " – not only scientific research, but also education, socio-economic planning, environmental monitoring, emergency management, tourism, architecture, are of particular importance, providing quick, accurate and interactive solutions in dozens of areas. In the modern world, virtual cartographic competencies have become an important advantage for professionals. In Uzbekistan, serious attention should be paid to the consistent development of this direction, training of personnel, enrichment of the technical base and professional development.

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