

Use of GIS technology in geographical education

Arman Demeuov¹, Zhanna Tilekova¹, Yerkin Tokpanov², Olena Hanchuk³, Natalia Panteleeva^{3*}, and Iryna Varfolomyeyeva³

¹Abai Kazakh National Pedagogical University, 13 Dostyk ave., Almaty, 050010, Republic of Kazakhstan

²Ilyas Zhansugurov Zhetysu State University, 187 A st. Zhansugurov, Taldykorgan, 040009, Republic of Kazakhstan

³Kryvyi Rih State Pedagogical University, 54, Gagarina Ave., Kryvyi Rih, 50086, Ukraine

Abstract. At the present stage, digital information technologies create a new education system focused on the global educational space. In general education schools, in connection with the adoption of the updated program, the section Geoinformatics and cartography provides for the use of developing a map-scheme, modeling and conducting small studies on the topic under study. As a result, digital technology has a place in geographical education. This is due to significant changes in the pedagogical and methodological approach in teaching geography and other disciplines. As a result, the education system has changed, the content of education has been updated, a new approach has appeared, a new attitude to geoinformation technologies in schools. The article discusses the importance of computer technologies in the education system, including the effectiveness and necessity of using geoinformation technologies. The article substantiates the relevance of the use of geoinformation technologies in the teaching of geography.

1 Introduction

It is quite obvious that without modern information technologies it is impossible to achieve competitiveness in the market. The most important of them is the lack of a single or unified market for joint software tools, which would allow partners to use the resources accumulated in different automation systems. Currently, digital technologies are rapidly developing. The number of sites is growing daily. Search engines already refuse to name the exact number of them, citing the impossibility of accounting.

In the modern world, geoinformation technologies are widely used in geography, tourism and many other spheres of human activity. To improve the quality of education in Kazakhstan, the State Program for the Development of Education for 2011-2020 has been developed. The law on the status of a teacher was adopted [1].

In this regard, reforms and policies, changes and innovations in the country's education system can become the basis for every pedagogical community to think, reflect on the past and present. Work with new ideas and face the challenges of an updated program. "Geography" in high school (grades 10-11) - is, creating conditions for students to apply geographical knowledge, skills and abilities aimed at solving geocological, geo-economic, social, geopolitical and global problems that arise at all levels of geographical space [2].

Technology (from greek. "techno" – art, "logos" – thought, reason, technique, method of production) – a set

of methods, processes and materials used in any branch of activity, as well as a scientific description of the methods of technical production [3]. Geographical information – information about objects and phenomena that take place in the surrounding space on the territory of the planet Earth and are accompanied by geographical coordinates (longitude, latitude). The combination of geographic information and computer technology has led to the creation of geographic information technologies or geographic information systems (GIS) [4].

GIS is "... information systems that ensure the collection, storage, processing, display and dissemination of data, as well as obtaining new information and knowledge about spatially coordinated phenomena...".

Therefore, we offer technologies for using GIS mapping. Here, the main place is occupied by satellite images and remote sensing of the Earth. In our practical work for the last 2-3 years, we have been using this method to develop tourist routes and to draw up map schemes for some sections of geography. When developing routes using remote sensing and GIS technology, we determine the state of the route, the terrain, and dangerous mountain areas for safety purposes. In the research works of graduate students and doctoral students, there is a mandatory requirement to apply remote sensing methods.

Here is a concrete example of how to use remote sensing and GIS technologies in the educational process. From a scientific point of view, this moment has been tested, and is used in the dissertation work of the doctoral student A. Demeuov.

For the first time, the term "geographic information system" appeared in English-language literature and was

* Corresponding author: panteleeva4y@gmail.com

used in two versions, such as geographic information system and geographic information system, very soon it also received the abbreviated name GIS.

2 Initial data and research methods

A breakthrough in the field of creating geographic information systems and the beginning of the development of geoinformatics is the development and creation of the Canada Geographic Information System (Canada GIS). Its history begins in the 60s of the last century and to this day this large-scale geoinformation system is being developed and maintained.

The components of the geographic information system include:

- 1) data (spatial data);
- 2) hardware (computers, peripherals, network equipment);
- 3) software (software);
- 4) methods;
- 5) specialists.

There are many examples of using GIS. Currently, almost every Internet user has at least once accessed map resources (such as Google Maps, Bing, OpenStreetMap, Yandex Maps, etc.) that provide information on a free basis. This area is called web mapping.

Along with web mapping, there are network GIS, as well as desktop GIS. Their use in areas of human activity, such as the extraction of natural resources, the study of the environment and climate, as well as education, is growing every day. They are widely distributed all over the world. The Republic of Kazakhstan is also no exception.

For example, in the Russian Federation a closed JSC "Design Bureau Panorama" developed educational-methodical complex "Living Geography", including a dedicated set of satellite images, guidelines.

The analysis of changes in various spheres of activity over the past decades allows us to speak about the progress that has allowed us to move rapidly in various sectors of the economy. The search for solutions to some problems leads to innovative methods. Innovation impresses with its growth rate and becomes an integral part of our lives.

Online information technology strategies require innovative approaches and organizational restructuring. In order to take advantage of the Internet and counter the risks associated with it, it is necessary to adopt new approaches. Only those who innovatively use traditional advertising strategies or offer fundamentally new concepts can achieve success in the Network. For example, Interactive maps and photos. With the help of several sites, you can get into the universal GlobeXplorer library, which contains satellite aerial photographs of almost the entire surface of the Earth. MapQuest is the first brand to introduce this technology. With the help of GlobeXplorer technology, the consumer sees interactive aerial photos of many cities, rural areas and major tourist attractions. The combination of aerial photography and digital mapping makes it easy for tourists to navigate unfamiliar terrain. For example, AOL (America Online) members and MapQuest users planning a trip can design

a travel itinerary, then view the map and see the selected location from a bird's eye view. With the navigation features provided by MapQuest and GlobeXplorer, the tourist can easily navigate the site in all directions and visually find roads, rivers and other landmarks. An attractive and fundamentally new project for promoting the tourist opportunities of our country should be the "Interactive Tourist Map of Kazakhstan".

The principle of its construction should be that a potential tourist can get comprehensive, interactive information about the country, its tourist opportunities and attractive tourist sites in all regions. An interactive tourist map of Kazakhstan should provide an opportunity for a potential tourist to make a virtual trip along the route chosen and interesting to the client, or excursions, to have a complete idea of the tourist center, this or that attractive tourist object.

Innovation is an implemented innovation that provides a qualitative increase in the efficiency of processes or products that are in demand by the market. It is the end result of a person's intellectual activity, imagination, creative process, discoveries, inventions and rationalization [3]. Since tourism is an important sector of the economy, which is one of the main sources of income in many countries of the world, innovations have also affected its development. Innovation in tourism brings new ideas, services and products to markets.

The main directions of innovative activity in the field of tourism are the release of new types of tourist products, the use of new equipment and technology, marketing, management; identification and use of new markets for products. Tourism is a multi-faceted phenomenon that carries an economic function and the function of satisfying the spiritual needs of a person.

Innovative activities in tourism with the use of high-tech equipment for remote sensing of the Earth (ERS), new materials have influenced the nature and structure of modern tourism. The new era of information technologies has expanded the scope of their application. One of the most striking examples of this is GIS technology.

Geographic information system – a system for collecting, storing, analyzing and graphically visualizing spatial (geographical) data and related information about the necessary objects [4].

At first glance, GIS is a tool for preparing digital maps and printing them on paper or polymer media. However, the real range of GIS applications is much wider, since these technologies are currently used in various fields of activity, including tourism.

To solve the problems of tourism development, interactive maps using GIS technologies are needed. They will mark major resorts, recreation centers, plans of resort areas and adjacent territories, give characteristics of tourist and recreational facilities, information about the quality of service, photos of the room stock, cuisine, beaches, etc. This would provide potential tourists with comprehensive information, since it is believed that GIS is a technology that answers questions instantly. In addition, in some countries GIS tools are used for planning the development of regional tourism [5].

In the opinion of the authors, the work on the creation of tourist GIS can be successful if they focus on the

creation of so-called Internet services using GIS technologies.

A big advantage of these services is their popularity among a large mass of Internet users, as well as the availability of detailed maps of major cities. However, according to the authors, the lack of these services for the development of tourism in the Republic of Kazakhstan is the lack of specialized information about tourist and recreational facilities located both within urban areas and outside them and related various attribute information.

In order to solve the problem of increasing income from inbound tourism, there are various strategic programs at the state level in the Republic of Kazakhstan, covering various activities, including the creation of tourist information Internet portals. As an example, you can use the website www.VisitKazakhstan.kz implemented by relevant departments. The site provides a large amount of useful information about tourist and recreational facilities, routes, and so on. However, users often require the presence of interactive tourist maps.

Since, in the current conditions of the world economy, tourism is becoming one of the leading and dynamically developing industries, the relevance of the chosen topic is not in doubt.

According to the UNWTO, tourism ranks fourth in world exports of goods and services (7.4 %). However, in Kazakhstan, unfortunately, tourism is still not perceived as a full-fledged branch of the economy and the subject of scientific analysis. In general, the concept of “tourism” in the republic is more often associated with sports and health promotion, rather than with an economic sector that generates significant revenues, primarily in hard currency. After all, in fact, tourism is a complex multi – faceted manifestation of public life, but first of all, it is a “spatial socio-economic phenomenon”, also in many ways “spatial cognition”, firmly connected with the territory of the country and its individual regions.

3 Results and discussion

In Kazakhstan tourism, it is necessary to pay more attention to poorly developed, but no less interesting tourist products. A striking example is the city of Ridder (Figure 1). It has a unique tourist potential. A strong point in terms of tourism development are: a convenient geographical location (proximity to Russia and China), also this unique mountain area for Kazakhstan is located close to the regional center – Ust-Kamenogorsk, and the presence of a developed transport infrastructure – the city has its own railway station “Leninogorsk” [6].

The environs of Ridder include: Ivanovsky and Stanovoy ridges, the upper reaches of the Black and White Uba rivers. Here is located the West Altai State Nature Reserve, the main object of protection of which are typical for the Western Altai landscapes, in particular-the black taiga. The area of the protected area is 54533 hectares. The region has 8 recreation centers, 2 ski resorts, 4 public organizations of tourist orientation, 4 children's camps.

When visiting Ridder and its surroundings, the priority types of tourism can be distinguished: active (mountain, ski and ski, bicycle and car, sports, equestrian

and hiking); ecological and educational (amateur photo safari, spa treatment, fishing and hunting, village, ethnic and ethnographic). The territory of the mountain suburbs of Ridder is suitable for organizing almost all types of geotourism.



Fig. 1. Survey image of the research area (Google Earth).

Free and quick access to the vicinity of Ridder (no special pass to the border zone is needed), allows you to organize tours of short duration up to 2-3 days (“weekend tours”). So, the recreation centers “Belaya Uba”, “Gromotukha” and “Klimovka” serve just such tourists. A wide range of interesting places is covered for making routes of various nature and complexity (mountaineering, mountain tourism, horse tourism, rafting, sport hunting, cycling). In terms of tourism, the Ivanovo and Stanovoy ridges, the upper reaches of the Black and White Uba Rivers are attractive. Here is the largest number of recreation centers, more prepared infrastructure [7].

The most popular places to visit, in the general structure of land use of the city, include water resources – the sources of many Altai rivers: the Gromotukha (spring rafting), Tikhaya, Bystrukha, Zhuravlykha and Filippovka rivers, merging, form the Ulba River (rafting), Lake Kedrovoye (fishing), Malouba Reservoir (trekking, historical tourism, skiing), the Turgusun River (rafting).

The tourist significance of mountain ranges lies in the fact that under the influence of endogenous and exogenous factors, various natural and territorial complexes were formed. Objects of the mountain environment (typical unique mountain complexes, natural monuments) that are of great educational, sports, health, religious and scientific interest. This includes the highest mountain peaks and peaks, passes, bizarre rocks, grottoes, boulders, etc.

One of the most famous tourist places in the vicinity of the city is the “Black Knot” - the junction of the three main ridges of the district (Koksuisky, Ivanovsky and Kholzun). Here is a unique natural monument – the Museum of Giant Stones “Kamennaya Skazka”. At an altitude of 2000 m, stone statues of the most bizarre shapes froze. Here are the “Line Pillars”, “Maryin Utes” and “Stone River”, where the filming of the famous TV series “Eternal Call” took place.

This region is also known for sports tourism. Since 2009, Ridder has hosted auto and motorcycle races 3...4 times a year. They bring together participants and spectators from all over Kazakhstan and some regions of the CIS. Thanks to these events, the city became known as the “Capital of motor racing in East Kazakhstan”.

The region is an important destination for skiing and alpine skiing tourism. It is not at all inferior, and perhaps, in terms of technical characteristics, it is somewhere superior to many ski and ski slopes. In the suburbs of Ridder, there are many so-called mountain squirrels, where snow lies almost all year round. For example, the well-known Vyshivanovsky Belok (Voroshilov Peak) (trekking, mountain tourism, summer ski camps, ecotourism). Ridder is the pearl of East Kazakhstan for skiers.

The first project of a high-mountain base in Kazakhstan—a shelter located far from the benefits of civilization, surrounded by the pristine nature of the Western Altai—is located on the passable protein (1800 m) [6]. In the “Ridderhutte” develops an extensive list of priority areas of tourist activity, which is developed by the sports project of the base, aimed at promoting the development of skiing in Kazakhstan. It allows athletes to train in the summer at home, without going abroad and without incurring huge financial costs. In the vicinity of the 2nd district of Ridder, there is a ski center equipped with an anchor cable lift. Restored ski lift in the Upper Harutoki.

If we consider the development of Ridder as a ski and ski resort, it should be noted that this is a large-scale project, the implementation of which is currently unthinkable without geoinformation support [7]. The relief of the mountainous surroundings of Ridder has a huge tourist potential. For the protection and rational use of this potential, it is necessary to map it at the level of modern science and technology. The objects of research and cartography should be mountain slopes, which will serve as the basis for creating tourist trails in the future.

Ensuring the design, construction, and in the future – the successful operation of many tourist facilities, requires timely and high-quality cartographic support. At the same time, at the stage of development of project materials, it is necessary to solve problems related to the selection of sites of spatial location of various tourist objects and structures. On the one hand, special requirements are imposed on them (for example, for ski routes – slopes for various types of competitions, features of wind characteristics for springboards, etc.), and, on the other hand, transport accessibility must be ensured while minimizing the violation of the unique natural conditions of the region.

The accuracy and other qualities of the compiled map depend on the cartographic source used and the methodology used. Maps should be compiled on the basis of a number of cartographic sources: general geographical, physical, geomorphological maps of the Ridder area of different scales, tourist schemes, extensive use of specialized literature and departmental materials.

Modern GIS technologies allow you to create tourist GIS, i.e. systematized data for the organization of tourist activities [8]. Every tourist visiting Ridder will be able to quickly get any information in the form of maps, digital

models, graphs, diagrams and other types of information using GIS materials.

For this purpose, in the preparation of this article was used software QGIS v2.4.0 and data on the topography of the open-source ASTER GDEM v2.0.

So, with the use of tools for morphometric analysis were analyzed the topography of the study area and the resulting maps of the exposure of the slopes (Figure 2), shaded relief, and ruggedness.

Analysis of the exposure of the slopes of the area showed the predominance of south-western and north-eastern orientation, which is clearly demonstrated on the map.

At the heart of the initial stage of the formation of the design of Ridder as a ski resort is the translation of previously obtained by traditional methods of cartographic materials of the city and its mountain surroundings into an electronic cartographic form with their subsequent unification on the basis of a single cartographic basis. In the future, these blocks of the geoinformation system are increased by electronic cartographic data obtained directly in solving the problems of developing a mountain climate resort, including updating data on the results of monitoring (environmental, geological, technological, service, etc.).

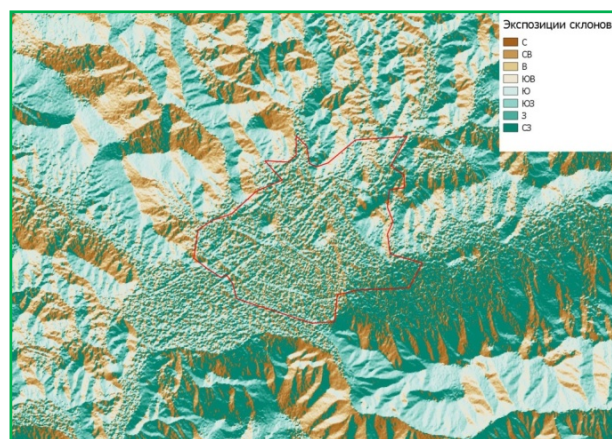


Fig. 2. Slope exposure map.

The second feature of the work on the creation of a block of detailed electronic cartographic materials is the need for 3D data from specialists who perform work on engineering and environmental surveys, design, engineering protection of the territory from dangerous hydrometeorological and geological processes. 3D data has significant advantages in providing information about the nature of the surface and its inhomogeneities. These heterogeneities are caused by the complex geological structure of the region and formed, at present, as a result of the development of geological processes, including requiring consideration in the design of various buildings and structures.

These materials related to 3D data should fully reflect the three-dimensional structure of the mountain area under consideration for ski tourist trails and other auxiliary facilities (Figure 3).



Fig. 3. Washing of the relief of the research area.

For example, economic geography reveals the features of the geographical location of the city – this specific resource, perhaps the most important for development. It obliges to consider the city together with the environment, acting as its partner and at the same time addition, as well as the sponsored territory that it is obliged to serve and take care of. Changes in the city cause a response in the environment. By managing the development of the city, you can also manage the development of adjacent territories. The city, as an object of research, is important for geography, which finds application in it for subsidiary sciences and can realize the potential of an integrator science. Being a set of enterprises and devices that have a strong impact on the environment, the city not only becomes an area with a tense environmental situation, but also a factor that changes the environmental situation within a vast space [8].

The capital of the Republic of Kazakhstan is Nur-Sultan, located in the center of the country in the steppe zone. From the point of view of the relief of the earth's surface, the city is located on the low above-floodplain terraces of the Yesil River, which is the main waterway of the city. The climate is characterized as sharply continental with long cold winters and hot summers.

Nur-Sultan today is an example of sophistication of architectural style, striving to achieve the harmony of an environmentally friendly metropolis. The area of the capital's "green belt" around the city is regularly increasing, it has become a kind of oasis in the center of the steppe. Nur-Sultan is also the political, administrative, business and cultural center of the country, where the central authorities, diplomatic missions, universities, modern medical institutions and cultural centers are located [9].

Currently, the role of the city as a transport, logistics and communication center in the center of Eurasia is increasing. Despite the short period since the beginning of the historical change of the capital, Nur-Sultan became the main city of Kazakhstan during the formation of the young state (Table 1).

In this regard, the role of the city as one of the centers of tourism has increased, as the flow of tourists seeking to visit the capital of our country increases from year to year. According to some foreign tourists, the architectural appearance of Nur-Sultan is at the same time similar to

Dubai (UAE) and Tokyo (Japan), and is something in between. The unique architecture of the capital of Kazakhstan embodies the so-called "eclecticism", i.e. a mixture of different styles. This has been achieved over the past 15 years with the involvement of internationally recognized architects Sir N. Foster and K. Kurokawa, as well as many other architects.

Table 1. Classification of some tourist and recreational facilities in Nur-Sultan.

№	Name	Type of tourism	Subspecies of tourism
1.	Ethno-memorial complex "Atameken"	Historical and cultural	Architectural culture tourism
2.	Palace of Peace and Reconciliation		
3.	Independence Monument		
4.	The Palace Of Independence		
5.	Palace of Creativity "Shabyt"		Tourism of the urban environment and culture
6.	National Museum		Architectural culture tourism
7.	"Astana Opera" Theatre		Tourism of the urban environment and culture
8.	"Khan Shatyr" Shopping Center		Architectural culture tourism
9.	The Monument "Baiterek"		
10.	"Alau" Ice Palace		Tourism of theme parks of culture
11.	"Astana Arena" Stadium		
12.	The Cycle Track "Saryarka"		
13.	Hippodrome "Kazanat"		Architectural culture tourism
14.	Stella "Astana Zhuldyzy" (Stars of Astana)		
15.	Nazarbayev University		Tourism of theme parks of culture
16.	Triumphal Arch (Mangilik El)		Architectural culture tourism

The full list of places offered for visiting is about 70. However, for objective reasons, this article contains only part of the specified list of tourist and recreational facilities.

Currently, the achievements of science and technology offer various tools for human activities to increase efficiency, including for tourism. Such a tool can be called GIS or geographic information systems designed for the collection, storage, analysis and graphical visualization of geographical data. Since there are a lot of materials on this topic in open sources, the authors of the article did not stop at explaining the terminology, but preferred to focus on the results of the work. As mentioned above, geographic information systems have a number of functional properties that allow you to enter, store, process and visualize geographical data. In this regard, the authors of the article used software with an open license Quantum GIS v.2.6.1 [10].

The scheme was based on the list of tourist and recreational facilities compiled earlier. The objects were plotted on space images provided in the public domain through the Google Maps service. Keep in mind that GIS data is stored in layers in vector and raster formats. Thus, in the future, a point layer with the image and names of objects is obtained, as well as a linear layer with the image of the route line. Then the attribute tables of these layers were integrated with the above table of tourist and recreational objects of the research area, the symbols were set, and the layout of the scheme was prepared for printing.

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In the work carried out, the map of the city of Nur-Sultan was used, covering the objects of tourist infrastructure (Figure 4).



Fig. 4. Scheme of a complex tourist route on the territory of Nur-Sultan.

As a result of the work, a map of the tourist route within the city of Nur-Sultan was drawn up, which covers the above types of tourism (Figure 4).

This method of work can be useful both for educational activities in the field of tourism, and for drawing up route diagrams in the development of tourist

products using hardware and software tools to obtain high-precision data.

GIS significantly speeds up many stages of mapping. Tourist maps compiled in the GIS environment are characterized by good design, accuracy, attractiveness, speed and production options [11; 12]. In addition, it is

possible to analyze any component of the mountain route separately, create a digital terrain model (DEM), organize e-tourism, disseminate information, etc.

4 Conclusions

The use of GIS technology in geographical education is thus acceptable in the development of tourist maps, at school and at university. In practice, we were convinced that high school students in the geography sections together with teachers can use GIS in geography lessons, and we were convinced of the possibility of creating a unified geoinformation system for Ridder and its districts as a mountain climate resort.

The creation of a unified geographic information system of Ridder and its districts as a mountain climate resort should be carried out in several stages, starting with the formation of a block of medium-scale electronic cartographic materials, which is clearly demonstrated in this article. By saturating the unified geographic information system with detailed electronic cartographic materials from various performers, which are received as engineering and environmental surveys are completed at individual sites, it is easy to create a large-scale map of Ridder as a tourist destination in Kazakhstan.

At the moment, we are developing an application for tourist sites in certain regions of Kazakhstan. Internet services using GIS technology were demonstrated in some sectors of the economy during the world exhibition EXPO-2017 in Nur-Sultan.

The use of GIS technologies in educational activities, both in the specialty “Geography” and “Tourism”, and in other specialties, increases the accuracy of data, their reliability, and also clearly demonstrates the current situation and makes it possible to create various models. In turn, the above allows you to improve the quality of higher education.

References

1. *Law of the Republic of Kazakhstan on the status of a teacher*, <http://adilet.zan.kz/eng/docs/Z1900000293> Accessed 19 Jul 2020
2. O. Mazbayev, L. Alieva, A. Demeuov, Problematic issues of geographical education in Kazakhstan. E3S Web of Conferences **166** (2020)
3. G. Azgaldov, A. Kostin, EcST **60**, 162-164 (2008).
4. A. Ayapbekova, K. Samarkhanov, A. Demeuov, *Hyd&Ec*, **1** (88), 150-161 (2018), <https://www.elibrary.ru/item.asp?id=35197734>
5. E. Kapralov, A. Koshkarev, V. Tikunov at all *Geoinformatica* (Geoinformatics), (Publishing center “Academy”, Moscow, 2005), p. 480
6. *Virtual 3D tour of East Kazakhstan*, https://3d-maps.kz/en_place_587-altayskiy-botanicheskiy-sad-v-okrestnosti-g-ridder#iframe Accessed: 07.02.2019
7. *Ivanovskiy khrebet* (Ivanovsky ridge) Portal Ridder City (2017), <https://invest.e-vko.kz/ru/menu/o-regione/rajonyi-vko/goroda-oblastnogo-podchineniya/gorod-ridder.html-ridder/> Accessed: 10.02.2021
8. K. Samarkhanov, Development of the hospitality industry in Astana. Paper presented at the Republican scientific and practical conference “The third modernization of Kazakhstan: the contribution of scientists and students to the industrial and innovative development of the country”. Kazakh University of Technology and Business, Astana, 12 December, 2017
9. Cartographic service <http://maps.yandex.kz/> Accessed 8 Sep 2020
10. Cartographic service <http://maps.google.com/> Accessed 8 Sep 2020
11. Sozdanie czifrovoj kartograficheskoy produkcii razlichnoj napravlenosti (Creation of digital cartographic products of various directions), *Kazakhstan Center for Geographic Information Systems* <https://gis-center.kz/ru/uslugi/sozdanie-tsifrovoj-kartograficheskoy-produktsii> Accessed 3 March 2021
12. L. Chesalov *GIS i kartografiya* (GIS and cartography) ARCREVIEW, **1(16)**, 13 (2001)
13. Cartographic service “Nur-sultan tourist map” <https://www.city-tour.kz/eng/index.php/almaty-event-calendar/item/154-astana-map> Accessed 28 Feb 2021