Electronic School Atlas as an Innovative Means of Development of Geographic Education in Kazakhstan Schools

Saule Kairollovna Damekova[a], Temirkhan Niyazovich Zharkinbekov[a], Gulnara Bayanovna Turtkarayeva[a], Sergey Inokenteevich Han[a], Oral Zhangabylovich Damekov[a],

[a] Kokshetau State University named after Sh. Ualikhanov, KAZAKHSTAN

ABSTRACT

Strategic role of geographic information systems (GIS) for the geographical entity is not in doubt, but there are differences in the understanding of what, when and how to teach. The article presents some aspects of the GIS integration in school education in Kazakhstan.

An analysis of the scientific and technical literature, teaching practice shows that the use of electronic school atlas in geography lessons and in extracurricular activities significantly expands the scope of learning activities of students and teachers, stimulates cognitive interest, forms the GIS competence of students.

The article considers the problem of formation of geo-information competence of the students on the basis of the use of the electronic geography school atlas developed by the author in the context of the requirements of the state standard of education in Kazakhstan.

Scientific novelty of our study is that there has been developed an innovative learning tool, that is an electronic school atlas that provides effective school training at geography lessons in school.

Introduction

Explore Importance of the Problem

Generalization of the current state of the use of GIS in the education systems of different countries has been made in the work of researchers (Milson et al., 2012), (Donert and González, 2014). Application of GIS in the design, research projects of students was considered by (Demirci, 2009). The e-MAPScholar project (Blake et al., 2004) considers the introduction of geo-information educational portal. (Roosaarea and Liibera, 2013) consider some aspects of GIS education in Estonia.

Analysis of articles on the use of GIS in education (Baker et al., 2015) shows that the status of GIS in school education has not been established. A classical question teaching geography with GIS or teaching the use of GIS tools remains still relevant. An objective reason for this situation is the rapid development of information and communication technologies (ICT), as a result of which specific GIS tools are rapidly developing and the understanding on the use of GIS is constantly changing. Universities are trying to go along with technological development, but school education has a limited ability to change so quickly. School teaching is traditionally conservative and is restrained by a fixed curriculum and strict rules to ensure the quality requirements in training. One of the major limitations of the use of GIS in real educational process is the lack of teachers possessing geo-information competencies (Höhnle al., 2010).

Describe Relevant Scholarship

Questions of creating specialized geographic information systems for education are discussed in the works of (Haeberling and Baer, 2011). In geography teaching practice in secondary schools there is used school geo-information system "Living geography", (Novenko et al., 2008). In the work of (Ormeling, 1996) the functions of the electronic school atlas are defined. In the works (Stefanakis et al., 2006) there is carried out a theoretical analysis of the concept, of definitions the electronic atlas, classification of electronic atlases, as well as the issue of the difference between geographical information system and electronic atlases. The properties of the multimedia atlas are considered in (Hurni, 2008). At geography lessons there are actively used "Interactive maps on geography" of the publishing house "Drofa", which is a multimedia complex of 62 CD discs with the content that covers the entire course of the Russian school geography (Multimedia cartographical visual aids of Drofa publishing house, August 28). The Institute of advanced technologies created a technological construction line, drafting, editing and preparation for the publication of electronic school atlas for schools of Ukraine on the basis of geoinformation technologies (Baraldin, 2015).

Problems of scientific justification of the essence of geoinformation competence and its formation have been the subject of several studies. The work (Orekhova, 2014) introduced the following definition of geographic information competence: "Geoinformation Competence refers to the characteristic of the individual learner, willing and able to solve practical problems and cognitive geographical focus, resulting in learning and different spheres of social activities that require effective decision-making and their execution with taking into account the existing experience with GIS technologies means".

Since the GIS expertise is highly valued in many professions, students who have received this competence during training in high school have many advantages in career planning, or in labor market (Arrowsmith et al., 2011).

The role of GIS in the State Program of education development

Currently, Kazakhstan is actively implementing the State Program of Education Development in the Republic of Kazakhstan for 2011-2020, in which one of the important tasks is to introduce e-learning, which implies ensuring equal access for all participants in the educational process to the best educational resources and technologies.

The activities of educational institutions of the Republic of Kazakhstan are carried out in accordance with the State educational standards of secondary education of the updated content (SES) (State educational standards, August 28, 2016). SES is focused on practice-forming skills of students, the development of functional literacy. The functional literacy is defined as "the ability to use knowledge and skills acquired in school for a wide range of vital tasks in various spheres of human activity, as well as in interpersonal communication and social relationships."

The development of functional literacy of today's students has required the introduction into the curricula of a practice-oriented component with the increased share of practical, project, experimental and research tasks, implementation of educational projects that enhance the innovative character of the educational process, its focus on self-development and self-realization.

All practical work by school grades are specifically formulated according to program topics, aimed at explanation, comparison, analysis, synthesis, description, calculation, communication, modeling. The work requires creativity, analytical approach, have a developmental nature, aimed at the application of theoretical knowledge on specific objects and territories, the use of new information technologies. Training results planned in the new curricula suggest a systematic, purposeful application of GIS in geography lessons.

On the agenda in today's Kazakhstan is the study of multilingual non-language subjects, such as geography. Thus, requirements a national program to contribute fully to the application of GIS in schools in terms of multilingual education is realized.

State curriculum has a significant impact on school teaching, the real learning process in classrooms depends on teachers' professionalism. Many studies show that a lack of teacher training in GIS, lack of suitable training packages, high total load of teachers and the need for additional preparation time are the main obstacles to the integration of GIS into school geography (Liu and Zhu, 2008). These constraints are given in our study considering Kazakhstan geography teachers.

Kokshetau State University after Sh.Ualikhanov carried out the project "The geo-info set of educational maps Atlas" (2013-2015) by the budget program of MES of RK in the direction of GIS. The purpose of the study is the definition of the structure, functionality, content and technology of working out electronic school atlas. (Damekova and Kuttykozhayeva, 2016)

Currently in Kazakhstan there are separate thematic GIS projects directed to the specific scientific and applied problems in the field of management and business. Electronic school atlas has been developed for schools of Kazakhstan for the first time.

Methods

In the process of research a set of theoretical (analysis and synthesis of scientific, educational and methodical literature on the research problem, the state educational standards, school books, geography work programs, electronic atlases), empirical (pedagogical supervision, the study of the practice of teachers, questionnaires, pilot training school, testing, introspection of personal experience), statistical methods (mathematical processing, graphical and tabular

interpretation of experimental learning outcomes), geoinformation methods and programming were used.

Implementation of the first phase of the research work was based on the methods of analysis of the internal consumer market - survey and geo-information methods of working with electronic raster images and converting them to a common coordinate system and map projection with a further vectorization. Research work on the development of e-learning atlas began with an analysis of school security cards. The results of the survey of 96 Akmola region geography teachers were summarized in a diagram shown in Figure 1.
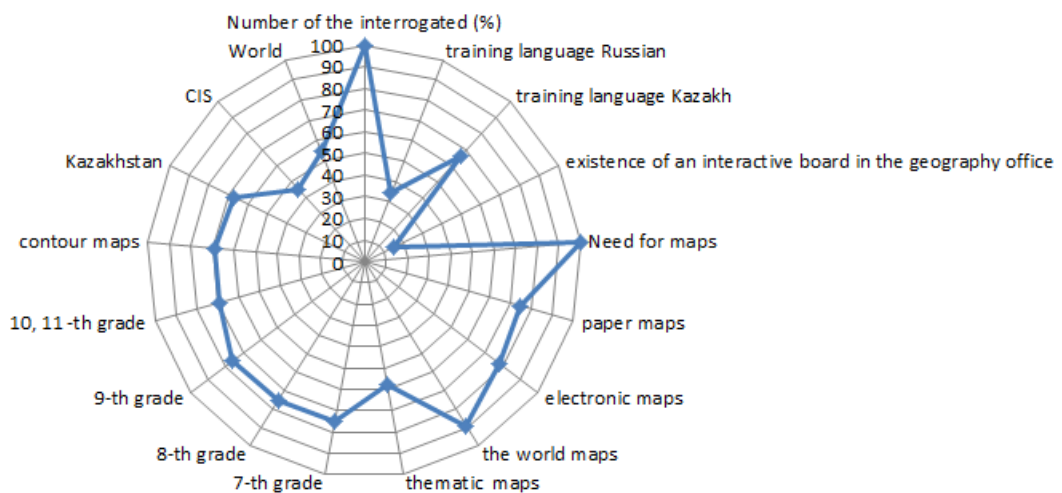

Figure 1. Results of questioning of geography teachers within the project "The geo-info set of educational maps Atlas"

Provision of schools with maps is quite low, as 100% of the respondents indicated the need for maps. 15% of teachers confirmed the presence in the office of the geography of interactive maps.75% of respondents indicated the need for electronic maps, 73% in the paper form, 69% the need for the contour maps. Among the maps on the territorial coverage 67% of respondents pointed to the need for maps of Kazakhstan, 53% the world map and 45% CIS card. The need for maps for the 10-11 grades was detected in 69% of the respondents, 72-73% of respondents indicated a need for maps $7^{th} - 9^{th}$ grades. Thus, after analyzing the questionnaires we had identified the need for the creation of a school atlas with in-depth thematic content for the territory of Kazakhstan.

When creating vector layers there never arises doubt in the technical side of the accuracy of sampling, because when working with raster mathematical aspects of the maps have been taken into account. Coordinate system Pulkovo-42 with normal map projection Kavraiskii was given for maps of Kazakhstan. Designed vector thematic layers combine reasonable generalization and selection of objects.

During the second year of the research there was developed e-learning geography atlas work by means of working with spatial data MapWindow library (Welcome to the MapWinGIS, 2016) and the programming language C # 5.0 in Visual Studio 2013 environment. The atlas represents the soft shell with tools for working with geographic information, digital geographic Kazakhstan maps page.

Testing and implementation of the results of research was carried out in the course of experiential learning in educational institutions such as schools #1, #4 Kokshetau, as well as on the basis of the Faculty of Natural Sciences of Sh.Ualihanov KSU.

Results and Discussion

Functions of an electronic school atlas

During the first year of implementation of scientific research work analysis of the researches (Haeberling et al., 2011, Novenko et al., 2008, Krylova et al., 2007), Russian unified collection of digital educational resources (Russian unified collection August 28, 2016), Ukrainian cards on Geography (Ukrainian cards on Geography August 28, 2016). On the basis of the carried out analysis the functions of the electronic school atlas has been identified.

Software e-learning atlas interface consists of: menu, toolbar, working area in which the map layers are displayed, the status bar. The workspace consists of two parts. The left half displays the names of the maps, layers, the legend of hierarchically structured electronic atlas. In the right half of the work area the electronic map layers selected by the user is opened.

By the commands of the view menu the appearance of elements of the main window is regulated. One can turn on, turn off the display of the toolbar, status bar, and the names of maps and layers. In addition to the working area of the screen the scale bar, the coordinates in the upper right corner of the selected geographic object of the map are displayed. The program includes the following modes of operation with the map by means of the MapWinGIS library resources: oncoming of the map; removal of the map; displacement of the map, return of the map to the default position, the selection of the object on the map, providing information about it; measuring distances and areas on the map.

One of the important functions of electronic school atlas is the possibility to choose the language of instruction. Switching between languages is done by the menu command Service, language, and then Kazakh, Russian or English is selected. After switching all the elements of the program interface, digital maps, the legend is displayed, and the search for geographic objects is carried out in the selected language

The ability to read a map is one of the basic in school geography program. Therefore, the first thing that the teacher should be able to do and student to learn is the ability to read geographic data on digital maps with the help of electronic school atlas.

As is known, the geographical information is mapped in the conventional signs. To understand what is shown on the map, it is enough to get acquainted with its legend. The legend of the digital map has a hierarchical structure that can be viewed as it is done in the Windows operating system.

Reading of digital maps can be enabled by turning off the display of various layers. The right half of the main window provides a complete listing of all available layers. They can be turned on or off depending on the needs of the

user. To do this, by the click of the left mouse button the layer that you want to disable must be either deselected, or the layer you want to display on the map be selected.

Reading a paper map is essentially limited to comparing and analyzing the location of objects deposited in the conventional signs displayed in the legend. The digital map carries more information about the objects represented in the conventional signs. This information is contained in the semantics of the objects mapped. For more information about the object it is enough to bring the cursor to it and click the right mouse button. This will open an additional window in which you can get acquainted with all the semantic properties of the selected object. Semantic characteristics can be both qualitative (the name, a brief description of the properties) and quantitative (numerical parameters, the number of inhabitants, etc.). The characteristics of maps and information relating to the whole map or layer are opened by the button on the toolbar.

Ability to carry out measurements and calculations on the maps is very important both for the teacher and for the student. Overloading students with factual material, teachers often do not pay enough attention to the practical tasks on measurements and calculations on the maps. This is partly due to the laborious measurement on conventional maps that leads to inefficient spending instructional time.

Electronic school atlas gives into the hands of the student the speed measuring instruments that exempt him from routine measurements and calculations. They allow one to focus on the geographic nature of the results.

Measurement of distances between objects is done with the button for length and distance from the toolbar. This mode defines the shortest distance between two objects, the map indicated the left mouse button, the result is displayed on the map. Determination of the area of territory is carried out using the same button toolbar. The combination of <Ctrl> key and the left mouse button indicates a territory, and the results window is activated, where object area (excluding sub-object area) will be recorded. The fundamental basis of the school geographical education consists in the ability to determine on maps the geographic coordinates of objects. Electronic school atlas toolkit allows to quickly determine the coordinates of any point on the map with a fairly high degree of accuracy. To do this, simply move the cursor to the desired point on the map. In the upper right corner of coordinates latitude and longitude values will be displayed.

The electronic school atlas provides search tool for quick search of objects on the set parameters. At first we need to find an object by name. By means of a button from the main toolbar, it is necessary to set the name of the map layer on which you want to search, then you should choose from a list of names of layers specific value and press the button. To perform a search in the Kazakh or English language it is necessary to switch the electronic school atlas menu command Tools, Language.

The electronic school atlas has a function of printing of digital maps and work with contour maps. Working with contour maps in the school geography course is one of the most important forms of organization of educational process in the subject. Electronic school atlas allows to upgrade this process, make it more interesting and exciting for the students.

Contour map in this case is a special case of digital custom maps that a teacher can make. In contrast to the traditional set of paper scratch maps, the

teacher is able to offer a student any contour maps. For example, it is possible can make a contour map of the whole Kazakhstan or as individual subject. It can be a part of these maps leaving only 2-3 layers to display the basic relations, such as "land – sea", and then these maps will be similar to the published paper counterparts. And you can delete only those objects and their signatures, the knowledge of which the teacher wants to check on this particular lesson.

Different variants of contour territory and content maps can be cumulated in the course of their formation. Subsequently, this will lead to the formation of each individual teacher's own library of contour maps, most "fitting" to the peculiarities of the educational process in a particular school, and taking into account the individual educational-methodical features of the teacher.

Contour maps built by means of electronic school atlas can be filled electronically by exporting it to the editing, and can be printed (photocopy) and filled in the traditional way. To realize this possibility maps of export procedures for editing and image viewer were developed. The figure 2 shows the screenshots exported from the electronic school atlas maps.
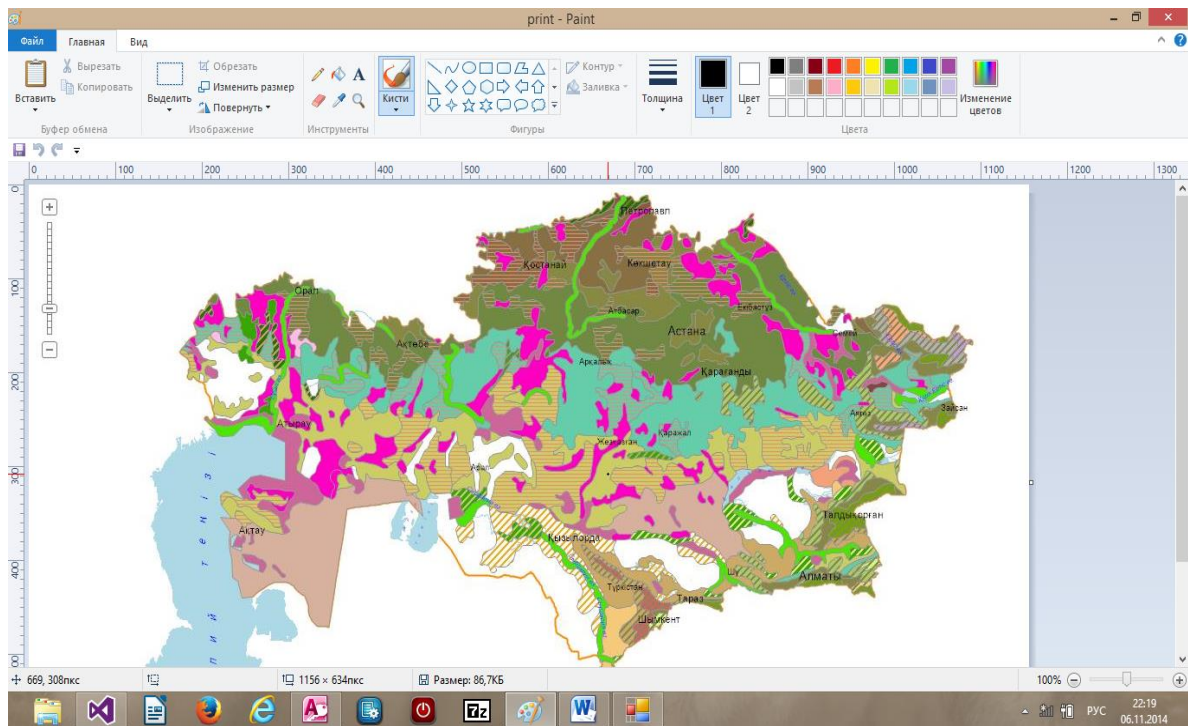

Figure 2. Window of graphics editor Paint with exported from electronic school atlas

Formation of GIS competence of students using electronic school atlas

The first stage is the initial acquaintance with electronic school atlas. The acquisition phase is carried out by students in the study of the initial course of geography in grades 6th -7th grades and is defined as the knowledge and the formation of the basic techniques of working with electronic atlas and training students to master the simplest ways of learning activity. Students master the general methods of creating, editing, copying, transferring and storing information in electronic format.

The second stage is the main once, where in addition to the basic methods of educational activity, pupils of 8th-9th grades studying the course "Geography of Kazakhstan" learn the following: digital overlay layers, maps, preparation of specifications and descriptions of the different territories on digital maps, the description of the relationships between geographic objects, phenomena and processes, statistical data analysis and the construction of its own thematic maps. Developed electronic school atlas includes 80 maps on the program of a school course of geography of 8th-9th grades , allows the use of GIS in secondary school.

Electronic training atlas improves the efficiency of the educational process through the use of geo-information technologies in solving traditional and new geographic problems at geography lessons. Among these objectives there can be named the comparison and the adjoint mapping analysis of maps of different content on the same territory in order to identify the relationships, for example, between tectonics and mineral resources, the climate and the state of water resources, topography and vegetation areas. Figure 3 shows an electronic school atlas interface in overlay mode of tectonic maps and of maps of mineral resources of Kazakhstan. Such tasks are difficult to perform with conventional cards, because they are based on the superposition of several card transactions mentally. Electronic training atlas allows us to solve this problem quickly and helps the student to carry out a dual analysis that develops the skills of scientific work. For example, Figure 4 shows the interface of the electronic atlas mode overlay of hydrography layer (rivers and lakes) and the freezing rivers of Kazakhstan map, in Figure 5 the electronic atlas interface mode imposing physical map and the soil map of Kazakhstan, and in Figure 6 the imposition of physical maps and Kazakhstan vegetation map.
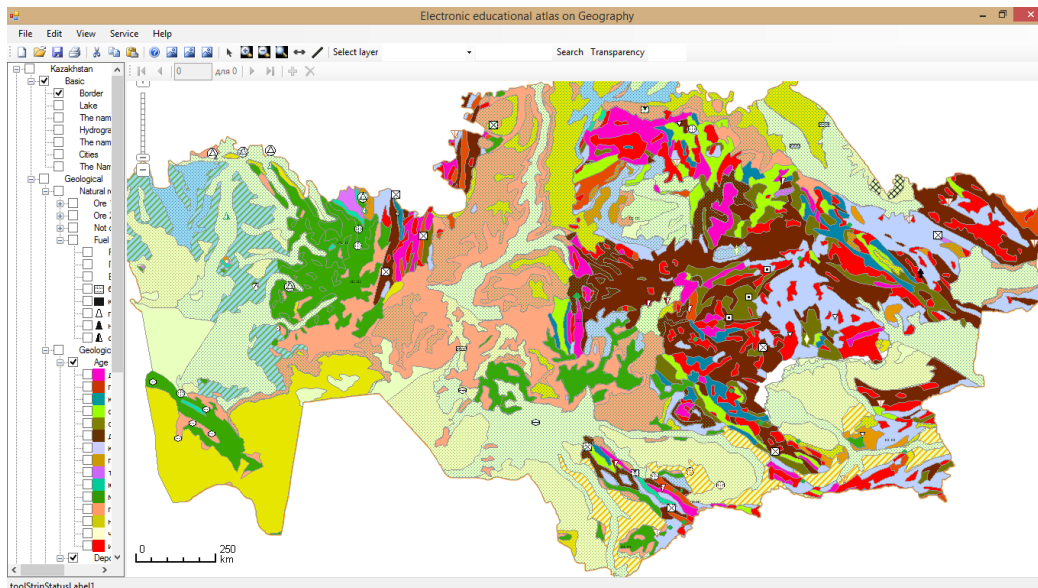

Figure 3. Electronic school atlas interface mode overlay of tectonic maps and maps of minerals in Kazakhstan
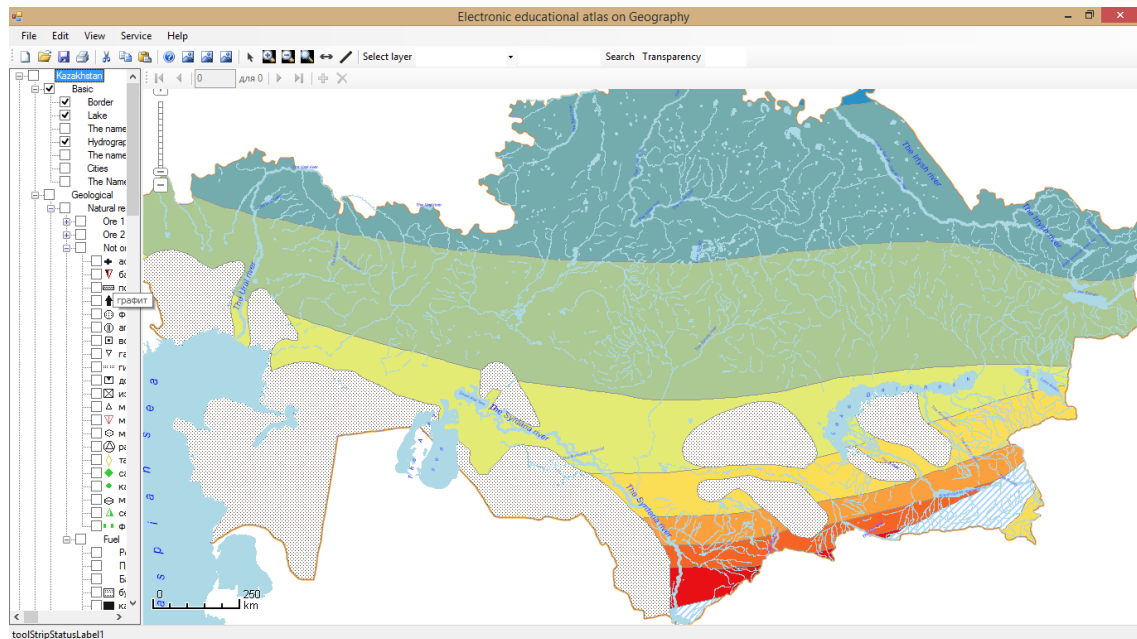
Figure 4. Electronic school atlas interface mode overlay layer of hydrography (rivers and lakes) and maps of freezing rivers of Kazakhstan
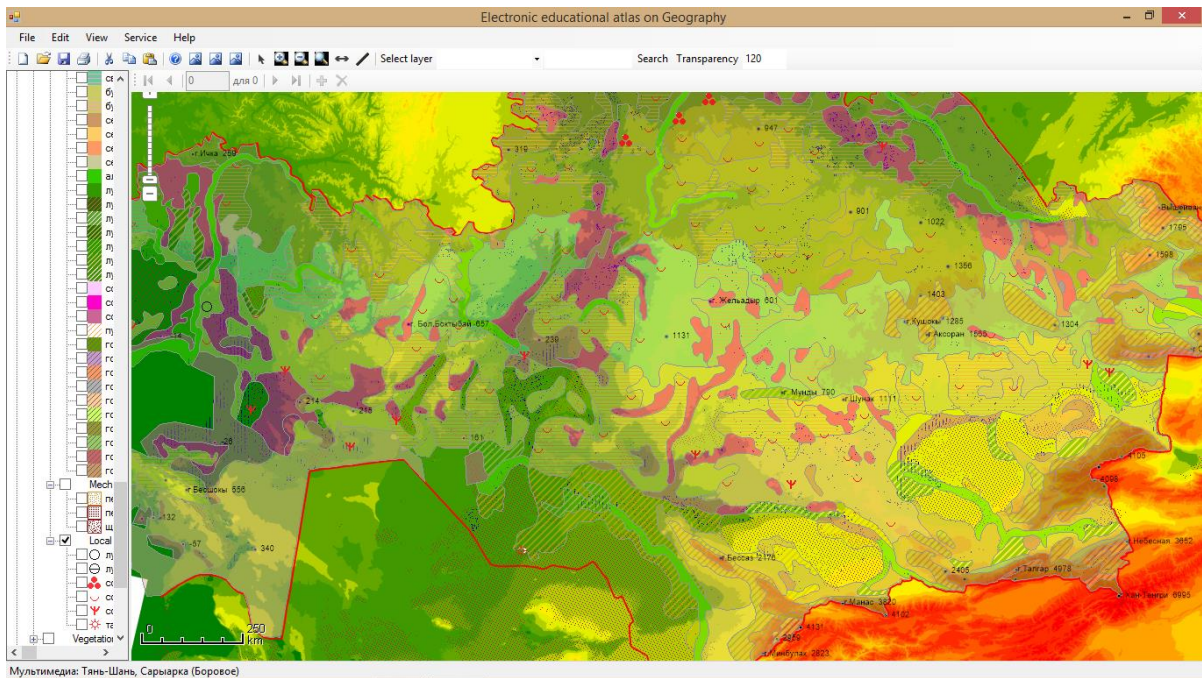

Figure 5. Electronic school atlas interface mode imposing physical map and the soil map of Kazakhstan
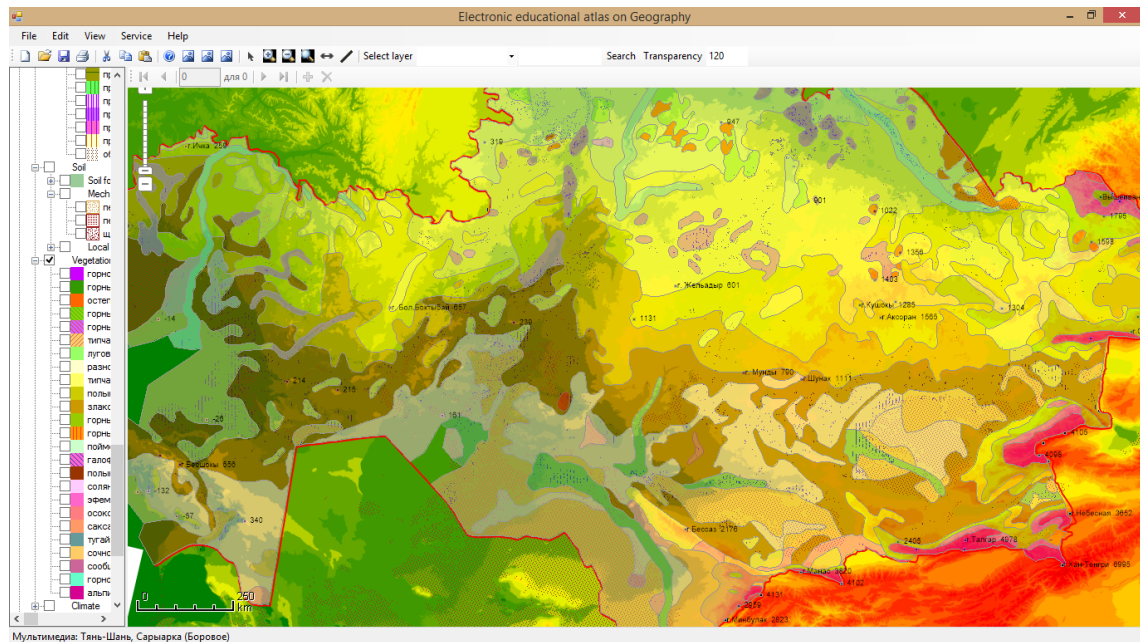
Figure 6. Electronic school atlas interface mode imposing physical maps and vegetation maps of Kazakhstan

Developed electronic school atlas allows to solve the following set of tasks in the Kazakh, Russian, English for the teacher:

- The use of digital vector maps at the lessons;
- Quickly change the scale of the cartographic image on the screen to change the details of placement of geographical objects and phenomena;
- Impose some thematic maps (layers) on the other, as well as on the general geographical, physical map;
- To prepare a set of digital maps, including contour ones required for practical work;
- To use a set of demonstration cartograms and map diagrams, placed in the library of additional multimedia information.

Students working with electronic school atlas can perform in the Kazakh, Russian and English languages:

- Read maps in digital form, to determine the coordinates of geographic features;
- To search for geographic objects on a digital map;
- Measurements and calculations on a digital map;
- Fill the digital contour maps;
- Create their own digital geographical map;
- analyze statistical materials placed in the library of additional multimedia information;
- describe directly the relationship between geographic objects and phenomena when applying digital thematic maps of different content;
- Maintain digital maps and multimedia content in a file, output to a printer or plotter.

In experimental testing of electronic school atlas there were taken two groups with the total number of 96 students: experimental - 48 students and a

control group - 48 students of the 8th grade of schools #1, #4 Kokshetau. The training in the experimental group was conducted with the use of the electronic atlas of geography. The results of the test input on the geography at the beginning of the test and the results on the geography test at the end of the experiment are shown in Figure 7.

Students were offered the job, aimed at identifying geographical knowledge and students' geo-information competence. Efficiency follows from the chart analysis, compiled by the results of student achievement, where the coefficient (K) of Learning is assessed according to the method (Bespalko, 1989) using the formula: $K = A / N$, where A - number of points for correct execution of the task, N - the maximum possible number of points.
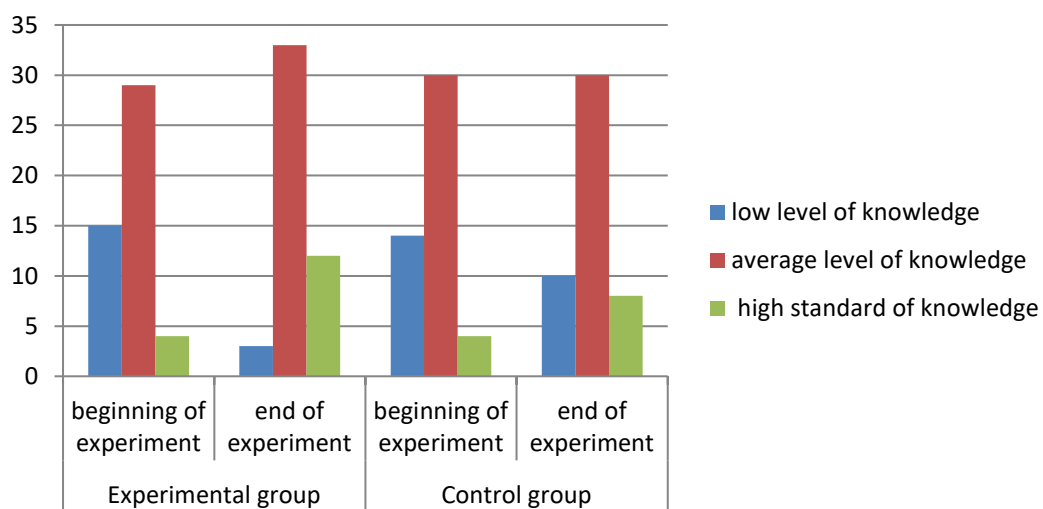

Figure 7. Analysis of the experimental results

Analysis of the experimental results presented in the chart in Figure 7 shows that learning through the use of electronic atlas forms the GIS competence of students in the study of geography. The resulting experimental numerical data suggest pedagogical efficiency of the developed electronic training atlas.

Conclusions

Electronic training geography atlas significantly expands the visibility and methodical opportunities. The use of electronic maps with layered connection, the selection of images, media objects allows you to compare different phenomena and geographical objects, it is possible to create copyright lessons, presentations and abstracts of students, as well as the ability to design contour maps in electronic and paper form. It is designed for collecting, storing, processing, display and transmission of spatially coordinated data and modern sources of geographic information - digital maps. The use of electronic school atlas significantly enhances the activity aspect of training, students acquire new work methods including features of modern scientific methods of geographic

knowledge.The use of electronic school atlas in geography allows to create GIS competence and gain practical skills using GIS.

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