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<https://doi.org/10.51889/2022-1.2077-6861.16>Sh. LAISKHANOV¹, N. MYRZALY^{1*}, Zh. KOKTEUBAY², D. ALIASKAROV¹¹ Abai Kazakh National pedagogical university,²Kazakh National Women's Pedagogical University (Almaty, Kazakhstan)

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**APPLIED ISSUES OF IMPLEMENTING GIS TECHNOLOGIES
IN SCHOOL GEOGRAPHY***Abstract*

Nowadays, based on world and private experience, the issue of introducing information technologies into educational programs of secondary education institutions is becoming relevant. One of these technologies – GIS (Geoinformation system) technology, which has great importance in teaching geography. During the study, a retrospective analysis of the state of implementation of GIS technologies in second stage of education across the world has been carried out, an overview of foreign experience was conducted, ways and methods of implementation were determined. In accordance with the content of the updated geography textbook for secondary education institutions of Kazakhstan, issues related to using GIS technologies were studied through a survey. As a result of the study, 67.2% of geography teachers showed that they cannot or partially use GIS technology in teaching, 96.6% want to attend advanced training courses that teach the applied basics of GIS technology, and 93.3% of teachers need educational and methodological tools aimed at teaching Geoinformation resources and technologies. These studies have shown the applied issues of GIS technologies in modern geographical education.

Keywords: geographical education; geography textbook; updated content; GIS technologies; secondary education institutions; geoinformation technologies.

Introduction. XXI century – information age. In comparison with the material and labor resources of previous eras, intelligence and the availability of information are crucial factors in the development of modern society. In this regard, there is a tendency in the world to use geoinformation technologies in all sectors of the economy that provide full and prompt access to spatial and temporal data and their analysis. In the developed countries of the world, geoinformation technologies have become one of the priority tools in education [1], including geographical education. Scientists conducting research in this area [2] show that the role of vehicles in the era of “great geographical discoveries” is the same like GIS technologies in modern geography. From this, we can see the importance of the widespread use of digital Geoinformation technologies in geographical education of students. However, GIS technologies are not fully implemented in

secondary education programs in all countries of the world [1-17].

In our country, according to the updated content of education, the content of Geography textbooks for school provides issue of teaching GIS technologies and their methods. Even in the content of geography textbooks for higher secondary education, there are sections “Cartography and geoinformatics” [18-21] and “Cartography and geographical databases” [22]. These sections should teach GIS technologies and their methods used in cartography and geoinformatics. The authors of geography textbooks focused on geoinformation technologies and methods, but did not specify ways to use them. Work performed with the help of Geoinformation technologies and resources was left within the competence of the teacher. However, the inability of many teachers to use Geoinformation technologies, low digital literacy or lack of skills in using Geoinformation

resources in education negatively affects the full assimilation of new knowledge in accordance with the educational program. These issues mean that the topic we are studying is relevant.

The main purpose of the study is to determine the possibilities and ways of implementing GIS technologies into the curriculum of the school course of geography in the countries of the world through a retrospective analysis and to identify the applied problems of introducing GIS technologies in the school geography of the country at the present stage.

Main body. There are many definitions of GIS. Some researchers [3] argue that GIS is a tool for storing, collecting, processing, converting, analyzing, and transporting geographical information.

Characteristics of GIS:

- collection, management, analysis and output of various geographic information with spatial and dynamic characteristics;

- managing spatial and geographic data with a computer and using it to simulate the usual professional method of geographic analysis so that spatial data can provide useful information;

- an important characteristic of a GIS is its relationship with a computer system, since a computer system can be easily integrated into a geographic system of varying degrees of complexity, perform spatial positioning and dynamic analysis [4].

- GIS technologies provide an opportunity to explore real-world global problems that contribute to the development of students' geographical understanding [5]. Based on this, GIS technologies in geography are a set of methods and approaches for practical application of these geoinformatics achievements for spatial data management, their presentation and analysis. They have a lot of software such as GRASSGIS, Quantum GIS, GDAL, Ilwis, SAGA GIS ArcGIS, Mapinfo Professional, ERDAS Imagine.

These named programs contribute to the effective assimilation of knowledge in geography during the creative and educational activities of students with a teacher. In accordance with some studies [6], using GIS improves computer

literacy of pupils and provides training in the process of collecting, analysing, evaluating and presenting spatial data. In addition, GIS has been successfully used to improve spatial literacy: perform field work and study geographical phenomena and improve students' visualization in an interactive digital environment [7].

Using GIS allows to activate the functions: visual-figurative, educating, developing, informational, propagandizing, as well as the formation of skills and abilities when working with GIS. Thus, the visual-figurative function allows students to expand and enrich circular representations by means of sensory perception, makes learning more accessible, improves a deeper and more durable assimilation of educational material.

The role of the educational function when working with GIS is to include various tasks for working with GIS in the process of education of students. The teacher can solve problems of ecological, aesthetic education, etc.

Due to the gradual and continuous complexity of tasks, it is important to use GIS in their execution. After all, using this information technology, you can increase students' interest in the subject and reveal their scientific and creative abilities. Information and propaganda functions are implemented through systematic work with GIS, since it carries a significant semantic and informational load like any teaching tool.

Literature review. Through a retrospective analysis of the scientific literature [8-17], the implementation of GIS technologies in second stage of education across the world can be divided into 4 stages:

1. The first stage of introduction of GIS technologies in process of school geography education is associated with appearance of the first educational programs based on GIS in Canada and the USA in the late 70s and early 90s of the XX century. Subsequently, GIS started introduced in school curricula of countries such as Great Britain, Denmark, Germany, France, Finland, Sweden and the Netherlands. The National Geographic Society of America (NGSA) was one of the first to begin work on the implementation of GIS into educational

process at school and in 1986 created a system of seminars to train teachers to apply basics of GIS [8]. Since 1993, ESRI has released the newsletter ArcSchool Reader, which has also been engaged in improving the abilities of teachers in the United States. Educational materials for schools have been developed, work has been carried out on systematic GIS training [9].

2. The second stage of GIS implementation in school geographical education falls in the mid-1990s – the beginning of the 21st century. This period is characterized by the spread of GIS curricula in schools in most developed countries of Europe and Australia. Under the leadership of Peter O. Connor, the teachers of Bishop Stortford College in the early 1990s developed a multi-level program in order to use of GIS in schools like part of a geographical community project. Development of GIS functions during this period contributed to training of students in such works as analysis, processing of geodata in schools [8]. It was established that geographic information system technology of New Zealand contributes to the formation of students' research skills by experimenting with the teaching of social disciplines [10].

3. *The third stage* of introduction of GIS in school geographical education is associated with transfer of geoinformation knowledge in schools in Eastern Europe, Asia, Africa and Latin America in 2005-2012. The emergence of ArcGIS Online platform and implementation of projects such as Schoolnet Future classroom Lab have contributed to development of geoinformation education in secondary education institutions in Turkey, India and China, Taiwan and other countries [2]. The effectiveness of using GIS programs in the study of geography sections has been studied [17]. While in Africa, under the auspices of ESRI, GIS was introduced into the South African's school curricula with small information resources [11].

4. *The fourth stage* of development of GIS technology in geographical education of schools is characterized by the introduction of GIS in school programs of Eastern European countries and some Asian countries (since 2012, to the

present). This period covers also Kazakhstan. Russia occupies one of the leading positions among Eastern European countries in respect of the level of Secondary Education. In this country, in Russia, elective course programs and manuals about using GIS technologies in geography lessons have been developed, and special attention is being paid to the issue of Geoinformation education of students [8]. And GIS technologies have been introduced into the school curriculum of Kazakhstan since 2019 [18-22].

Methods. The review of works and collection of materials on the problems of scientific users of GIS technologies in secondary education institutions around the world was carried out through domestic and international systems of scientific research (Scopus, Web Science, Academy Google, Educational Resource Information Center, CiteSeer publications ResearchIndex, Ingenta, Electronic Library). In the analysis of accumulated materials, such general theoretical methods as synthesis, analysis, study of regulatory documents on education, and comparison are widely used. And in the study of modern problems of using GIS technology in teaching school geography in Kazakhstan, as the main method was used the survey method.

Research results and discussion. As a result of a retrospective analysis of scientific papers, it was found that Kazakhstan is one of the countries of the 4th stage of implementing GIS in the field of Secondary Education. In order to identify applied issues related to the introduction of GIS technology, an online survey was conducted among geography teachers working in secondary education institutions of the country in 2020. In the survey participated 119 geography teachers, working in rural and urban schools and colleges of all regions of the country, also in secondary education institutions of the cities of Nur-Sultan, Almaty and Shymkent of national significance. In the survey, participants answered 8 questions, providing information about themselves. The results of 3 main questions are shown in the figures below (Figure. 1, 2, 3)

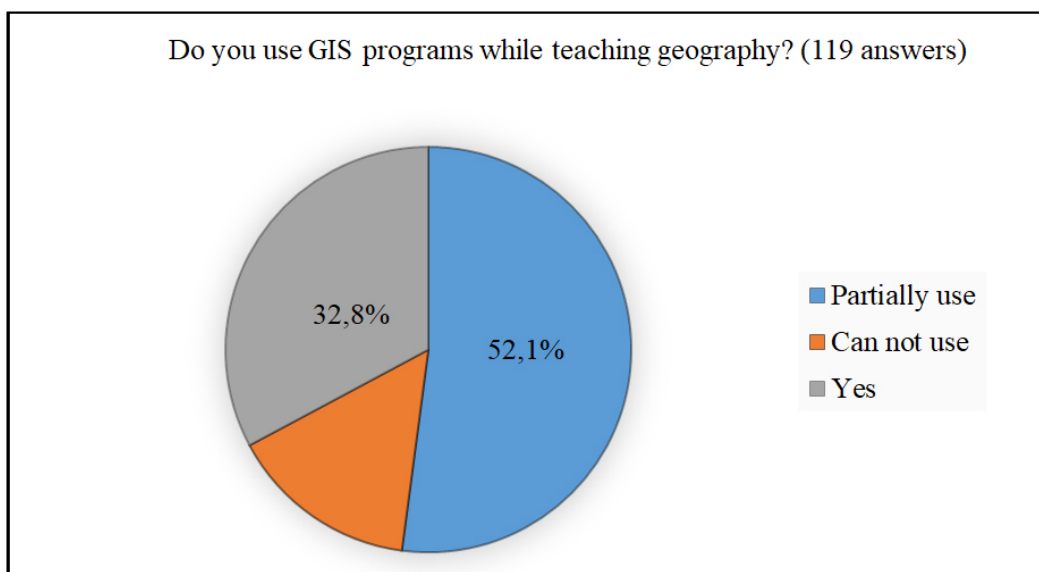


Figure 1. Answer to question 1

As shown in Figure 1, to the question about the ability to use GIS programs for teaching geography in school, 32.8% respondents answered positively, while the rest (67.2%) responded that they do not know how to use or partially use it. However, when they were asked

about the types of programs used by teachers who responded positively, they noted Excel, Word, Daryn, Kundelik, Internet. As long as none of them belong to the GIS program, it can be seen that the amount of those who can not use GIS is much higher.

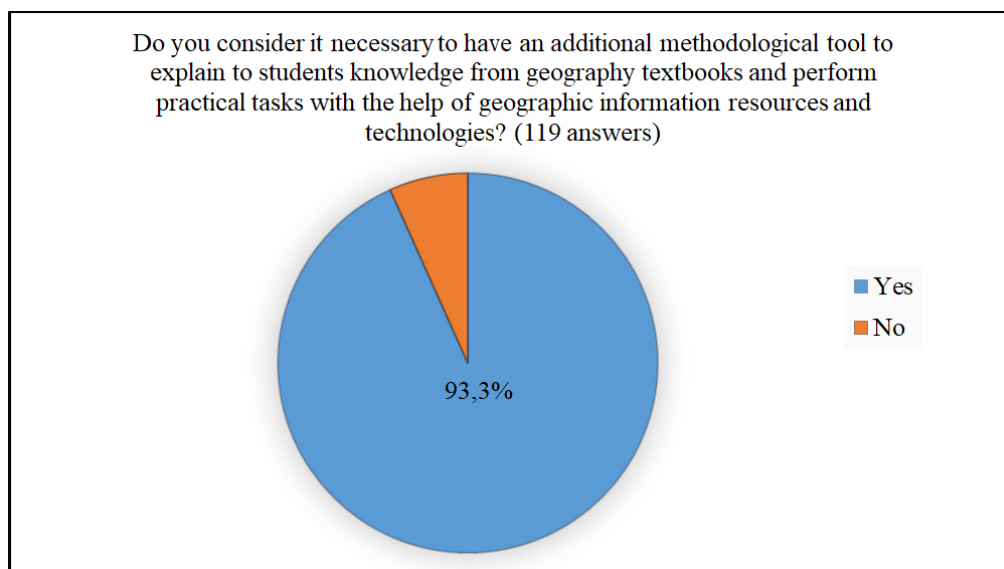


Figure 2. Answer to question 2

To the question regarding the need for an auxiliary methodological tool to explain to students the knowledge contained in geography textbooks and to perform practical tasks using geoinformation resources and technologies

93.3% of geography teachers answered to the question positively. Also, 96.6% of geography teachers surveyed stated that they would like to take advanced training courses that teach the applied basics of GIS technology (Figure 3).

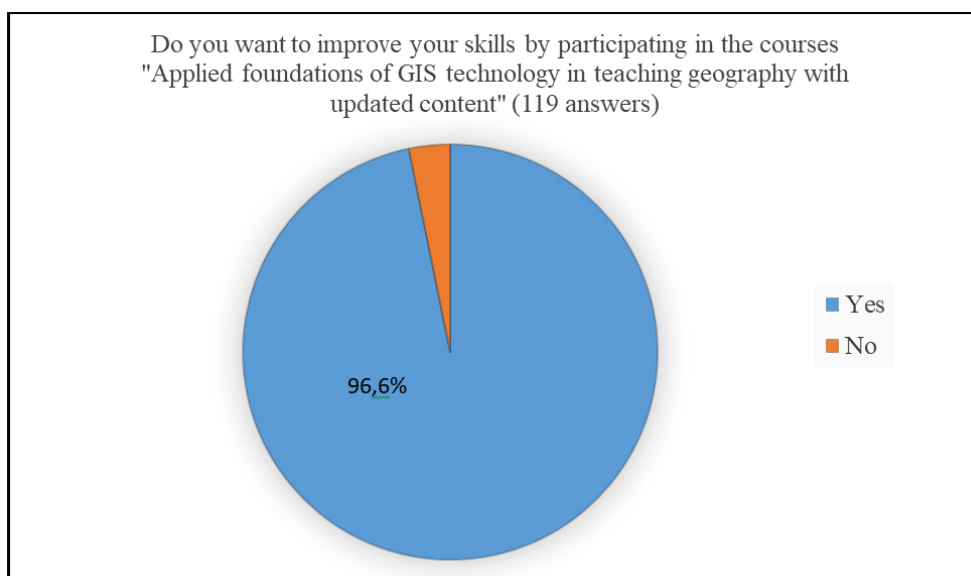


Figure 3. Answer to question 3

The results of the above-mentioned research show that GIS technologies are rarely used in practice in secondary education institutions, and it is necessary to develop teaching aids and materials aimed at teaching GIS technologies and organize advanced training courses in order to improve the digital literacy of teachers and teach the applied basics of GIS. Specialists of the National Academy of Education named after I. Altynsarin, after analytical work on teaching the subject “geography”, concluded that “In geographical education, it is still necessary to use modern technologies, geoinformation sources, digital resources and educational tools” [23]. After all, GIS technologies allow teachers to conduct research within the framework of two constructivist methods (IBL – inquiry-based learning [24] and PBL – problem-based learning [10]). We believe that this will contribute to the development of research competencies and digital literacy of teachers, as well as the formation of an digital literacy and the introduction of scientific research through

the transfer of geoinformation knowledge to students.

Conclusion. GIS technologies have been introduced into the curricula of secondary education institutions around the world, depending on the state of Information technology development in that country. If we divide the implementation of GIS technologies into 4 stages, the work in this direction in Kazakhstan corresponds to the 4th stage. Although, the results of the survey showed that in spite of the fact that new technologies are already being introduced into the school curriculum, the issue of their practical use is still relevant. Also, the study revealed a high demand for educational and methodological materials and advanced training courses for secondary education institutions and aimed at teaching the applied basics of GIS. We believe that only by executing these requests, the problem of mastering geographical knowledge in accordance with the educational goals of standard curricula will be fully solved.

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Мектеп географиясына ГАЖ технологиясын ендірудің қолданбалы мәселелері

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Аңдатпа

Қазіргі кезде әлемдік және жекелей жүргізген тәжірибелерге негізделе отырып, орта білім беру мекемелерінің білім бағдарламаларына ақпараттық технологияларды ендіру мәселесі өзекті болып отыр. Сондай технологиялардың бірі – география пәнін оқытуда үлкен маңызға ие ГАЖ (геоақпараттық жүйе) технологиясы. Зерттеу барысында дүниежүзі бойынша орта білім беру саласына ГАЖ технологияларының ендірілу жағдайына ретроспективті талдау жасалып, шетелдік тәжірибелерге шолу жасалды және ендірудің тәсілдері мен жолдары айқындалды. Қазақстанның орта білім беру мекемелеріне арналған жаңартылған мазмұндағы география оқулығының мазмұнына сәйкес, қолданылуы тиіс ГАЖ технологияларымен байланысты мәселелер сауалнама жүргізу арқылы зерттелді. Зерттеу нәтижесінде география пәні мұғалімдерінің 67,2%-ы оқытуда ГАЖ технологиясын пайдалана алмайтындығын немесе ішінара пайдаланатындығын, 96,6%-ы ГАЖ технологиясының қолданбалы негіздерін үйрететін біліктілікті арттыру курстарына қатысқысы келетіндігін, ал мұғалімдердің 93,3%-ы геоақпараттық ресурстар мен технологияларды үйретуге бағытталған оқу-әдістемелік құралдар қажет екендігін көрсеткен. Бұл зерттеулер қазіргі географиялық білім берудегі ГАЖ технологияларының қолданбалы мәселелерін көрсетіп берді.

Түйін сөздер: географиялық білім беру; жаңартылған мазмұн; география оқулығы; ГАЖ технологиялары; орта білім беру мекемелері; геоақпараттық технологиялар.

Прикладные вопросы внедрения ГИС-технологий в школьную географию

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Аннотация

В настоящее время, исходя из мирового и индивидуального опыта, актуальным становится вопрос внедрения информационных технологий в образовательные программы учреждений среднего образования. Одной из таких технологий является технология ГИС (геоинформационная система), которая имеет большое значение в преподавании географии. В ходе исследования проведен ретроспективный анализ состояния внедрения ГИС технологий в среднем образовании по всему миру, проведен обзор зарубежного опыта и определены подходы и пути внедрения. В соответствии с содержанием учебника географии обновленного содержания для учреждений среднего образования Казахстана изучены вопросы, связан-

ные с ГИС-технологиями, которые должны быть применены путем проведения анкетирования. В результате исследования 67,2% учителей географии показали, что они не могут или частично используют ГИС-технологии в обучении, 96,6% хотели бы посещать курсы повышения квалификации по обучению прикладным основам ГИС-технологии, а 93,3% учителей нуждались в учебно-методических пособиях, направленных на обучение геоинформационным ресурсам и технологиям. Эти исследования показали прикладные проблемы ГИС-технологий в современном географическом образовании.

Ключевые слова: географическое образование; учебник географии; обновленное содержание; ГИС технологии; учреждения среднего образования; геоинформационные технологии.

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МАТЕМАТИКА САБАҒЫНДА МЕКТЕП ОҚУШЫЛАРЫНЫҢ ФУНКЦИОНАЛДЫҚ САУАТТЫЛЫҚТАРЫН ДАМУ АӘДІСТЕРІ

Аңдатпа

Мақалада мектеп оқушыларының функционалдық сауаттылығын дамыту әдістері баяндалған. Функционалдық сауаттылық ғылым мен экономикада, халық шаруашылығында, өмірдің барлық саласында адамға сыртқы ортамен қарым-қатынасқа түсуге және онымен жұмыс істеуге қажет. PISA мен TIMSS зерттеулерінде қазақстандық оқушылар пәндік білім бойынша нәтижелері жоғары болғанмен, оны нақты өмірдегі жағдайларда пайдалана білмейтіндігін көрсетеді. Бұл зерттеудің өзектілігі қазіргі заманғы білім берудің мақсаттары мен міндеттеріне байланысты: оқушылардың қоғам өміріне қатысуына мүмкіндік беретін функционалдық сауаттылықты қалыптастыру. Жұмыстың мақсаты: мектеп оқушыларының функционалдық сауаттылығын арттыру әдістерін көрсету. Мақалада Мақалада осы мәселенің өзектілігі негізделеді және бірнеше практикалық мазмұнды есептердің моделдеу арқылы, проблемалық әдіс арқылы шығару жолдары көрсетілген.

Түйін сөздер: функционалдық сауаттылық; практикалық мазмұнды есептер; модельдеу әдісі; проблемалық әдіс; жалпы білім беретін мектеп.

Кіріспе. Егемендік алған мемлекетіміздің экономикалық, әлеуметтік және саяси өркендеуінің, сапалы жаңаруының қажетті шарты оның зияткерлік әлеуетін арттыру болып табылады. үшін алдымен отандық білімді жетілдіру, өзінің және оған жақын мамандықтарды еркін меңгерген, Қоғамға мамандығы бойынша әлемдік стандарт деңгейіне сай нәтижелі жұмыс атқара алатын білікті кәсіби құзырлы мамандар қажет. Мұның өзі болашақ маманды дайындаудың үлгісін құзыреттілік тұрғыдан жасау-

ды талап етеді. Құзыреттілікті дамыту – функционалдық сауаттылықты дамыту мәселесіне әкеп тірейді.

«Функционалдық сауаттылық» терминін 1957 жылы ЮНЕСКО «сауаттылық» ұғымымен қатар енгізген. «Сауаттылық – бұл адамның құқығы және өмір бойы білім алуының негізі. Бұл жеке адамдардың, отбасылар мен қауымдастықтардың құқықтары мен мүмкіндіктерін кеңейтеді және олардың өмір сүру сапасын жақсартады» [1].