



Research Article

# Implementation of mapping through ArcGIS using elements of local history for training geography and history teachers

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## Abstract

The article is dedicated to the matter of implementing a local history studies component among the students majoring in Geography at higher education institutions, in conjunction with the Geoinformation mapping courses. When studying courses of the major, the students consider the matter of local history studies that allows them not only to get informed about the territory of the native land as a whole but also enables them to create its general geoinformational model. The practical stage of the research engaged the 3rd and 4th year students majoring in Geography and Geography and History at Sarsen Amanzholov East Kazakhstan University. During the experiment, the students created a layout of unique places and tourist zones of their native land. As a result, using region information mapping, the students prepared digital layouts of the East Kazakhstan region, which had not been previously mentioned in the Geoinformational mapping course.

**Key words:** ArcMap, digital maps, geographic maps, geoinformational systems, regional component, teaching methodology



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## 1. Introduction

The effectiveness of civic consciousness education of the students largely depends on social relations in the society, as well as on the techniques which are used by professors to form the students' civic and nation awareness. All this leads to the growth of the role of local history studies, which is aimed at instilling a sense of civic consciousness, nation awareness, self-esteem and positive personal qualities in a person (Yespolova et al. 2023). Local history studies have long been a part of the teaching and educational process in a comprehensive school. These days this component is being expanded and enhanced. Local history studies have become a significant part of the regional component of educational standards which shows the diversity of a region, including its geography and history, biology and ecology, folklore and literature, art and more, as well as regional specific needs and interests in the area of education (Devine-Wright 2001).

Advanced educational experience demonstrates that educating the coming generation in the fields of tourism and local history studies is successful only

when the combined approach is used. That is, the more fully pedagogical principles are reflected, and the more research-based its content and methods are, the more effective the process of education of children and teenagers becomes. One such method is the use of geographic information systems in education.

The use of geographic information systems (GIS), such as ArcGIS, in education creates new opportunities for training geography and history teachers in Kazakhstan. The use of such technologies helps develop important competencies, including data analysis, spatial thinking, and working with geographic and historical materials (Zaytseva and Arkhipova 2014). In the domestic educational context, GIS with elements of local history not only increases interest in learning but also contributes to a deeper understanding of the relationships between historical and geographical events and processes that took place in the country and individual regions. Thus, a study on the implementation of ArcGIS technologies with elements of local history is a significant step in the preparation of modern teachers who are able to use innovative teaching methods in schools.

The implementation of GIS technologies in the educational process, especially with a focus on local history, is of great importance, as it helps instill in students and teachers an interest in local communities and events, as well as develop analytical and critical thinking skills. In a context where teaching requires greater digital immersion and geodata skills, GIS are becoming an integral part of teacher training. Using local historical elements through GIS develops interdisciplinary thinking in future teachers, which in turn makes the educational process more modern and applicable to life in the digital age.

Evidences drawn from scientific literature prove that applying the geoinformational systems by domestic and foreign scientists, during the process of studying, could be an effective method. Considering research papers of Bondarenko (2016), Dangermond (2011), Nechypurenko and Semerikov (2017), Zaytseva and Arkhipova (2014) we can discover that the value of using the geoinformational systems, compared with the traditional teaching methods, has been demonstrated (Kholoshyn et al. 2019). In their article, *Local History Practice in the System of Bachelors-historians Training: Experience and Prospects*, Vovk and Kudelko (2022) have shown that student engagement increased from 26 to 40%, including the correlation, due to the students' practice on studying the basis of local history studies. This result was obtained, based on the research conducted from 2013 to 2020. Following Galochkin et al. (2015) we can discover that the using of the element of general local history studies in the process of teaching disciplines encourages a deep and good-quality topics mastering and tasks performance of historical and patriotic education. Nowadays one of the most important issues is the application of professional geographic knowledge in the formation of historical and patriotic education among the students of Geography educational programs (Bondarenko 2016).

Additionally, scientific sources considered educational approaches and methodologies in science. The works of Patterson and Raczek (2024) and Ammoneit et al. (2024) addressed the issues of teaching effectiveness and competence formation in science education. These studies highlight the importance of thoughtful methodological interventions to improve educational outcomes, which helps to understand how scientific data can be effectively used in the educational process. Importantly, the study of Cho and Permzadian (2024) demonstrated the positive impact of open educational resources on

student performance, which also enriched the theoretical basis of our study. These articles served as the basis for the selection of instruments and methods, as well as for constructing the overall structure of the study, ensuring its theoretical soundness and methodological consistency.

Today, mapping using GIS is becoming an increasingly popular tool for education, especially for the training of geography and history teachers. The existing literature widely covers the potential of GIS in educational activities, including the creation of digital maps, spatial data analysis, and the integration of local cultural and historical context into the learning process (Sarafova 2018). However, most studies focus on the technical aspects of GIS implementation, while an integrated approach that combines teacher training with local historical data remains understudied. Such an approach could increase students' interest and help them better understand both geographic and historical materials, which provide a basis for further discussion of the research problem. The problem of the research is the insufficient development of methods that would allow for the effective use of GIS capabilities in the training of history and geography teachers. In particular, the issues of using GIS to combine information on local history with the teaching of mapping remain open. One promising solution is the development of innovative methods aimed at integrating regional cultural heritage into educational programs using ArcGIS. This will create a more lively and interactive learning experience that will help students develop a deep understanding of the cultural and geographical features of their native land.

The main purpose of higher education is to train a highly qualified specialist, who not only masters the fundamentals of their chosen major but also is able to apply the acquired knowledge practically (Bussotti 2015; Öztürk 2016; Nurgaliyeva et al. 2018). To achieve this purpose, we have established a program, aimed at teaching the young generation local history studies. We have assumed that improvement of local history knowledge of people, first of all, should increase their interest in it (Lewicka 2005, 2013). This increased interest in the native land should lead to a stronger attachment to the place and, consequently, lead to a greater willingness to local civic engagement and, perhaps, to wider civic trust.

This study aims to develop and implement a methodology for using ArcGIS with elements of local history for training teachers of geography and history. The main objectives include:

1. to study the effectiveness of using GIS in the educational process, using local historical materials;
2. to develop educational materials using ArcGIS, including local historical and cultural elements;
3. to test the proposed methodology in practice with subsequent evaluation of its effectiveness for improving the quality of teaching.

## 2. Materials and methods

To achieve the aim of the study, we combined elements of local history studies with the Geoinformational mapping course for Geography students to improve the effectiveness of a teaching method. It is related to the fact that Geoinformational mapping is currently one of the fastest growing fields, and geoinformational maps are of greater significance in the learning process. However,

there are few designed maps around Kazakhstan which focus on the history of its certain areas, particularly in the East Kazakhstan region, as well as sacral or tourist places and protected areas of the region. For this reason, maps, designed by the future professors and geographers, their knowledge and capabilities, acquired during the learning, will be the most effective solution for their teaching process (Pace 2016).

The methods applied in this study included several stages, each of which was aimed at collecting data and analyzing the results of implementing GIS technologies in the educational process.

*Student survey.* At the initial stage of the study, a survey was conducted among 3rd and 4th year students studying in the specialties “Geography-History” and “Geography”. The survey allowed us to collect basic data on their initial level of skills in working with cartographic tools and understanding of local history. A repeated survey was conducted after the implementation of the GIS method in the educational process in order to identify changes in the level of competence and perception of the material. This comparison allowed us to assess the difference before and after the implementation of GIS.

*Practical work with ArcGIS for data visualization.* After the survey, the students went through a stage of practical use of GIS technologies. As part of the classes, they created maps and visualized historical and geographical data using ArcGIS. The tasks included integrating elements of local history, which helped to consolidate the material studied and develop mapping skills. Using the local cultural and historical context made the visualization process more meaningful and exciting for students.

*Analysis of completed work.* Upon completion of the practical tasks, the students’ work was analyzed. The quality of cartographic visualization, the correctness of the presented data, and the students’ ability to integrate elements of local history into their projects were assessed. This stage helped to identify how successfully the students mastered GIS tools and how they applied the knowledge they gained in practice.

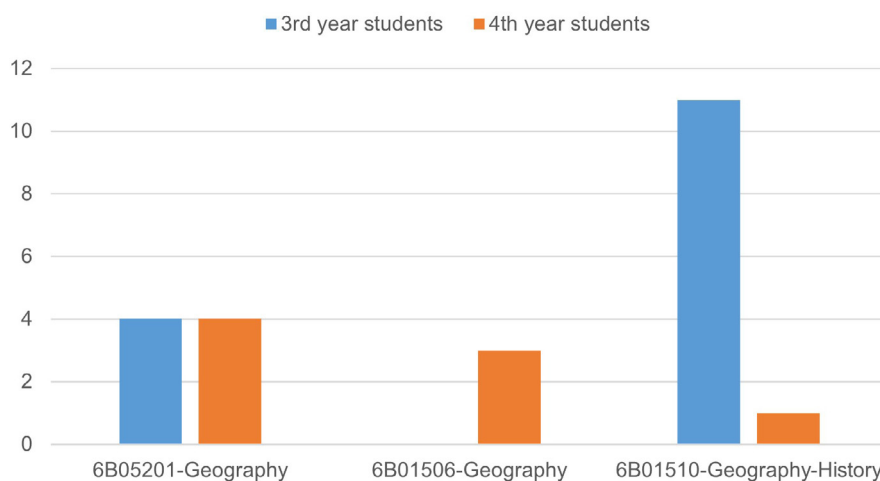
*Assessment of acquired skills.* The final stage included an analysis of the skills acquired by the students during the implementation of GIS in the educational process. Both quantitative and qualitative analysis of student responses and the results of their work were used to assess the following indicators: ability to perform spatial analysis, skills in working with ArcGIS, and the ability to use local historical data to create maps. The results of this stage made it possible to assess the effectiveness of using ArcGIS for training future geography and history teachers. Thus, a comprehensive approach, including a questionnaire, practical work, analysis of results and assessment of skills, made it possible to obtain a complete picture of the level of assimilation of GIS methods by students and their potential for further application in teaching practice.

## 2.1. Participants

In this study, we have worked with 237 students of Sarsen Amanzholov East Kazakhstan University (from 19 years to 21 years old), majoring in Geography. Survey questions were asked and the students’ interests in history and the nature of the native land were identified before the practice session (Table 1, Fig. 1). The survey was conducted two times during the research period. The survey

**Table 1.** The number of students who participated in the study.

Year	2014–2015	2015–2016	2016–2017	2017–2018	2018–2019	2019–2020	2020–2021	2021–2022	2022–2023	2023–2024
<b>Number of students</b>	26	16	19	21	42	26	25	19	20	23



**Figure 1.** The structure of students on specialties and courses. The inscriptions 6B05201-Geography, 6B01506-Geography, and 6B01510-Geography-History are codes of educational programs. Each code includes the education level (6B–bachelor’s degree), the field of study (05–natural sciences, 015–pedagogy), as well as a specific profile or specialization. They represent areas of training: scientific geography, pedagogical geography, and geography-history, respectively.

is conducted during the first seven weeks of the first semester, covering the key initial period of the academic year. The participants in this experiment are third- and fourth-year students and their involvement in the study has been ongoing since 2014. The main part of participants are third-year students studying in the specialty “Geography-History”, as well as students specializing in scientific geography (Fig. 1). This structure of the participants allows us to evaluate the results of the study in different contexts of training future specialists and draw conclusions about the role and significance of these programs for their educational activities.

## 2.2. Instrument and procedures

The survey consists of three parts and ten questions. The surveys were conducted on “History of the native land”, “The nature of the native land” and “Geoinformational systems” sections. The survey has demonstrated that the number of the students, showing interest in searching for information about their native land and being competent at its sacral places, is very small.

The students’ answers were analyzed and mapped after the survey. Analyzing the survey results, we switched to the main stage of the practice session. During the first seven weeks of the Web-mapping course, conducted in the pe-

riod of the 5<sup>th</sup> and the 7<sup>th</sup> semesters, as the main period of practice session among the 3<sup>rd</sup> year and the 4<sup>th</sup> year students of Geography major, the local history topics were studied in terms of the mapping.

### 2.3. Data analysis

The main software system used for designing a map was ArcGIS 10.3 during the research. According to the 7-week educational program plan, the students were informed about the general work process using software such as ArcMap, necessary tools for designing maps and software key functions (Jovanović 2008). In addition, a new training program and a practical work program for the 7-week discipline “Geoinformation mapping” have been prepared for the research work (Turk and Gumusay 2004). More details are shown in Table 2 (Wu et al. 2018).

**Table 2.** New educational program “GIS with the elements of local history” (seven weeks) (Zhensikbayeva et al. 2023; Seidualin et al. 2024; Zhensikbayeva et al. 2024).

Week	GIS	The local history studies	GIS with the elements of history	Topic task
1	Introduction to GIS. GIS functional area	Concept and meaning of local history studies	Introduction to GIS. ArcGIS software features.	Introduction to personal dashboard of ArcMap software. Adding such sections as ArcCatalog, ArcToolbox and collecting information on provided tools
2	Structure and functions of the geoinformational systems	History and value of populated areas of the native land	New project. Selecting a topic of the first ArcMap project	The students were asked to develop a project, related to the tourist places, historical and geographical places, specially protected and sacral places of the native land.
3	Data base management system	The main geographical objects of the region	Creating of geodatabase of a region. Shapefiles preparing, depending on the topic of a project.	Creating of new geodatabase in ArcMap software. Shapefiles preparing, depending on the topic of a project and components of the nature. Shapefile structure preparing
4	Vector and raster data input.	Historical and geographical features of a region	Region vector and raster data input. Establishing a spatial reference	Spatial reference of physics and geographical, landscape and topographic base to the a new project
5	Creating new objects in the software. Points, lines, polygons	Tourist places of a region	Region vector and raster data input. Establishing a spatial reference	Vector and raster data capture
6	Geoinformational map assemblage	Specially protected areas of a region and nature protection	Producing an assemblage and regional map symbols on the chosen topic	Preparing a map assemblage. Preparing map symbols by the map appearance rule
7	Geoinformational project. Thematic map preparation	Research preparation on chosen region	Report on prepared research	Familiarizing the research procedure and goal. Research preparation

When preparing practical work, a lot of works related to the history and tourism of the East Kazakhstan region were used (Zhensikbayeva et al. 2017; Zhensikbayeva et al. 2018; Kabdrakhmanova et al. 2019; Zhensikbayeva et al. 2023). In addition, methods for preparing tourist maps using GIS were considered (Chlachula et al. 2021; Seidualin et al. 2024; Zhensikbayeva et al. 2024).

### 3. Results

The process of increasing interest of the students occurs not only through social objectives but also through the educational process. The academic performance of the students of educational institutions that used innovative methods was 1.5 times lower than the academic performance of the students, learning through traditional methods (Freeman et al. 2014). The development of local history studies elements based on mapping methods was required during the differentiation of such issues.

The learning process aimed at developing students' interest in local history and natural objects demonstrated positive results. Including elements of local history in the course turned out to be a successful solution, as it not only enriched the students' knowledge but also contributed to the development of new competencies in the field of geoinformation technologies (GIS). The training was based on assignments for developing maps and a geodatabase, which allowed students to feel the importance of working with relevant data and to understand the value of their native land. In this context, the program contributed to the formation of both professional and social skills.

Over seven weeks of the course, the students designed two geographical maps and three strips in the ArcGIS Story Maps software system.

The students worked on topics outlined in the educational plan over seven weeks. Adding the element of local history studies into the educational plan of the Geoinformational mapping main course has not significantly affected the total volume of the educational process. Otherwise, the use of the unique material in the lectures makes them more fascinating for the students. As evidence, we will consider the results of the first and last survey in Table 3. Additionally, the students have prepared the geodatabase of the East Kazakhstan region and have worked with vector and raster data (Turyspekova et al. 2022).

During the course, students applied remote sensing methods and processed satellite images. Mastering these methods allowed them to create a digital relief model and identify key hydrographic objects, which is especially important for regions with unique natural conditions, such as the East Kazakhstan region. Considerable attention was also paid to creating a map of tourist attractions, sacred places and specially protected natural areas, which allowed students to feel a connection with the historical and cultural heritage of the region.

During the process of creating a geodatabase, students learned to run computer simulations and ground geomorphological analysis. The following research area data have been prepared using data created by the students (shape file) (Knowles 2008; Chang and Caneday 2011; Essel et al. 2022):

- processed research area mapping by satellite imagery;
- digital elevation model;
- hydrographical water bodies;
- state and administrative area division;



- tourist attractions, archaeological and historical sites, sacral places and specially protected natural area data.

One of the key aspects was working with vector and raster data. This taught students not only to systematize information but also to present it in the form of multimedia products, such as digital video. Such skills are especially in demand in the modern world, where data visualization is becoming an integral part of analysis and decision-making. Working in ArcGIS Story Maps, students created not only maps but also holistic stories linking the natural and cultural objects of the region.

The introduction to the GIS and its application fields were demonstrated during the first week according to the educational plan.

The seven week-long local history studies and the geoinformational systems educational lectures, including practical sessions resulted in the students' developing professional skills in designing maps and acquiring knowledge about their native land. As it was mentioned in the first completed survey, the students showed a poor level of knowledge and interest in their native land. After the lectures, conducted by the educational plan, the students improved their knowledge of archeological and historical sites, tourist places and protected nature sites. The results of the research work and the dynamics of indicators can be seen in Table 3. As we can see on the line chart, there was a significant increase of the students' knowledge of the GIS mapping with the index, ranging from 91.3 to 95.6%. Additionally, as a result of the experience, the students' knowledge of sacral places of their native land increased from 13% to 95.6%. The difference of 82.6% indicates that maps, containing sacral places and archeological sites, designed using the ArcGIS software system, significantly affected the experimental work. And also below are several maps made by students during practice (Figs 2, 3).

**Table 3.** The results of the preliminary and second testing, and changes in indicators.

Question	Pretesting		Second testing		Difference
	Number	Average grade	Number	Average grade	
I am very interested in the history of my native land.	9	39.1	15	65.2	26.1
I am familiar with cultural property site of my native land	10	43.4	21	91.3	47.9
I am familiar with sacral places of my native land	3	13.0	22	95.6	82.6
I have visited sacral places of my native land	2	8.6	4	17.3	8.7
I am familiar with tourist places of my native land.	15	23.0	23	100	77.0
I have visited tourist places of my native land.	12	52.1	12	52.1	0
I am familiar with environmentally protected sites of my native land.	17	73.9	23	100	26.1
I am aware of the ecological and economical problems of my native land.	15	65.2	18	78.2	13.0
I can design maps on the basis of the geoinformational systems.	0	0	22	95.6	95.6
I can design a map on the basis of ArcGIS software system	0	0	21	91.3	91.3



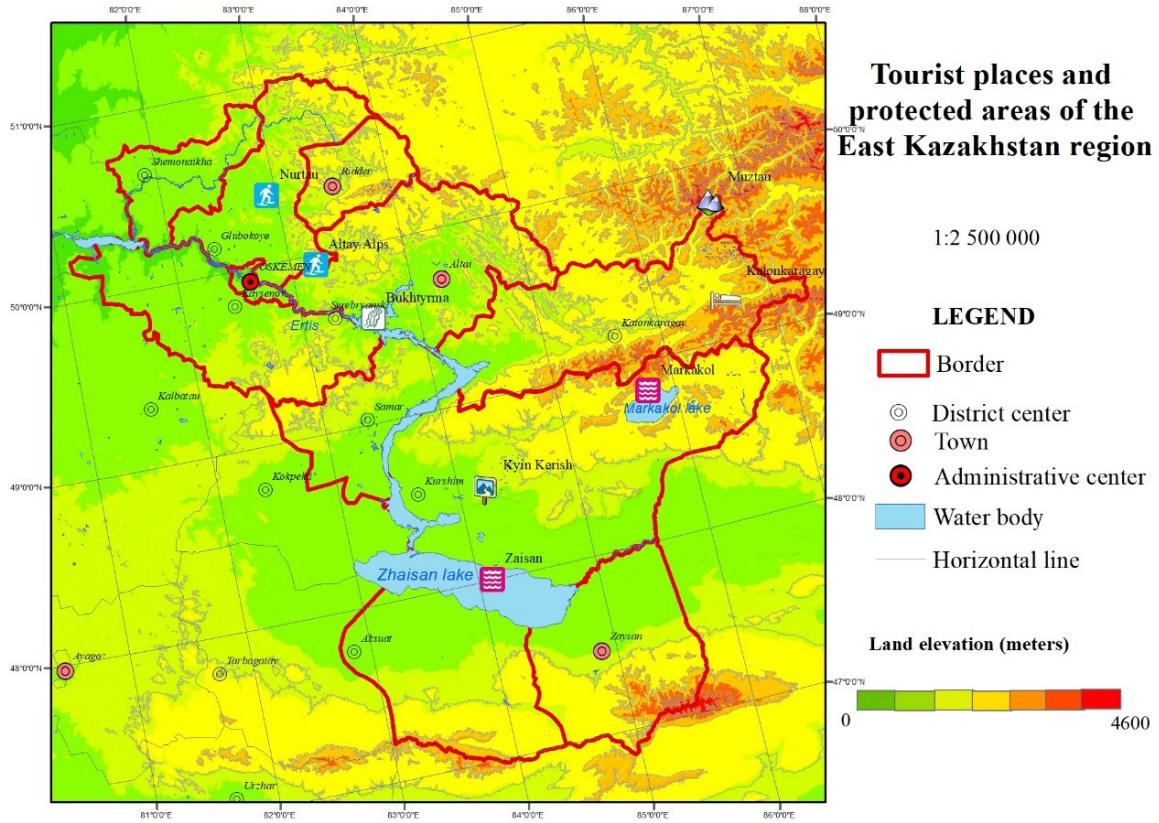


Figure 2. Tourist places and protected areas of the East Kazakhstan region.

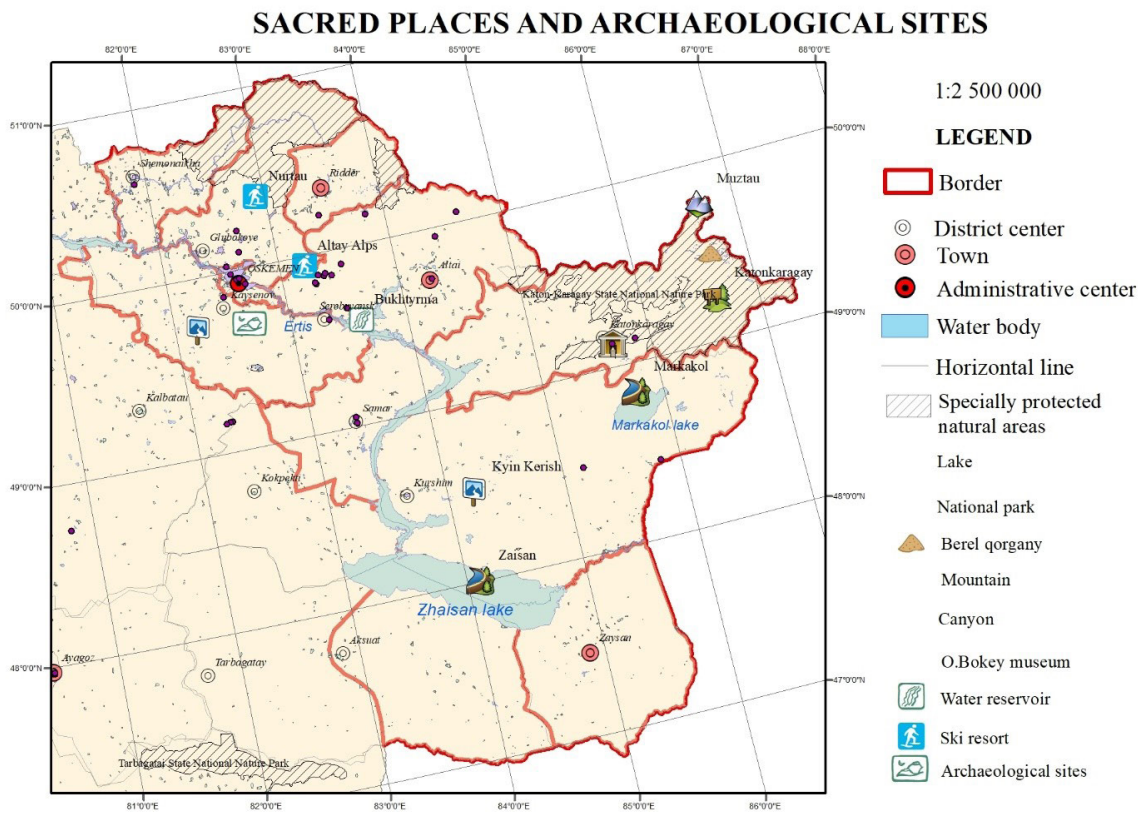


Figure 3. Sacred places and archaeological sites.

Studying the geoinformational systems with the element of local history studies led to greater respect among the students and increased their interest in the native land. In view of the above, we suggested that increasing the interest of the population in the local history can lead to a stronger attachment to the native land. Additionally, such stronger attachment to the native land must lead to increased civic engagement. Moreover, in this research, we intended to investigate whether these effects, specific to local context, can lead to an overall index increase in the social capital, including social trust. To accomplish this, we have developed an intervention program, aimed at teaching young residents the history of their local communities. We suggested that increasing the local history knowledge of people must primarily heighten their interest in the local history (Devine-Wright 2001; Lewicka 2005, 2013). This heightened interest in the past of the local land should lead to a strengthening of attachment to the native place, as well as to increased local civic engagement, and perhaps, to wider trust.

## 4. Discussion

### 4.1. Geoinformation technologies as a means of developing cultural awareness and civic engagement

The student, first and foremost, emerges as a participant in the civil community of the state. Harmony in the relationship between the individual and the collective, as well as the fulfillment of civic duties, becomes the most important aspect of a citizen's activity for the home country. The path to carrying out this activity can be varied but its basis lies in developing an interest in the history and culture of the native country. At the present stage, there is a decrease in the level of knowledge among young people about the cultural heritage, historical figures, and monuments of their native land. One of the main methods of overcoming this problem is the integration into the educational process of information that helps to increase the level of awareness of one's locality, using modern reproductive and computer technologies (Bahaire and Elliott-White 1999). In this regard, elements of local history sciences were introduced into the curriculum of students in the specialties "Geography" and "Geography-History". From 2014 to 2024, four geographic information mapping programs (MapInfo, ArcGIS) were included in the curriculum and three changes were made to the training content. However, the main component of the elective discipline associated with local history education remained unchanged. Over the past six years, students have made significant progress compared to previous years, performing analytical work on creating cartographic materials, developing digital elevation models, and creating projects in three dimensions.

### 4.2. Improving the qualifications of teachers through the integration of GIS into the educational process

In addition to the educational effect, this course opened up new opportunities for practical interaction between students and local communities. For example, the developed maps and databases can be used by local authorities and travel agencies to promote tourist routes and preserve cultural heritage. Thus,

students felt like not only learners but also active participants in public life, which increases their motivation to continue their education in the field of GIS and local history. Training in geographic information systems with an emphasis on the local history component has been widely utilized in the context of teacher training. This is a prerequisite for improving the competence of teachers in the field of education. This is due to the fact that specialists in the field of geography and history, as well as geographical historians, have realized the importance of using geographical and historical maps in the educational process for schoolchildren. Additionally, within the framework of the new school curricula in grades 10–11 of Kazakhstan, “geographic information mapping” is considered as a separate section in the subject of geography. This helps teachers master new geographic information systems. In this regard, an educational program of advanced training courses for teachers entitled “GIS in teaching geographical disciplines” was developed, with the support of the Ministry of Science and Higher Education of the Republic of Kazakhstan. The program is planned to be implemented from September 2024 to the academic year 2025. The main goal of the program is to improve the knowledge of geography teachers in the field of geographic information systems and teach the skills of drawing up geographic maps.

### **4.3. Limitations of the study**

Despite the positive results of the educational program, the study identified a number of limitations that may affect the completeness and objectivity of the findings.

#### **4.3.1. Limited sample and control scope.**

While the program showed an increase in interest and knowledge, its duration is only seven weeks, which may be insufficient for a long-term assessment of the effectiveness of the educational approach. In addition, only 8.7% of students participate in excursions and trips to historical and cultural sites (e.g., the Akbaur complex), indicating limited participation.

#### **4.3.2. Lack of control over the influence of external factors**

The effect of the program may be influenced by other sources of information or educational activities, making it difficult to assess the extent to which the course influences the results. For example, the increase in interest in environmental and political issues (+13%) may also be due to events outside the curriculum.

#### **4.3.3. Limited integration of practical skills**

While students mastered GIS tools and thematic mapping, the degree of adaptation of applied knowledge to specific professional tasks was not demonstrated. There is no data on student participation in projects related to solving local problems using GIS.

#### 4.3.4. Subjectivity of knowledge and interest assessment

Student achievement assessment is based on self-reports and comparison of data before and after the course. However, this approach may be subjective, as students may over- or underestimate their level of knowledge.

### 4.4. Suggested improvements

The following improvements can be made to improve the quality and consistency of research results.

#### 4.4.1. Extend the program duration and expand the sample

Expanding the course and involving a wider range of students will allow for more substantiated conclusions. Additional fieldwork and trips are recommended to increase participation. For example, regular visits to natural and historical areas can reinforce theoretical knowledge.

#### 4.4.2. Implementation of projects and case studies

Project work related to local issues should be included in the program to increase the practical relevance of the course. For example, creating maps of natural area conservation or analyzing environmental risks in the East Kazakhstan region improves the level of students' professional skills.

#### 4.4.3. Conducting control group studies

To reduce the influence of external factors, control groups not participating in the Program can be used to compare their results with those of the course participants. This allows for an objective assessment of the impact of the educational process.

#### 4.4.4. Accurate means of educational assessment

Instead of self-reporting, it is recommended to introduce objective methods of knowledge assessment, such as tests and practical assignments checked by teachers. This ensures a more accurate assessment of the level of acquired skills.

#### 4.4.5. Supporting long-term motivation of students

To maintain students' interest in studying regional and environmental issues, associations and clubs can be created where students can continue their research after the end of the course. Platforms for sharing results (e.g. publishing maps or surveys) can stimulate long-term interaction.

Thus, taking into account the proposed improvements, the Program allows for more sustainable results, increases the practical significance of training and ensures that students develop not only theoretical knowledge but also professional competence in the field of GIS and regional studies.



## 5. Conclusions

The results of the study clearly showed that the introduction of geographic information systems (GIS) and elements of local history into the educational process significantly contributes to increasing students' interest in studying geography and history, as well as helps to form new professional and social skills.

The implementation of the program using ArcGIS, with an emphasis on local history and natural features, contributed not only to improving academic performance but also to increasing the general interest of students. The program has shown that the combination of innovative methods and regional material has a powerful educational effect, increasing the importance of learning for students. As a result, the level of interest has increased significantly: interest in the history of the native land has increased by 26%, and knowledge about sacred and cultural sites—by 82.6%. This confirms the effectiveness of using interactive maps and databases developed by students to create links between the subject and real life.

An important result is an increase in the level of knowledge and skills of students, especially in the field of GIS and local history. Using ArcGIS, in particular for creating maps and processing satellite images, allows students to gain a deeper understanding of the value of working with relevant data. According to surveys and estimates, the academic performance of students who completed this course improved by 1.5 times compared to those who studied using traditional methods. This confirms the importance of innovative educational methods, especially in the context of rapidly changing requirements for the professional skills of future specialists.

The program provided students with a unique opportunity to develop the professional competencies necessary to work with geographic information systems and cartographic technologies. The main result of the research was the successful mastery of key skills in working with GIS by students. During the course, 95.6% of students learned how to create thematic maps, and 91.3% mastered the tools of geo-analysis, which confirms the high effectiveness of the educational program. This result is explained by the fact that the course covered the basic principles of mapping using GIS and integrated elements of local history. During the course, students have mastered methods of working with vector and raster data, remote sensing and satellite image processing skills, which is especially important for regions such as the East Kazakhstan region. Students learned how to create digital terrain models, identify hydrographic objects and make maps that can be used not only for educational purposes but also for real projects related to tourism and ecology.

The study confirmed that the study of the history and natural objects of the native land has a positive effect on the formation of students' feelings of attachment to their native land and promotes a thrifty attitude towards nature. By participating in the creation of maps and geodata covering sacred and natural sites, students not only deepened their knowledge of local history and geography but also expressed greater respect for the cultural and natural heritage of the region (Hristova and Stoycheva 2021). The level of familiarity with the tourist and environmental sites of the region has increased to 100%, which indicates that the inclusion of elements of local history and environmental edu-

cation in the program has significantly strengthened their understanding and commitment to the conservation of natural resources and cultural values.

The conducted research has confirmed the effectiveness of using GIS and elements of local history in teaching geography and history teachers. Thus, the program not only helped students acquire professional skills in the field of geoinformation technologies but also became an effective means to foster respect for the country's history and natural heritage. The results demonstrate that the integration of GIS technologies and local cultural elements into the educational process promotes civic awareness and activism, strengthening students' sense of belonging to their region and responsibility for its preservation. This aspect is especially important in the context of the need for sustainable development and strengthening the environmental and cultural awareness of the younger generation.

## References

- Ammonet R, Göhner MF, Bielik T, Krell M (2024) Why most definitions of modeling competence in science education fall short: Analyzing the relevance of volition for modeling. *Science Education* 108(2): 443–466. <https://doi.org/10.1002/sce.21841>
- Bahaire T, Elliott-White M (1999) The Application of Geographical Information Systems (GIS) in Sustainable Tourism Planning: A Review. *Journal of Sustainable Tourism* 7: 159–174. <https://doi.org/10.1080/09669589908667333>
- Bondarenko O (2016) Vykorystannia Google Classroom pid chas vyvchennia rehionalnoi ekonomichnoi i sotsialnoi heohrafii svitu (Using Google Classroom towards a study of the regional economic and social geography of the world): Implementation of ICT in the educational process of educational institutions: 3–5. <https://doi.org/10.31812/0564/1859>
- Bussotti P (2015) The teaching of history of science at the university: some brief considerations. *Journal of Baltic Science Education* 14: 564–568. <https://doi.org/10.33225/jbse/15.14.564>
- Chang G, Caneday L (2011) Web-based GIS in tourism information search: Perceptions, tasks, and trip attributes. *Tourism Management* 32: 1435–1437. <https://doi.org/10.1016/j.tourman.2011.01.006>
- Chlachula J, Zhensikbayeva NZh, Yegorina AV, Kabdrakhmanova NK, Czerniawska J, Kumarbekuly S (2021) Territorial Assessment of the East Kazakhstan Geo/Ecotourism: Sustainable Travel Prospects in the Southern Altai Area. *Geosciences* 11(4): 156. <https://doi.org/10.3390/geosciences11040156>
- Cho KW, Permzadian V (2024) The impact of open educational resources on student achievement: A meta-analysis. *International Journal of Educational Research* 126: 102365. <https://doi.org/10.1016/j.ijer.2024.102365>
- Dangermond J (2011) GIS in a Changing World. *Essays on Geography and GIS* 3: 55–59. <https://www.esri.com/content/dam/esrisites/sitecore-archive/Files/Pdfs/library/bestpractices/essays-on-geography-gis-vol3.pdf>
- Devine-Wright P (2001) History and identity in Northern Ireland: An exploratory investigation of the role of historical commemorations in contexts of intergroup conflict. *Peace and Conflict: Journal of Peace Psychology* 7(4): 297–315. [https://doi.org/10.1207/S15327949PAC0704\\_01](https://doi.org/10.1207/S15327949PAC0704_01)
- Essel B, McDonald J, Bolger M, Cahalane C (2022) Initial study assessing the suitability of drones with low-cost GNSS and imu for mapping over featureless terrain

- using direct georeferencing. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences XLIII-B2-2022*: 37–44. <https://doi.org/10.5194/isprs-archives-XLIII-B2-2022-37-2022>
- Freeman S, Eddy SL, McDonough M, Smith MK, Okoroafor N, Jordt H, Wenderoth MP (2014) Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences* 111: 8410–8415. <https://doi.org/10.1073/pnas.1319030111>
- Galochkin EA, Gaponova S, Lazarev OE, Shchekotilov VG (2015) Experience in the application of resources with archival maps, information technologies and GIS students of schools, students of colleges, universities in other research works in local history. *Herald of Tver State University. Series: geography and geocology* 1: 14–25. <https://journal.tversu.ru/index.php/geo/article/view/138>
- Hristova D, Stoycheva V (2021) Mapping of ecosystems in Bulgaria for the needs of natural heritage assessment. *Journal of the Bulgarian Geographical Society* 45: 89–98. <https://doi.org/10.3897/jbgs.e76457>
- Jovanovic V, Njegus A (2008) The application of GIS and its components in tourism. *Yugoslav Journal of Operations Research* 18: 261–272. <https://doi.org/10.2298/YJOR0802261J>
- Kabdrakhmanova NK, Mussabayeva MN, Atasoy E, Zhensikbayeva NZ, Kumarbekuly S (2019) Landscape and recreational analysis of Yertis river upper part on the basis of basin approach (Kazakhstan). *Geo Journal of Tourism and Geosites* 27(4): 1392–1400. <https://doi.org/10.30892/gtg.27423-442>
- Kholoshyn IV, Bondarenko OV, Hanchuk OV, Shmeltser EO (2019) Cloud ArcGIS Online as an innovative tool for developing geoinformation competence with future geography teachers. *CTE Workshop Proceedings* 6: 403–412. <https://doi.org/10.55056/cte.401>
- Knowles AK (2008) GIS and History. In: Knowles AK (Ed.) *Placing history: How maps, spatial data, and GIS are changing historical scholarship*. ESRI Press, Redlands, 1–25.
- Lewicka M (2005) Ways to make people active: The role of place attachment, cultural capital, and neighborhood ties. *Journal of Environmental Psychology* 25: 381–395. <https://doi.org/10.1016/j.jenvp.2005.10.004>
- Lewicka M (2013) Localism and Activity as two dimensions of people–place bonding: The role of cultural capital. *Journal of Environmental Psychology* 36: 43–53. <https://doi.org/10.1016/j.jenvp.2013.07.002>
- Nechypurenko P, Semerikov S (2017) VlabEmbed—the New Plugin Moodle for the Chemistry Education. In: Ermolayev et al. (Eds) *Proceedings of the 13th International Conference on ICT in Education, Research and Industrial Applications. Integration, Harmonization and Knowledge Transfer*, Kyiv (Ukraine), May 2017. *CEUR Workshop Proceedings*, Kyiv, 1844: 319–326. <https://doi.org/10.31812/0564/731>
- Nurgaliyeva SA, Zeynolla SZ, Galiyeva AN, Espolova GK (2018) On the issue of modernization of the system of professional development of teachers of high schools of Kazakhstan: *Opción* 34(85): 308–326. <https://produccioncientificaluz.org/index.php/opcion/article/view/23526>
- Öztürk FÖ (2016) Using the history of science to teach scientific inquiry. *Journal of Baltic Science Education* 15: 28–47. <https://doi.org/10.33225/jbse/16.15.28>
- Pace P (2016) Education for sustainable development at higher education institutions: A critique. *Journal of Baltic Science Education* 15 (3): 268–270. <https://doi.org/10.33225/jbse/16.15.268>



- Patterson MW, Raczek TP (2024) Comparing effectiveness of teaching interventions in online lab-based physical geography general education courses. *Journal of Geography in Higher Education*: 1–18. <https://doi.org/10.1080/03098265.2024.2403084>
- Sarafova E (2018) Spatial Modeling of the Ecotourism Potential of Kyustendil Municipality through Analytic Hierarchy Process and Remote Sensing Data in GIS. *Journal of the Bulgarian Geographical Society* 39: 45–50. <https://doi.org/10.3897/jbgs.2018.39.8>
- Seidualin DA, Mukanov AH, Agybetova RY, Mussina KP, Berdenov ZG, Babkenova LT, Zhensikbayeva NZ (2024) Development of a geographical information system for optimizing tourist routes in the Ulytau national natural park: *GeoJournal of Tourism and Geosites* 52(1): 351–359. <https://doi.org/10.30892/gtg.52134-1211>
- Turk T, Gumusay MU (2004) GIS design and application for tourism. In: Altan O (Ed.) XXth ISPRS Congress, Technical Commission IV. Istanbul (Turkey), July 2004. ISPRS, 485–488. <https://www.isprs.org/proceedings/XXXV/congress/comm4/papers/397.pdf>
- Turyspekova E, Ramazanova N, Atasoy E (2022) Prospects for the development of ecotourism in the territory of the Katon-Karagai state national nature park of the East Kazakhstan region: *Geo Journal of Tourism and Geosites* 45: 1560–1569. <https://doi.org/10.30892/gtg.454spl04-975>
- Vovk O, Kudelko S (2022) Local History Practice in the System of Bachelors-Historians Training: Experience and Prospects. *Journal of Curriculum and Teaching* 11(1): 129. <https://doi.org/10.5430/jct.v11n1p129>
- Wu L, Li L, Liu H, Cheng X, Zhu T (2018) Application of ArcGIS in Geography Teaching of Secondary School: A Case Study in the Practice of Map Teaching. *Wireless Personal Communications* 102: 2543–2553. <https://doi.org/10.1007/s11277-018-5276-6>
- Yespolova G, Irodakhon K, Bekzod B, Rabiga B, Zhupat A (2023) The influence of learning technology on the formation of research skills in primary school students: Action research. *Journal of Education and e-Learning Research* 10(3): 421–428. <https://doi.org/10.20448/jeelr.v10i3.4795>
- Zaytseva T, Arkhipova T (2014) Cloud technology as a way of Ukrainian education development. *Information Technologies in Education* 19: 54–61. <https://doi.org/10.14308/ite000484>
- Zhensikbayeva NZ, Abiyeva G, Sabyrbayeva BT, Avgusthanova GA, Kabdrakhmanova NK, Amangeldy N (2024) Studying the development potential of tourism industries in the South Altai by hydrological, climatic, geomorphological way and visualization using gis: *GeoJournal of Tourism and Geosites*, 53(2): 528–537. <https://doi.org/10.30892/gtg.53216-1228>
- Zhensikbayeva NZ, Kabdrakhmanova NK, Yeginbayeva AY, Beisembayeva RS, Amangeldy N (2023) Assessment of forest fires factors in Eastern Kazakhstan over the last 20 years (2003 - 2023) using gis technologies: *GeoJournal of Tourism and Geosites*, 51: 1803–1811. <https://doi.org/10.30892/gtg.514spl21-1176>
- Zhensikbayeva NZ, Saparov KT, Chlachula J, Yegorina AV, Uruzbaeva N, Wendt J (2018) Natural potential for tourism development in Southern Altai (Kazakhstan): *GeoJournal of Tourism and Geosites* 21(1): 200–212. [https://gtg.webhost.uoradea.ro/PDF/GTG-1-2018/281\\_Wendt.pdf](https://gtg.webhost.uoradea.ro/PDF/GTG-1-2018/281_Wendt.pdf)
- Zhensikbayeva NZ, Saparov KT, Kulzhanova SM, Atasoy E, Wendt JA (2017) Determination of Southern Altai geography propitiousness extent for tourism development: *GeoJournal of Tourism and Geosites* 2(20): 158–164. [https://gtg.webhost.uoradea.ro/PDF/GTG-2-2017/248\\_Wendt\\_Jan.pdf](https://gtg.webhost.uoradea.ro/PDF/GTG-2-2017/248_Wendt_Jan.pdf)

## Additional information

### Conflict of interest

No conflict of interest was declared.

### Ethical statement

No ethical statement was reported.

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### Author contributions

Conceptualization: NNA, NZZ. Data curation: GA, NNA. Formal analysis: SA, NNA. Funding acquisition: NZZ. Methodology: GA, SA. Project administration: NZZ. Resources: GA. Software: GA. Supervision: SA. Visualization: NZZ, NNA. Writing - original draft: NZZ, SA, GA. Writing - review and editing: SA, NNA.

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### Data availability

All of the data that support the findings of this study are available in the main text or Supplementary Information.