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METHODOLOGY OF USING ARTIFICIAL INTELLIGENCE AND GEOINFORMATION SYSTEMS IN MODELING GEOGRAPHIC SITUATIONS AND ORGANIZING PRACTICAL TRAINING

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Abstract

The article examines the methodology of modeling geographic situations and organizing practical training using artificial intelligence and geoinformation systems in geography education. The study of regional processes is based on the stages of geographic data collection, comparison of spatial layers, modeling of possible changes and evaluation of the obtained results. A system of practical training is offered on the analysis of population location, expansion of urban territory, territorial distribution of service facilities and changes in land cover. Through the combined use of SI and GAT tools, the development of students' spatial thinking, research skills, and evidence-based decision-making skills will be addressed.

Keywords

artificial intelligence, geoinformation systems, geographic situation, modeling, practical training, spatial analysis, geographic data, digital map, research skills, geography education.

Introduction

In teaching geography, one of the important tasks is to explain the territorial characteristics of natural and socio-economic processes, to identify the connections between them, and to assess future changes. To effectively implement these tasks, students need to conduct practical research based on real geographical data, along with mastering theoretical knowledge.

Modeling geographic situations allows us to study the factors, interrelationships, and potential outcomes of processes that have occurred or may occur in a given area.

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For example, population growth, urban sprawl, increased demand for water resources, or the location of service facilities can be studied through geographic analysis and modeling.

Geographic information systems allow for the integration of spatial data into map layers, the calculation of distances, the identification of spatial relationships, and the visualization of results. Artificial intelligence can serve as an auxiliary tool for formulating research questions, discussing possible scenarios, providing preliminary interpretation of data, and presenting the results of the analysis.

Systematic studies on the use of GAT in geography education demonstrate the educational potential of digital mapping and spatial analysis, but also emphasize the need for methodological preparation for their effective implementation.

UNESCO's recommendations on the use of generative AI in education pay special attention to issues of human control, data security, and the purposeful use of technology.

The purpose of the article is to define the stages of modeling geographic situations based on the integration of SI and GAT, to develop a system of practical exercises and to justify the methodological features of their application in the educational process.

Research methodology

The research is based on theoretical-methodical analysis, modeling of geographic situations, design of practical tasks and generalization of approaches to evaluation of results.

The following steps are suggested for modeling geographic situations:

1. Defining the problem. The area under study and the geographical process are defined.

2. Data collection. Statistical data, digital maps, remote sensing materials and other reliable sources are selected.

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3. Data preparation. The date, territorial coverage, coordinate system and accuracy of the data are checked.

4. Spatial analysis. With the help of GAT, regional layers are compared, distances are calculated and spatial relationships are determined.

5. Scenario modeling. Based on available information, possible changes or alternative solutions are considered.

6. Validation of results. The model's assumptions and limitations are evaluated, and the results are compared with available data.

7. Summary and presentation. Students defend their conclusions based on a map, table, and written comments.

In this process, the GAT is the main spatial calculation and mapping tool. The SI is used to develop scenarios, clarify analysis questions, and initially interpret results. If the SI or a specialized modeling program performs the calculations, the methods and assumptions used should be clearly stated.

Results and Discussion

Methodological possibilities of modeling geographical situations

Geographic modeling allows students to not only describe a particular process, but also to explore its causes and possible outcomes. The purpose of the model, its input data, key assumptions, and limitations should be clearly defined.

For example, in studying urban sprawl, map layers from different years are compared. Students identify changes in built-up areas, analyze connections with transportation routes and population density. SI can be used to systematize potential influencing factors and discuss alternative scenarios.

However, past trends do not guarantee that they will continue in the future. Therefore, scenarios should be interpreted not as precise predictions, but as possible situations based on certain assumptions.

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Example of a practical exercise: placement of service facilities for the population

In this exercise, students are given the task of studying the territorial location of settlements and service facilities. The main question of the research is determined as follows: how easily can the population reach the service facilities in the selected area, and in which places is it necessary to improve the coverage of services?

The first stage is data preparation. Students collect information about settlements, available services, and roads. The sources are checked for reliability and date of update.

The second stage is analysis in the GAT. The data is placed on map layers. The distances between settlements and service facilities are calculated. If necessary, the distance or time of movement based on the road network is analyzed separately.

The third stage is alternative scenarios. Students discuss options such as moving the service facility to another location or creating an additional facility. SI can be used to systematize questions and alternative solutions for scenarios.

The fourth stage is evaluation. Each scenario is compared in terms of scope, distance, population needs, and implementation constraints. Students justify their choice of scenario with evidence.

The fifth stage is presentation of results. Students will prepare a map, table, and short report. The report shows the data used, the analysis method and the limitations of the model.

The ultimate goal of this exercise is not to automatically find the best location, but to develop the student's ability to independently analyze a geographical problem, compare options, and justify a decision.

In modeling-based exercises, evaluation should not be limited to the appearance of the result. Even if the map is correctly prepared, the data may have been incorrectly selected or the conclusions may not be sufficiently substantiated.The criteria cover the student's performance from understanding the problem to spatial

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analysis and final conclusion. Points can be determined by the teacher according to the content and complexity of the task.

Discussion

Exercises based on modeling geographic situations guide students from repeating ready-made data to conducting independent research. While GAT allows for the analysis and visualization of spatial data, SI can help discuss different scenarios and clarify analysis questions.

However, the quality of the model depends on the data used, the calculation method, and the assumptions made. For example, the distance calculated along a straight line is not equal to the distance traveled along a real road. Similarly, the proximity of service facilities does not provide complete information about their capacity, operating hours, or quality of service. Therefore, students need to understand the model's capabilities as well as its limitations.

Caution is also required when using SI. The scenarios proposed by SI may seem geographically logical, but their confirmation requires real data and calculations in the GAT. The principles of human control and responsible use in UNESCO recommendations serve as an important methodological basis for organizing such exercises.

The proposed system of exercises is a theoretical and methodological development. After its implementation in practice, the quality of students' spatial analysis, data processing skills, and the validity of their conclusions can be assessed through experimentation.

Conclusion

The integration of artificial intelligence and geo-information systems in geography education allows for the modeling of geographic situations and the organization of practical training in a research-oriented form. In this approach, GAT is considered as the main tool for spatial data processing and analysis, and SI as a tool for clarifying research questions, discussing alternative scenarios and preliminary interpretation of results.

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The article proposed the stages of modeling geographic situations, a model system of practical exercises, an exercise on the analysis of the territorial location of service facilities, and a 100-point evaluation rubric.

The main pedagogical value of this methodology is that it is aimed at developing students' spatial thinking, independent research skills, and decision-making skills based on geographical information. In the next stage, the proposed exercises should be tested in specific geographical disciplines and their results should be evaluated based on scientific criteria.

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