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PROBLEMS OF INTEGRATING ARTIFICIAL INTELLIGENCE AND GEOINFORMATION SYSTEMS IN GEOGRAPHY EDUCATION AND WAYS TO OVERCOME THEM

Soataliyev Yorkinjon Minosibjon ugli
independent researcher
https://orcid.org/0009-0009-3395-5261 yorkinjonsoataliyev@gmail.com

Abstract

This article analyzes the organizational, methodological, technological and informational challenges involved in integrating artificial intelligence and geographic information systems into geography education. Particular attention is given to teachers' digital readiness, software accessibility, the reliability of geographical data, assessment practices and academic integrity. Based on a review of scholarly literature and a classification of the identified challenges, practical measures are proposed to address them. The article argues that successful integration requires technological capabilities to be aligned with pedagogical objectives, teacher supervision and students' independent learning.

Keywords

geography education, artificial intelligence, geographic information systems, digital competence, educational challenges, geographical data.

Introduction

The development of digital technologies places new demands on the methods of forming geographical knowledge and studying territorial processes. The use of digital maps, remote sensing data, geographic information systems, and artificial intelligence tools in geography education allows students to analyze geographical phenomena, identify territorial differences, and explain problems based on evidence.

At the same time, the introduction of technologies into the educational process also raises new problems related to their use. In particular, the lack of practical training of teachers, difficulties in using software tools, the selection of reliable geographic data, checking artificial intelligence answers, and ensuring independent thinking of students are pressing issues.

A systematic review by Bernhäuserová et al., published in 2022, examined the factors that hinder the implementation of ICT in education. The study analyzed 34 empirical studies and identified a total of 68 specific constraints. The authors identified teacher-related factors and problems with technological resources as important areas.

The use of generative artificial intelligence in education also raises issues such as data confidentiality, reliability of results, and pedagogical suitability of the technologies. The relevant UNESCO recommendations emphasize the need to use these technologies with human interests as a priority.

Based on this, the purpose of the article is to classify the main problems associated with the integration of SI and GAT in geography education, explain their impact on the educational process, and develop practical recommendations for their elimination.

Research methodology

The research is based on theoretical analysis and systematization of problems. It used the methods of studying scientific literature, comparative analysis, classification, generalization and problem-solution relations.

Systematic reviews on the implementation of GAT in education and international recommendations on the use of generative SI in education and research were selected for analysis. Based on the characteristics of geography education, the problems were divided into the following areas:

1. Problems related to personnel and digital competence.
2. Technical and software problems.
3. Issues related to the quality and reliability of geographic information.
4. Problems of methodical integration and design of educational tasks.
5. Assessment, academic integrity, and information security issues.

For each area, the possible causes of the problem, the forms of its manifestation in the educational process, and measures to eliminate it are summarized. This classification is the result of the author's theoretical analysis and should not be interpreted as a statistical study indicating the prevalence of problems in specific higher education institutions.

Results and Discussion

The analysis shows that there are several interrelated problems in the effective implementation of SI and GAT integration in geography education.

Digital and methodical training of teachers

One important issue is the gap between technical skills in using technologies and the competence to adapt them to educational goals. For example, a teacher may be able to prepare texts or questions using an IS tool, but additional methodological training is required to adapt these materials to the geographical context, student readiness level, and learning outcomes.

Working with GAT requires practical skills such as loading digital layers, selecting a coordinate system, analyzing data, and correctly interpreting the map.

Solution: Develop practical seminars, model exercises, independent projects, and methodological manuals for teachers on SI and GAT. The main criterion in the process of professional development should be the implementation of geographical educational tasks with its help, not the use of technology.

Hardware and software issues

Access to GAT software, digital maps, geodatabases, and stable Internet access may not be uniform across educational institutions. License requirements of some programs, technical capabilities of computers and difficulties in loading data affect the organization of practical training.

Solution: Use open source GIS software such as QGIS whenever possible, create pre-prepared training datasets, and develop practical tasks that can be completed offline. When choosing a program, one should consider its technical requirements, ease of use, and relevance to the learning objectives, along with its price.

Reliability of geographic information

The information provided by the SI may sometimes be inaccurate, outdated, or not adequately supported by sources. In geography education, such errors can lead to incorrect conclusions about population size, territorial boundaries, climate indicators, and changes in land cover.

Also in GAT, the accuracy of the data depends on their source, time of collection, spatial accuracy and appropriateness to scale.

Solution: Each practical assignment requires the data source, publication or update date, and territorial coverage to be indicated. SI results should be compared with official statistics, scientific sources, or reliable geodata. Students should be taught to evaluate not only the result, but also the quality of the data used to obtain it.

Inadequate methodological integration

Using technology does not always provide in-depth geographical analysis. For example, students may write a paper on urbanization using AI, but if they do not compare regional changes through maps and verify the data, the assignment will not fully achieve its spatial analysis goal.

Solution: It is necessary to organize the tasks of SI and GAT in a form that complements each other. GAT can be used to spatially analyze and visualize geographic data, while SI can be used to clarify research questions, make preliminary interpretations of analysis results, and consider alternative explanations.

For example, when students study land cover changes in a particular area, they compare map layers from different periods in GAT. It then uses SI to systematize probable causes. The final conclusion is formed by the student himself based on the map, data and reliable sources.

Discussion

The problems analyzed may not be isolated from each other, but rather interrelated. For example, if a teacher is not sufficiently trained in GAT, they may not be able to use existing software effectively. Also, if the skills of selecting and verifying geographic data are not developed, it will be difficult to identify incorrect data provided by the SI.

Systematic research on the implementation of GAT in education also points to teacher training and technological resources as important constraints.

This means that the problem cannot be solved by simply providing a program or device.

It is advisable to implement the solutions proposed in the article at three levels:

Institutional level: improving access to software, geographic data, and methodological materials in higher education institutions, developing rules for responsible use of IS.

Level of subject teaching: planning the integration of SI and GAT in accordance with the curriculum, formulating practical assignments based on geographical problems, and pre-determining assessment criteria.

Level of Student Activity: Develop skills in independent data verification, map analysis, critical evaluation of SI results, and evidence-based inference.

This approach is consistent with UNESCO's recommendations aimed at ensuring human control, privacy, and pedagogical relevance in the use of generative AI.

At the same time, the classification of problems in the article is based on theoretical analysis. To determine the extent to which they occur in specific higher education institutions, it is necessary to conduct empirical research, including a questionnaire survey of professors and teachers, student practical work, lesson observations, and an analysis of educational documents.

Conclusion

The integration of artificial intelligence and geographic information systems in geography education may pose challenges related to staff training, technical support, reliability of geographic data, methodological consistency, assessment, and academic integrity. Addressing these challenges requires a comprehensive approach.

Based on the analysis, the following conclusions were formed:

1. It is necessary to develop practical and methodical competences of teachers in using SI and GAT.
2. When working with geographic data, it is necessary to check the reliability of the sources, the time of data update, and the spatial accuracy.
3. The use of SI and GAT should be associated with problematic and research-oriented tasks that have a geographical context.
4. The assessment should take into account, along with the final product, the student's independent analysis, the sources used, and the validity of their conclusions.
5. Academic integrity, privacy, and human oversight must be ensured when using technology.

Thus, the success of the integration of SI and GAT is determined not only by the availability of technical tools, but also by their pedagogically correct organization and

orientation towards the development of geographical thinking. It is important to evaluate the effectiveness of the measures proposed in subsequent studies on an experimental basis.

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