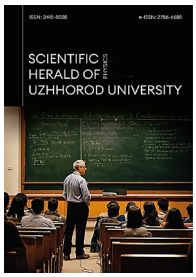
Scientific Herald of Uzhhorod University
Series "Physics"
Journal homepage: https://physics.uz.ua/en
Issue 55, 2911–2918
Received: 14.08.2023. Revised: 11.12.2023. Accepted: 27.02.2024



DOI: 10.54919/physics/55.2024.291am1

Crafting cartographic competence: A methodological approach for nurturing future geography teachers

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Abstract

Relevance. The reform of geography education poses new challenges for pre-service geography teacher training programs, particularly in developing cartographic competencies critical for effective teaching.

Purpose. The purpose of the study is to examine methods for integrating pedagogical approaches, multimedia tools, and geographic information systems (GIS) to foster cartographic skills in future geography teachers.

Methodology. A multimodal approach was implemented, integrating hands-on map reading, analysis of cartographic symbology, engagement with modern technologies like GIS, and field-based activities.

Results. The multimodal approach proved effective in building requisite cartographic skills in pre-service teachers. Continuous monitoring and skills upgrading were key factors in preparing teachers capable of translating curricula goals into practical classroom applications. Specific results include improved map interpretation and spatial analysis abilities, proficiency in utilizing GIS software for data visualization, enhanced understanding of cartographic design principles, and the ability to develop engaging map-based learning activities.

Conclusions. Developing robust cartographic competencies in pre-service programs enables future geography teachers to leverage maps, spatial representations, and geospatial technologies as powerful pedagogical tools. The immersive,

Suggested Citation:
Beikitova A, Kaimuldinova K, Berdygulova G, Sabdenalieva G, Abdikarimova G. Crafting cartographic competence: A methodological approach for nurturing future geography teachers. *Sci Herald Uzhhorod Univ Ser Phys.* 2024;(55):2911-2918. DOI: 10.54919/physics/55.2024.291am1

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technology-driven methods reflecting contemporary best practices produced educators proficient in cartographic instruction.

Keywords: teacher; geography; education; cartographic skills; cartographic competence; professional training; GIS technologies.

Introduction

Almost every student uses the Internet daily. Therefore, geography teachers are offered many new opportunities to raise interest in geographical knowledge not only during classes but also in extracurricular activities, since digital learning is now being practised in the field of geographical education. The idea of using a computer in geographical education is not new and is conditioned by the flow of various kinds of applications that test knowledge, electronic atlases, and didactic games. Increasingly rich Internet resources have allowed interested persons to gain access to popular scientific information, statistical and descriptive data, educational programmes, and libraries. Intensive development of various types of websites providing spatial information, including maps on the Internet, GIS – geographic information systems, play an increasingly important role in geographical education. They have evolved from closed commercial desktop PC software into GIS tools and products developed as widely available web applications [1]. In the last ten years, WebGIS has emerged among users of GIS systems, which is considered as the provision of spatial data and network services on the Internet. During the development of WebGIS, public geobrowsers, geoportals, virtual globes, and other services containing interactive maps appeared.

Ainhoa González, Christine Bonnin, Eoin O'Mahony and other authors in their research describe a GIS module jointly developed for the Vietnamese Bachelor's degree programme, advancement curriculum. It explores the opportunities and obstacles to its implementation by studying the feedback of students and faculty and academic staff. Based on the experience and conclusions, they offer several recommendations that open a discussion about GIS education in research on development in the Global South and how it can be facilitated [1].

Nick Bearmana, Nick Jones, etc., in their research, analysed the issue of teaching critical spatial thinking in higher education institutions which allows graduates to interact effectively with spatial data. Geographic information systems (GIS) and natural sciences are taught to students in many disciplines, and the authors estimated how it promotes critical spatial thinking. The researchers describe how some existing GIS practices could be improved to focus on developing critical spatial thinking skills, competencies, and abilities that are valuable to graduates [2].

Efforts to identify methods for the development of cartographic competence of future geography teachers determine the requirements of precise teaching provisions giving the teacher the maximum possible level of independence in establishing the process of geographical education. The sources of information and the choice of teaching methods create conditions for future teachers to build an integral structure of geographical knowledge and prospects for achieving educational results at a satisfactory level. Their formulation and deep comprehension of the content are important for understanding and adopting more detailed provisions of the framework as important determinants of geographical practice [2]. The main task of cartographic competence methods is to support the student in their own development, to recognise their predispositions, to awaken and maintain natural cognitive curiosity and develop interests. The promotion of the educational development of future geography teachers clearly defines the requirements that have a gradation of difficulties, to meet achievements and support ambitious plans. Today, the use of the activity of Internet users is an important element of education, including geographical. A teacher who knows how to use Internet resources can transfer them to students, supporting them in acquiring key cartographic competencies, preparing young people for effective functioning under the conditions of the information society, including lifelong learning, which will be largely based on the use of this type of resources [3; 4].

In recent years, innovations have acquired a new meaning, even though, for a long time, education was the place where people were afraid of innovation flows. Generally, innovation is perceived as the ability to develop modern products. Until recently, the training of cartographic competencies and literacy of future geography teachers was a very weak link in education. However, modern programmes correspond to the set goals and objectives, developing students' interests in the field of cartography using e-learning methods, which plays an important role in acquiring new competencies [5]. Despite the large financial costs associated with the preparation and conduct of training, e-learning methods are a valuable addition to conventional methods and available teaching aids. The use of data from various applications, that is, obtaining, selecting, analysing, and processing geographical information, can be used in geography lessons to develop the cartographic competence of future geography teachers. Geography teachers can use existing studies, lesson scenarios available on educational portals created by GIS software manufacturers. Relevant projects aimed at popularising the use of information, communication, and geoinformation technologies in the teaching of natural sciences are very popular [6; 7].

The purpose of the study is to consider the methods of identification of pedagogical, multimedia, and GIS technologies for the development of cartographic competence of future geography teachers.

Materials and Methods

The methodological basis of the study consisted of the following approaches to the research of the stated subject: socio-pedagogical, functional, pedagogical experiment. The socio-pedagogical method is a prerequisite for the entire educational process, knowledge, and activity in general. It is a specific, repeatable way to solve a certain type of scientific problems. In addition, the development of cartographic competence is an element of more structured research terminology, which distinguishes

concepts to facilitate their applications. There is no unambiguous definition of this research method from the standpoint of pedagogy. This is a kind of scientific procedure leading to the description of the formal pedagogical activity of a particular educational institution. Its use is aimed at studying curriculum more deeply to consider its functioning as a social system and as a generalised set of people, structures, principles that it follows, and the effectiveness of educational activities, the purpose of which is to establish some improvements or forecasts of the development of future geography teachers.

The functional approach of modern pedagogy constantly identifies paradigms that meet the current needs and challenges of the future. It has become popular and has almost joined the important components of the development of pedagogical categories and competencies. This method allows learning the secrets of the development of cartographic skills, expanding and updating knowledge by searching for theoretical substantiations of personal actions or answers to relevant questions. Its integrity deserves attention since the pedagogical roots lie in the anthropological view of man, one's development and achievements, which correspond to the practical needs of modernity. In methodology, functionalism is an important phase in changing approaches to the object of cognition through structural components that consider not only the essence of the object, its types, and components but also two groups of functions: conditions and consequences. The use of functionalism allows highlighting the current opportunities for the development of cartographic competence of future geography teachers in pedagogy, teaching, and education in general.

The pedagogical experiment was conducted at Abai KazNPU, in which about 60 students took part. It was established that the most important role in this matter is the role of a teacher who, in the case of teaching geography using Internet educational resources, WebGIS applications, and tools, can build a new learning environment for oneself and students. The role of a teacher using the achievements of information technology is twofold: firstly, the teacher must constantly develop own professional competencies, including in the field of information technology, secondly, the teacher must support students in developing self-study skills. Following these postulates – the idea of lifelong learning and the need to spread IT competencies among future geography teachers, the purpose of the experiment is to determine, in particular, the stages of providing teachers with the opportunity to obtain qualifications for teaching geography using various innovative methods for the development of cartographic competence. According to the results of the pedagogical experiment, the curriculum on information technologies in teaching geography assumes that most students effectively use the educational package provided to them.

Results and Discussion

Computer devices and software are becoming more common and accessible in everyday life, including in educational institutions. They provide fast and virtually unlimited access to information, change the worldview, offer new opportunities for independent and organised acquisition, and use of cartographic knowledge by future geography teachers. Currently, conditions are being actively created for the use of computer devices and software in the classroom since the computer should become a common and universal teaching aid that serves both the teacher and the student in the learning process. The educational environment should prepare students for free functioning in the information age, it should develop the ability not only to use computer devices but, above all, to search for and systematise cartographic information, effectively use it to solve problems [8]. There are many websites on the Internet that can be used in geography lessons, with information about various objects and studies. This information is fascinating, has a clear structure, interesting graphics, sometimes sound effects, and is constantly updated. The galleries of interesting photos and tables included in them, brief information will certainly interest and encourage students to search for information and, accordingly, to develop cartographic competence.

The dynamic development of information technologies and GIS systems in recent decades has contributed to the emergence of new information systems capable of storing, analysing, and transmitting a large amount of data. Постоянно увеличивающиеся ресурсы доступной информации и широкая область интересов отдельных географических наук создают возможность быстрого формирования картографической компетентности будущих учителей географии и получения актуальных новостей о мире. In obtaining data, it is necessary to pay special attention to the reliability of the source from which they come. The use of practical methods allows the student to work independently and hone skills. One of the main elements of the development of students' competencies is monitoring and evaluation of their academic performance, which consist of specific actions that determine the level of achievement of the curriculum objectives, the motivation of students to expand their skills. A computer in the development of cartographic competence is the main tool for obtaining geographical knowledge. Its role should not be overestimated, especially among the younger generation. Young people gain substantive knowledge on the most important issues of geography through in-depth theoretical and practical methods that help to strengthen and enrich competencies in the field of practical cartographic work. However, overuse of the computer, lack of constant supervision of the student, and improper teacher training may have a negative effect [9; 10].

Recently, there have been many multimedia trainings programmes in various fields. They are becoming more accessible and adapted to the appropriate level of education. These include atlases, dictionaries, courses, tests, encyclopedias. Comparing them with conventional sources of information, they have some advantages and disadvantages. The advantages include competitive price, a large amount of information, a quick search engine, connecting information using links, enriching programmes to create individual maps or databases, the ability to print or copy information. The disadvantages include the ability to use the information only through a computer, the time to start the computer, the ease of damaging information. Their advantage is that the information is presented in different languages and has a clear structure accessible to students, which is illustrated with many interesting photographs,

atlases, maps, diagrams, and tables. It is also very interesting to travel to very far corners of the globe using numerous cameras located on different continents that transmit images to the Internet. This allows confirming the weather condition or the prevailing time of day.

For the assumptions, goals, and requirements formulated in educational activities to be reflected in practice, it is important to identify the areas of learning processes in terms of changes and problems that concern them. Not to make previous mistakes, it is necessary to take a holistic view of the geographical area and gradually improve what needs to be corrected, monitoring the accompanying measures of the rapidly developing reform. The experience of previous reforms shows that the introduction of changes may be accompanied by various errors in the system, however, for the development of subject competencies of future teachers, this is the most important element in a broad understanding of the quality of training of future geography teachers [11]. The areas of modern research in the field of real interest in the teaching profession on the part of students, the current opportunities give hope for more favourable consideration of the development of cartographic skills and employment opportunities in an ever-changing labour market. An important role in maintaining the quality of education at a high level is played by constantly enriching and improving innovative processes, in institutions and in working with students to increase motivation and interest in the learning process. Such procedures allow the student to develop comprehensively, take part in the educational process, which includes classroom, extracurricular, and individual activities.

One of the main tasks of institutions in the development of cartographic competence of future geography teachers is to ensure the correct organisation of the educational process, including the establishment of study hours in the framework programme for the educational process. The fulfilment of modern aspects of the programme will allow to fully meet the training requirements. The programme must include organisation of geographical audience, sets of wall maps, geographical atlases, topographic maps, tourist maps, physical globes of students, induction balls, sets of models, rock samples, compasses, measuring instruments, statistical yearbooks, geographical library, sets of films on DVD and DVD player, computer with educational programmes, multimedia. When performing tasks and striving to develop cartographic skills, it is necessary to consider different ways of teaching and learning, which are influenced, among other things, by the student's intelligence, personality, maturity, and the environment in which this student lives. The learning process consists of factors such as previous knowledge, associations, knowledge transfer, emotions, and motivation, observation and learning styles [12]. Therefore, it is important that the teacher attempts to establish a connection with previously obtained student knowledge, bridging the gap between the known and the unknown. Knowledge of terms and facts without considering their relevance, relationship, or application limits the ability to understand their meaning, for example, in the case of a map, a student must not only understand the term map but also be able to use it. Observing processes in natural conditions and situations helps to better understand them.

The effective use of various sources of information requires the application of methods that will ensure the comprehensive development of the future geography teacher. It is especially recommended to use active description, timeline methods, auxiliary description, case study, classification description, or portfolio. Upon using various sources of information, the student gains the opportunity to develop the skills of understanding and managing information, including selection, comparison, analysis, processing, interpretation, legible representation in various forms, for example, graphic, creation of one's own information. Other methods leading to the effective achievement of cartographic educational goals are the mental map and field activities. A mental map is a method that is especially effective when conducting repeated classes, which allows systematising issues related to phenomena occurring in a geographical environment and understanding the interdependence between them. Field classes are mainly conditioned by the location and logistical capabilities of the institution. Such classes take place outside the building and allow using the natural environment as a source of geographical knowledge, which concerns the natural environment itself and its role in human social and economic development. Field exploration and spatial imagination can teach a sense of observation and consolidate practical skills. Field activities can relate to such content as measuring distance and area, formulating situational plans of small plots, analysis of geological detections [13].

Presentations can be an excellent material for the development of cartographic competencies since the graphics used make it easier to understand some of the mechanisms that determine the development of geographical phenomena. The use of a presentation, that is, its processing and creation, requires knowledge of the basics of a computer and PowerPoint software. PowerPoint is a simple tool for creating graphics and text that can be used to prepare presentations. The programme offers broad possibilities. Upon using it, a student can combine any type of graphic element with blocks of text. The main elements of the presentation are slides. PowerPoint offers a number of ready-made templates in which the user inserts graphics or types text in certain places. This programme allows placing graphics on the slide in many forms. Namely, drawings, maps, diagrams. It also offers drawing tools [14]. Ready-made graphics can be inserted into another programme, and it is also easy to combine graphics with text. The programme offers a number of visual effects that can animate individual elements of a slide using non-standard animations in various areas, for example, its crystallisation. Specifying the sequence of animated elements, the start time of animation or accompanying sound effects contribute to the development of pedagogical competencies in general.

One of the basic cartographic competencies in the field of information technology is the ability to search for information. Information search capabilities on the Internet include spatial information, maps, images available on servers containing statistical data. To implement the stages of the development of cartographic competence of future geography teachers and their classes on the e-learning platform, it is important to use resources in the form of HTML pages, PDF files, multimedia presentations, links to

websites, links to installation files, scientific and didactic papers available on the Internet. Practical classes using office software improve the geographical competence of students in general. During organisational classes held in computer classrooms, all students can use the standard Google search engine. Modern programmes are designed in such a way as to bring students closer to the possibilities of using elements of information technology, webGIS, and free GIS software in future didactic work as a teacher. Various practical tasks need to be prepared so that computer applications and programmes used during their execution are based on open access and so that the teacher can create the aforementioned new learning environment for oneself and students. For tasks related to computer graphics, a user-friendly programme named Paint.NET is used since it offers extensive editing capabilities and is available under a free license [15; 16].

In developing cartographic competence, it is crucial to use e-learning, which is preceded by introductory organisational classes in a computer context. To conduct them, it is possible to use various e-learning platforms running in the Moodle 2.0 software. Regarding the webGIS group of applications, the most popular applications used to perform practical exercises are: among geobrowsers – Google Maps, among virtual globes – GoogleEarth, from desktop GIS software – the non-profit Quantum GIS programme. The main aspect of improving the cartographic skills of future geography teachers is the ability to use computer graphics programmes. Due to the fact that classes can be effectively conducted in electronic format, students need to have the appropriate software to complete tasks, such as a free graphics programme Paint.NET. Such exercises include converting photos, drawing a simple sketch of the field, and adding vector layers to the existing raster base of the map [17]. The poor knowledge of geographical Internet resources among students is explained by the fact that not a single student has previously used geographical information systems, half of the students do not know about the possibility of searching for certain types of files and information about the selected site or domain. The content and scope of cartographic competence were influenced by a questionnaire testing students' skill in office software and the ability to search for spatial information.

Based on the pedagogical experiment, which was conducted at the Abai KazNPU, a lecture was held with a further survey. About 60 students set a rating scale with different indicators depending on the level of complexity of the tasks. Quizzes, forum activity, and participation in the compilation of a dictionary of terms were evaluated separately. The first two hours were a lecture, during which the principles of geographical training were discussed, the scope of classes was presented, and a survey was conducted, the next two hours were spent in a computer classroom – they were devoted to setting up accounts on the e-learning platform and brief training in its use. For most of the students who took part in the study, this was the first contact with the e-learning platform. Among the 60 people surveyed, 8 were over the age of 30. In the case of information technology education, age is of great importance, since students from the older age group, unlike the young, do not attend computer science or information technology classes during their studies. The data obtained, especially about the age and education of the respondents, confirmed the initial assumptions that students can evaluate their own IT skills differently. In practice, only about 10% of students do not use Microsoft Office. The task of the course participants was to prepare an illustrated geographical bulletin containing a combination of text, photographs, and maps.

During the survey, the students assessed their computer skills and the ability to use office software to develop cartographic competence on a five-point scale, where 0 – no skills, and 5 – very good skills. Based on the results, the average knowledge rating of individual computer programmes was calculated. The course participants gave the highest scores to their skills in using the programme to create a presentation – an average of 3.15% and a text editor – 2.95%. The average score of general computer literacy was 2.58%. The lowest indicators of the participants were their ability to work with tables – 2.32%. The diversity of IT skills in the studied group is mainly due to the fact that the course participants show a good knowledge of the text editor and presentation programmes, which allows them to focus on the preparation of geographical data and correctly executed graphs and calculations, the skills of filtering geographical data. A survey among the studied audience showed that 84 per cent of students most often use the Google search engine. 66% have heard of Google Maps, but only 36% have used them. During the e-learning experiment, the possibilities offered by the Google Maps geobrowser were presented. The exercises concerned well-known location search and route mapping functions, Google Maps API technology, which allows extending the functionality of the map interface, for example, to create a so-called spatial showcase of the selected location. Almost every Internet user has access to Google Maps, so there is a huge educational potential for future geography teachers.

Google Earth is a tool that can be successfully used in geography lessons, since providing access to various sources of geographical information with special emphasis on cartographic materials and teaching students how to use them are important tasks that a future geography teacher faces [18]. The use of virtual globes and mapping services is part of these tasks, allowing students to interact with the latest sources of geographical information and expand their knowledge of the world with their help. The task of the materials is of a lecture character, using which students can learn how to prepare a presentation illustrated with the contents of a virtual globe, intended for a geography lesson, with an explanation of any geographical issue, phenomenon, or process. Simple tools for drawing points, lines, and polygons, photos and motion trajectories can supplement the Google Earth virtual globe with one's own content to then be shared with other Internet users. A teacher who can use this tool can introduce students to the basics of vector recording of a digital map. The creation of individual digital maps using Google Maps API technology and saving one's own map content in KML format are actions to form elements of Web 2.0 technology, which are one of the components of the development areas for collecting spatial information and providing it based on open licenses [19].

One of the additional elements of the development of cartographic competence of future geography teachers

using Google maps and the Google Planet virtual globe is the Street View service. When using this app, students can view panoramic photos taken every few tens of meters from street level. The range of services covers the USA, Great Britain, large territories of Western Europe, large territories of South Africa, some regions of South America and Asia. Street view in geography education introduces students to interesting places, indications of typical natural landscapes, various types of urban space, and a network of settlements or characteristic features of individual climatic zones. This allows approaching and realising many of the issues discussed in geography lessons, since the teacher, through an interactive presentation of the possibilities of virtual exploration of the world, can awaken students' curiosity about research and their desire to travel not only virtually. Thematic websites containing geographical data, including the content of national and thematic geoportals, can be useful in the work of a teacher, being an excellent source of information, especially on a regional and local scale. The introduction of free software will allow students to use GIS elements in tasks dedicated to obtaining geographical data, data analysis, searching for information in geographical databases, cartographic representation to improve their professional activities in the future [20; 21].

Conducting geography classes in a computer classroom contributes to the correlation of this subject with computer science and improves students' skills in using a computer as a tool for searching and processing information, which stimulates the development of cartographic competence. According to the assumptions of the reform, the teacher should create conditions for students so that they can independently, creatively, and actively acquire knowledge and skills using activating methods and teaching tools, such as computers and training software. Multimedia encyclopedias are easy-to-use programmes with a clear structure and aesthetic graphic design that represent this area of knowledge, namely geography, in an understandable and attractive form for the student and allow them to imagine that large temporal and spatial distances cannot be achieved by direct observation. Upon using computer tools, one can get a lot of interesting and relevant information in the form of descriptions, photos, maps, animations, videos, tables, and dictionaries. While the use of presentations, other Internet technologies, and GIS systems require certain knowledge of programmes for their introduction in the educational process, so only those who are more advanced in the use of modern information technologies can apply them [22].

Conclusions

Thus, upon using various methods and means of developing cartographic competence, it is possible to change the curriculum, including the presentation of modern and accessible geographical information resources available on the Internet, which can be used by a geography teacher when discussing selected issues during a conventional lesson and in computer classrooms to mobilise students to visit cartographic portals while performing various tasks. Having introduced advanced methods of information retrieval, especially spatial information and statistical data, special attention should be paid to maps and photographs. However, to do this, it is necessary to introduce elements of computer graphics, including the graphic processing of images and maps. The main didactic purpose of the classes is to present a variety of geographical content available on the Internet and to introduce tools for analysing, processing, and presenting geographical data, including a GIS system and processing of geographical information. The development of cartographic competence in the form of digital learning will allow, in the future, promoting it among teachers who would like to expand their knowledge about the use of information technologies, including GIS elements in teaching geography.

Conducting classes using the method of electronic and digital learning forces students to independently use WebGIS applications and tools available on the Internet. The use of a text editor and the creation of multimedia presentations will considerably reduce the number of tasks dedicated to office packages. In turn, installing software on computers will allow teachers to train the ability to create a new learning environment for themselves and students, prompting their interest in this. The cartographic competence development programme should be designed in such a way that institutions train future teachers not only to provide students with the knowledge but also to improve skills in using GIS tools and applications, which is extremely useful for young people living in a modern information society where spatial information plays an increasingly important role. Meanwhile, the real change in education is not the result of the restructuring of the educational system, but a range of determinants of the effectiveness of reforms, the effects of which depend on the quality of changes taking place in many areas of education. The acceptance of changes by teachers is still an underestimated element that determines the productivity of acquiring relevant competencies.

Acknowledgements

This study was conducted under the project AP 15473403.

Conflict of Interest

None.

References

[1] González A, Bonnin C, O'Mahony E, Nguyen Hong N, Nguyen T, Minh T. Challenges and prospects of integrating GIS education in development studies in a Global South context. *J Geog.* 2020;120(1):12-22. DOI: 10.1080/00221341.2020.1825773.

[2] Bearmana N, Jones N, Andréc I, Alberto Cachinhoc H, DeMers M. The future role of GIS education in creating critical spatial thinkers. *J Geog High Educ*. 2016;40(3):394-408. DOI: 10.1080/03098265.2016.1144729.

[3] Winter IA. *Socio-professional competence as a holistic result of professional education: (Idealized model). Problems of quality of education. Competence approach in vocational education and design of educational standards*. Washington: Research Center of Problems of Quality of Preparation of Experts; 2020.

[4] de Almeida RA. *Cartographic education for teachers and children: Current and future Challenges*. Rua do Lago: University of San Paulo; 2019.
[5] Board C. The communication models in cartography. In *The Routledge Handbook of Mapping and Cartography*, edited by A. Kent, P. Vujakovic. London: Routledge; 2018. P. 26-31. DOI: 10.4324/9781315736822.
[6] van Bastian L. Developing geographic information infrastructures: The role of access policies. *Int J Geog Info Sci.* 2009;23(2):195-212. DOI: 10.1080/13658810701851412.
[7] Reyes NJJ, Juliarena M, Cristina E, *et al*. Resuming an international project: map use in Argentine and Hungarian schools. In *Second International Conference on Cartography & GIS*, Borovets; 2008.
[8] Wiegand P. *Learning and teaching with maps*. London: Routledge; 2006. DOI: 10.4324/9780203477793.
[9] Schuit W. A method for teaching topographic map interpretation. *J Geog.* 2011;12(4):452-457. DOI: 10.1080/00221341.2011.549497.
[10] Windiastuti LR, Munajati DK. Cartography education for children in Indonesia. In *24th International Cartographic Conference*. Santiago: International Cartographic Association; 2009.
[11] Keiper TA. GIS for elementary students: An inquiry into a new approach to learning geography. *J Geog.* 1999;98(2):47-59. DOI: 10.1080/00221349908978860.
[12] Shin EK. Using geographic information system (GIS) to improve fourth graders. *J Geog.* 2006;105(3):109-120. DOI: 10.1080/00221340608978672.
[13] Kerski JJ, Demirci AA, Milson AG. The global landscape of GIS in secondary education. *J Geog.* 2013;112(6):232-247. DOI: 10.1080/00221341.2013.801506.
[14] van Gasselt S, Naß A. Cartographic metadata for improving accessibility and facilitating knowledge extraction and validation in planetary mapping based on remote-sensing observations. *ISPRS Int J Geo-Inf.* 2024;13(3):69. DOI: 10.3390/ijgi13030069.
[15] Catling S. An understanding of geography: The perspectives of English primary trainee teachers. *GeoJ.* 2004;60:149-158. DOI: 10.1023/B:GEJO.0000033575.54510.c6.
[16] Bradbeer J, Healey M, Kneale P. Undergraduate geographer understandings of geography, learning and teaching: A phenomenographic study. *J Geog High Educ*. 2004;28(1):17-34. DOI: 10.1080/0309826042000198611.
[17] Anderson M, Arms Z. Business improvement districts, class turf war and the strategic weaponisation of class monopoly rent. *Urban Stud.* 2023;60(2):238-255. DOI: 10.1177/00420980221092339.
[18] Hutchinson N. Geography in Australian schools: A view from the AGTA Chair. *Int Res Geog Env Educ.* 2006;15(2):193-198. DOI: 10.2167/irgee192i.0.
[19] Leat D. Geography student teachers and their images of teaching. *Int Res Geog Env Educ*. 1996;5(1):63-68. DOI: 10.1080/10382046.1996.9964990.
[20] Livingstone DN. *The geographical tradition: Episodes in the history of a contested enterprise*. Hoboken: Wiley-Blackwell; 1992.
[21] Martin F. Postgraduate primary student images of geography and the relationship between these and student teaching. *Int Res Geog Env Educ.* 2000;9(3):223-244. DOI: 10.1080/10382040008667654.
[22] McNee RB. Lines of geography in Latin American narrative: National territory, national literature. *Canad J Hispan Stud.* 2019;43(3):767-769.

Формування картографічної компетентності: Методологічний підхід до підготовки майбутніх учителів географії

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Анотація

Актуальність. Реформа географічної освіти ставить нові виклики перед програмами підготовки вчителів географії, зокрема, щодо розвитку картографічних компетентностей, які є критично важливими для ефективного викладання.

Мета. Метою дослідження є вивчення методів інтеграції педагогічних підходів, мультимедійних засобів та геоінформаційних систем (ГІС) для формування картографічних навичок у майбутніх учителів географії.

Методологія. Застосовано мультимодальний підхід, що поєднує практичне читання карт, аналіз картографічної символіки, роботу з сучасними технологіями, такими як ГІС, та польові заняття.

Результати. Мультимодальний підхід виявився ефективним у формуванні необхідних картографічних навичок у майбутніх учителів. Постійний моніторинг і підвищення кваліфікації були ключовими факторами у підготовці вчителів, здатних втілювати цілі навчальних програм у практичне застосування в класі. Конкретні результати включають покращення навичок інтерпретації карт і просторового аналізу, вміння використовувати програмне забезпечення ГІС для візуалізації даних, поглиблення розуміння принципів картографічного дизайну і здатність розробляти цікаві навчальні заходи з використанням карт.

Висновки. Розвиток надійних картографічних компетентностей у рамках програм підготовки дає змогу майбутнім учителям географії використовувати карти, просторові уявлення та геопросторові технології як потужні педагогічні інструменти. Занурюючі, технологічні методи, що відображають сучасний передовий досвід, сприяють підготовці вчителів, які володіють картографічними знаннями.

Ключові слова: вчитель; географія; освіта; картографічні вміння; картографічна компетентність; професійна підготовка; ГІС-технології.