https://doi.org/10.26565/2410-7360-2022-57-14
UDC 911.9:001.89

Received 30 June 2022
Accepted 13 October 2022

Experience and prospects of mobile GIS use for practical training of geography students

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ABSTRACT

Problem statement. In recent decades, approaches to conducting field research have been significantly modernized. The use of smartphones, tablets and other portable devices with mobile GIS for field data collection has increased significantly. The rapid change in geospatial research technologies makes it necessary to introduce them into the educational process, in particular, in practical training of geography students.

Research methodology. Paper forms of field data collection, materials and reports from practical trainings of the previous years, stored at the Department of Physical Geography and Cartography of V. N. Karazin Kharkiv National University, served us as the source materials for the research. To implement the practical part of the research, ESRI software products such as Collector for ArcGIS, ArcGIS Online, ArcGIS Desktop were used.

The purpose of the research is to substantiate the content and to create electronic forms of field data collection with mobile GIS for the physiographic part of the educational natural science training of first-year students of specialty 106 Geography of V. N. Karazin Kharkiv National University.

Results. The use of mobile GIS for practical training of future geographers is widespread in Ukrainian and foreign universities. In particular, in recent years, teachers of the Department of Physical Geography and Cartography have been introducing mobile GIS into field data collection. We have developed 4 electronic forms of field data collection for the physiographic part of the educational natural science training of first-year students. They are soil profile description, forest phytocenosis description, geological and geomorphological observations, and hydrological station. Due to the wide functionality of Collector for ArcGIS, in particular, the ability to work offline, this mobile application and ArcGIS Online were used to develop forms. To optimize the work with individual text fields in electronic forms, we created domain values that allow students to select a certain option from the drop-down list.

Practical significance and research perspectives. The implementation of mobile GIS into practical training of future geographers contributes to the formation of cartographic and geoinformation competencies and helps students master modern approaches to the organization of various types of field studies. Testing developed electronic forms during summer practical training of students or through independent research in the study area remains a relevant task. In the future, it is advisable to create electronic forms for all sections of the physiographic part of the first-year students' practical training and to adapt data collection forms for independent use.

Keywords*: mobile GIS, field data collection, practical training, training of geography students.*

In cites: Popovych Nataliia, Sinna Olena, Nazarko Liudmyla (2022). Experience and prospects of mobile GIS use for practical training of geography students. Visnyk of V. N. Karazin Kharkiv National University, series "Geology. Geography. Ecology", (57), 184-194. https://doi.org/10.26565/2410-7360-2022-57-14

Formulation of the problem. Data collection is one of the key stages of any field studies. The location of certain objects (e.g., soil profiles, hydrological stations), their qualitative and quantitative attributes, and the interaction between the objects are important for physiographic research. Optimizing time and energy allocated to fieldwork through the use of convenient means of collecting high-precision data allows researchers to put greater emphasis on a meaningful and comprehensive study of an object or a phenomenon.

In recent decades, the use of smartphones, tablets and other portable devices for field data collection has increased significantly. It is caused by the general rapid development of geographic information systems (GIS), wide internet access on these devices, growing availability of GPS and GNSS technologies, and leads to a natural change in approaches to fieldwork. In the future, due to the increase in the number of satellites and their greater signal strength, the positional accuracy of portable devices equipped with GPS and GNSS will continue to grow [12].

The rapid change in geospatial research technologies and their availability for a wide range of specialists makes it necessary to introduce them into the educational process [2]. For geography students, first of all, this concerns field training, during which they learn to collect data about the state of the environment, its indicators and characteristics. To achieve these tasks, the transition from traditional means of collecting data on the location of terrain objects (e.g., measuring tapes, theodolites, paper maps) to modern mobile devices with appropriate software is promising. Such devices provide a number of advantages, such as: high accuracy of georeferencing, ease of measurement even for inexperienced users, improved detailing of attributes, and the automation of the process of loading results into a desktop GIS [19]. In addition, many students can work simultaneously on a certain task, entering data into a single synchronized database, which is impossible (in automatic mode) when using paper forms. As a result, the effectiveness of training increases and the results of field studies become more relevant. The long-term data can be easily accumulated, which, if properly systematized, become useful for both educational and scientific purposes.

Analysis of recent research and publications. Mobile GIS are usually defined as cartographic applications for portable devices that are used to collect, edit, process and visualize field data in real time and are integrated into the existing geodata infrastructure. They can work both on mobile devices (smartphones, tablets with IOS and Android operating systems) and on specialized high-precision devices from Trimble, Leica, Garmin and other companies. Mobile GIS allowed scientists to use appropriate tools not only at computer-equipped workplaces, but also during fieldwork, potentially from anywhere on the earth [9]. It is no surprise that the popularity of these applications is steadily increasing every year, just as the number of features available to users.

Since the 1960s, GIS have moved from desktop solutions to server-based solutions, and then to web-based solutions, which allowed mobile GIS to be used directly in the field. Initially, this technology was used mainly for transport navigation and surveying needs. In the first mobile GIS, data and software were preloaded on the device and operated without internet access. Gradually, with the development of communication technologies, they became able to work online. Now mobile GIS are considered as a component of web GIS. The emergence and development of this technology has opened up new opportunities and prospects in many fields: emergency management, agriculture and forestry, health care, law enforcement, navigation and tourism, and others [16].

In the world scientific circles, the use of mobile GIS in the research is widely implemented. Geospatial software and information systems have long become an important part of environmental modeling and studies. They allow researchers to use a powerful arsenal of cartography, spatial analysis and modeling and provide access to large datasets, analysis and decision-making support tools [17].

An example is the study aimed at obtaining a detailed dataset on flora and fauna of the Kujawy Mining Plant (Bielawy commune, Poland) for biodiversity management. Biotic data collection for an open-cast limestone mine was carried out by a group of specialists from the Faculty of Biology of the Adam Mickiewicz University in Poznan (Poland) using Collector for ArcGIS and ArcGIS Online (mobile application and online platform). The choice of this particular GIS software may be explained by the fact that the field survey was conducted at depths of up to 120 m below ground level. It was important to maintain the ability to collect data even without internet connection, as well as to share data from different groups of researchers within a single workspace while implementing the project [19].

Mobile GIS are actively used in the educational process. Thus, the Field Studies Council cooperates with ESRI, one of the world leaders in the field of GIS, to actively introduce modern technologies in different educational courses. In cooperation with the Open University, a web-based Field Network System was developed for data collection using mobile devices. The idea is that data collected by students in the field is uploaded via Dropbox, presented in classified tables, and further processed. Teachers, in turn, monitor data entered through mobile GIS and consult students [15].

The research of Jiří Pánek and Michael Glass is devoted to the experience of using Collector for ArcGIS in a learning task. It involved describing the sense of place for the Lawrenceville neighbourhood (Pittsburgh, the USA). For a week, students worked in the area in groups of 3–4 people, completing individual tasks, aimed at understanding people's perceptions of different parts of Lawrenceville. Collector for ArcGIS was used to capture location and upload geotagged photos and videos. The authors concluded that this mobile application serves as an effective data collection tool for student projects, in particular, socio-geographic ones [20].

The potential of using mobile GIS to improve the skills of future geographers is described in the article presenting the results of the project entitled "Geoinformation Technologies – the Tool for Improving Quality of Teaching Geography". Project tasks (measuring the areas of selected stores and the selected parameters of the Nitra River section) were implemented by students of the Department of Geography and Regional Development of Constantine the Philosopher University in Nitra (Slovakia) using Trimble Pathfinder Pro 6H device. The implementation of these exercises in traditional educational process made it possible to significantly improve practical skills of geography students [21].

Experience of foreign and domestic universities. The use of mobile GIS for practical training of future geographers is widespread both in Ukrainian and foreign universities. An example is the Department of Geography of the University of Calgary (Canada), where students of Geography and Earth Science programs do various field trainings. Using Mapit GIS application, they collect field data and then process them [14]. The teachers at Utrecht University (the Netherlands) diversified the fieldwork of first-year students of the Bachelor program Earth Science in the French Alps with the active use of GIS [18].

Students of the Department of Geography of the Faculty of Sciences and Arts of the National University of Singapore undergo practical training in northern Thailand and Bangkok. Using Collector for ArcGIS and GIS Cloud software, they collect data on the physiographic characteristics of the Mekong River and local landscapes [10].

At the Department of Geography of Tokyo Metropolitan University (Japan), using Trimble GeoXT mobile devices, students and teachers conduct field studies, which include the analysis of hydrological indicators, soil samples, and other components of the natural environment [11].

Among the domestic universities which experience we considered, mobile GIS are implemented in practical training of geography students by Taras Shevchenko National University of Kyiv, Ivan Franko National University of Lviv, Volodymyr Vynnychenko Central Ukrainian State Pedagogical University, Odessa I. I. Mechnikov National University, Pavlo Tychyna Uman State Pedagogical University, Kamyanets-Podilsky Ivan Ohienko National University, Ternopil Volodymyr Hnatiuk National Pedagogical University. Mobile GIS in practical training of students of these universities are used, for example, to:

- collect physiographic data in Ojców National Park (Poland) [5];
- describe points of various geological observations and measurements [4];
- record visited historical places and findings [4];
- determine the consequences of denudation in Podilski Tovtry National Nature Park [8].

In general, after analyzing the experience of more than 20 universities that actively use mobile GIS for educational and research purposes, we have concluded that in the vast majority of cases they are used for primary data collection. Much less often, such GIS applications are used for data post-processing, since there is more advanced software for these tasks.

Selection of previously unsolved parts of the general problem. Although the frequency of use of mobile devices and specialized applications for field studies is constantly increasing, this aspect is not given enough attention in the methodological sections of most scientific works [19]. The need to identify the main features of the use of free mobile GIS in practical training of geography students determines the relevance of this research.

The purpose of the research is to substantiate the content and to create electronic forms of field data collection with mobile GIS for the physiographic part of the educational natural science training of first-year students of specialty 106 Geography of V. N. Karazin Kharkiv National University.

Materials and methods of the research. Paper forms of field data collection, materials and reports from practical trainings of the previous years, stored at the Department of Physical Geography and Cartography, served us as the source materials for the research. To implement the practical part of the research, ESRI software products such as Collector for ArcGIS, ArcGIS Online, ArcGIS Desktop were used.

The following research methods have been used: analysis – to systematize the experience of using mobile GIS and to study the materials of practical trainings of the previous years (reports, paper data collection forms, diaries); comparative method – to substantiate the choice of the optimal mobile GIS for the development of electronic forms of field data collection; cartographic method – for creating maps of the plant composition of Slobozhanskyi National Nature Park and the results of field data collection (Fig. 1, 4); geoinformation method – for developing and presenting electronic forms in ArcGIS Online.

Presentation of the main research material. Students of all educational programs of the Department of Physical Geography and Cartography of V. N. Karazin Kharkiv National University do practical training every academic year. This gives them the opportunity to expand their own experience, understand their professional skills and abilities. Fieldwork is a compulsory element of training for first-year and second-year undergraduate students. Also, depending on the topic of the student's research project, fieldwork can be included in the program of the internships of the third and the fourth academic years [6].

Accordingly, the Department of Physical Geography and Cartography has a rich tradition in practical training of students, and during the last years, some teachers have been introducing mobile GIS in the field data collection process. A vivid example is the professionally-oriented educational training of second-year students. Thus, during the Carpathian part of this training, students collect physiographic data using Collector for ArcGIS, which makes it possible to conduct studies offline and optimize their time.

The second part of this training is held in Slobozhanskyi National Nature Park. It forms skills and abilities to conduct landscape studies both in the field and laboratory conditions. During this part of the training, students should identify plant facies using Sentinel-2 and Landsat 8 satellite data and perform overlay analysis. Then they carry out field studies in the area to collect more data about the landscapes.

While conducting fieldwork in Slobozhanskyi National Nature Park, to map new objects, students actively use mobile GIS. They are ArcGIS for Windows Mobile and ArcPad (for Trimble Juno devices) and ArcGIS for Windows Mobile and NextGIS (for smartphones). However, the issue of transferring data collected in the traditional way, using paper forms, into the GIS environment arises. It is quite a time-consuming activity. In order to solve this problem, for easier data integration into a desktop GIS, the supervisors together with students created a database for ArcGIS for Windows Mobile, which is an analogue of a paper landscape description form [1].

The developed database contains such categories of data as information about the author, time and place of observations, location, geological basis, relief, soil cover, moisture conditions, vegetation cover, names of the investigated facies [1]. It is worth noting that creating such a database takes quite a lot of time. It is not universal, because it is focused on the specific physiographic conditions of the area where this part of training takes place. A significant advantage of the created database is the possibility of integration with a desktop GIS, which speeds up further analysis of the collected data and their visualization in map form (Fig. 1).

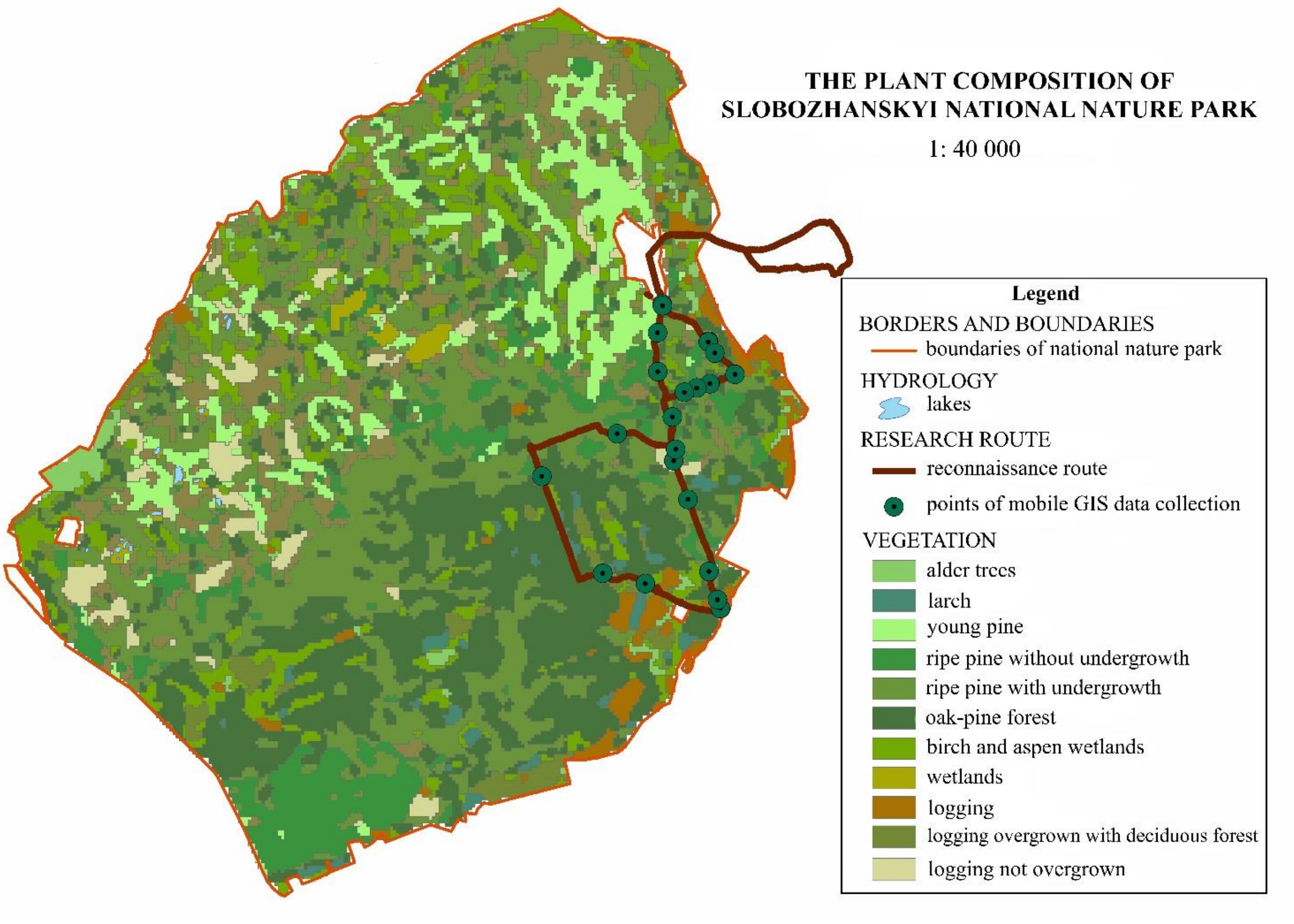

Fig. 1. The plant composition of Slobozhanskyi National Nature Park
(created by the authors, scale changed)

The physiographic part of the educational natural science training of all first-year geography students of V. N. Karazin Kharkiv National University takes place at Gaidary educational and scientific base. It was created in 1978 in Gaidary village area (Kharkiv region, Ukraine), on the right bank of the Siverskyi Donets river. The uniqueness of this base lies in the fact that geographical complexes of different complexity are represented in the area. It is suitable for visual demonstration of typical natural processes and analysis of the antropogenic impact on the environment [3].

The physiographic part of the above-mentioned training includes 5 sections: geological and geomorphological, meteorological, hydrological, soil science, and biogeographic. During each of them, students should master various methods of research, acquire skills of studying and mapping objects, both visually and instrumentally, and learn to identify patterns and interconnections in nature. For these purposes, students write their field diaries, collect materials that can be later analyzed in laboratory conditions (e.g., soil, water and plant samples), take instrument readings and fill out data collection forms.

Students go through such stages of training as design stage, field stage, cameral stage and final stage. The design stage involves the coordination of cartographic materials of the route and key areas of study. The field stage is the actual studies of the area. During the cameral stage, students process field data, analyze selected samples in laboratory conditions, perform calculations and make necessary graphical representations. At the final stage, obtained results are analyzed, reporting materials are drawn up, and students take an assessment for each section of the training [3].

During this training, students work with traditional paper forms, in which they enter data collected during field trips. However, when conducting long-term research, this method for the transfer and storage of information is somewhat outdated and inefficient. In addition, one of the key components of modern geographic education is introducing students to new technologies for data collection and analysis of spatially distributed features of the environment. That is why we suggest implementing the use of mobile GIS into the field training of first-year geography students.

After analyzing the fieldwork experience of the Department of Physical Geography and Cartography, we concluded that at the moment there are not enough Trimble Juno devices to meet the needs of the practical training of first-year students. Therefore, when developing electronic forms for studying the components of nature, we relied on the possibilities of collecting field data with smartphones, which are used by most students.

Having studied the characteristics of different free mobile GIS applications, based on a set of parameters (synchronization with web/desktop GIS; existing data collection forms; ability to work with points, lines and polygons; GPS tracking; compatibility with Android, iOS, Windows), we chose Collector for ArcGIS. It allows users to download maps and work offline, fixing necessary points, lines and polygons, entering data into electronic forms and tracking previously visited places. The ability to work offline is one of the most valuable features of this application, as students and their supervisors are able to collect data without internet access [13].

Considering different sections of the physicographic part of the first-year students' practical training, we developed a general algorithm for creating electronic data collection forms for field studies. First of all, a basemap should be chosen in Collector for ArcGIS to provide a visual context for the data. All ESRI applications use OpenStreetMap as a basemap. It is a free high-quality geographic geodatabase, which is constantly updated. Accordingly, it is also suitable for our needs.

Next, the data to be collected were determined, the structure of traditional paper forms was analyzed, and the main content data blocks were selected. During both soil science and biogeographic sections of the training, most of the data entered into the forms are textual [7]. Accordingly, it is easy to make mistakes in them. In addition, there is no single standard for processing these data, which becomes a problem at the further stage of processing and analysis of collected materials using desktop GIS. Accordingly, domain values were developed so that students could select one or another option from a drop-down list, instead of entering data into a form manually. Since our forms were developed for the specific practical training, all options in drop-down lists were limited to those that could be found in the physiographic conditions of the study area (Gaidary village and its surroundings).

After determining the view and ways of expressing specific fields, data collection models were placed in ArcGIS Online, and 4 electronic forms, that also let users attach photos and other files, were developed. In particular, it is suggested to add appropriate photos when describing a soil profile or a forest phytocenosis. These forms are publicly available in ArcGIS Online and Collector for ArcGIS (Fig. 2).

Existing paper field forms were taken as a basis for developing new electronic forms, and field diaries and reports were also analyzed. The developed forms do not cover all the needs of the fieldwork, there remains a significant part of the data collected by traditional methods. But later the content of such electronic forms could be expanded. Below is the description of each of the created electronic forms.

1) Soil profile description. Biogeographic studies are usually carried out together with soil studies: both soil profile description and biocenoses description are performed in a certain representative area of a particular natural complex. Therefore, common fields are distinguished in these two forms which are number of study, general relief, and anthropogenic impact. Soil science and biogeographic sections of the practical training usually include no more than 5 field days, so the domain values for the number of study are numbered from 1 to 5. Describing general relief, students may choose one of the 4 options: watershed, floodplain, the first above the floodplain terrace or the second above the floodplain terrace corresponding to the geomorphological levels of the study area (Fig. 3a).

The field of land and its economic condition defines key land types: forest land, recreational land, agricultural land, protected land and settlements (Fig. 3c). Groundwater level and hydrological conditions

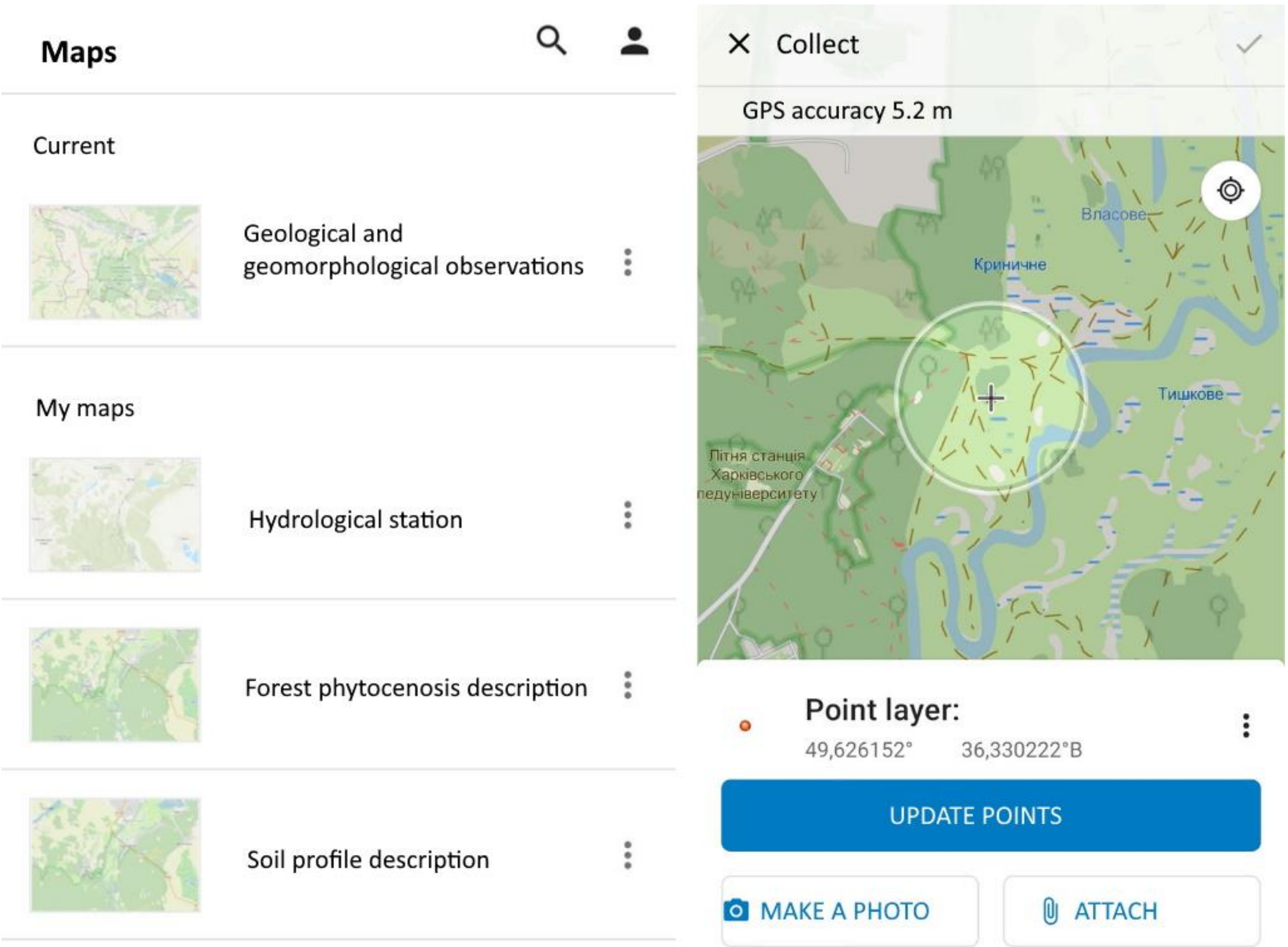

Fig. 2. The list of electronic data collection forms (created by the authors)

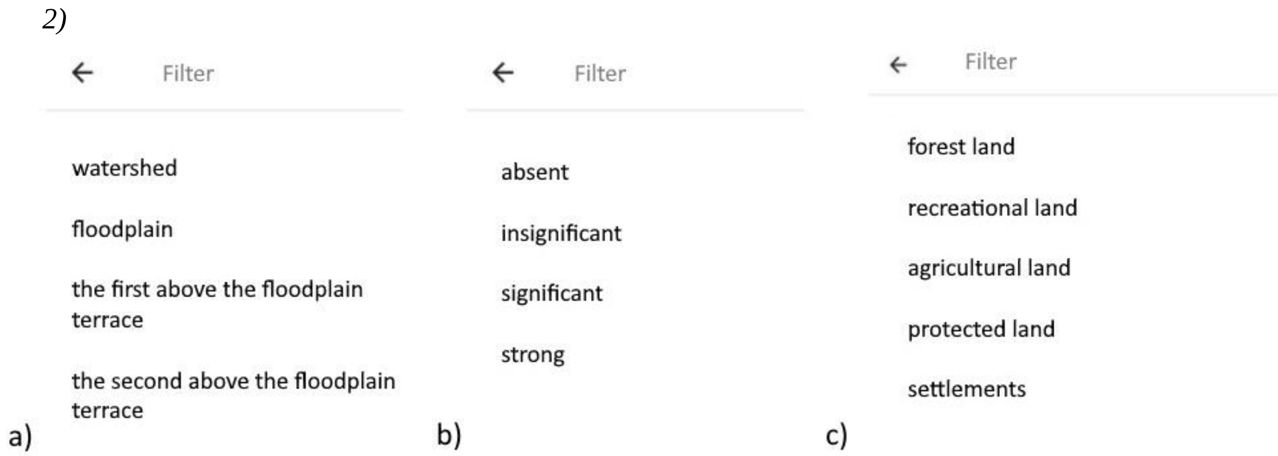

Fig. 3. Domain values of the fields of electronic forms: a) general relief;
b) anthropogenic impact; c) land and its economic condition (created by the authors)

are divided into two separate fields, since the first indicator is quantitative, and the second is qualitative. The intervals of groundwater level, indicated in the drop-down list, correspond to the data on the existing wells and boreholes of the area. The field of hydrological conditions contains 3 domain values: hydromorphic, semi-hydromorphic and automorphic conditions.

The field of underlying and soil-forming rock contains the following options: modern alluvial sands, old sandy alluvium, and loess loam. All other fields of this electronic form (microrelief, vegetation, field identification of soil) do not have options in the drop-down list. They cannot be clearly limited by a precise number of options, but are formulated in the process and according to the results of field studies.

Therefore, it is provided that students fill in these fields by direct manual input.

3) Forest phytocenosis description. The field of forest edificators has a list of values corresponding to the most common types of tree vegetation in the study area such as Scots pine and European oak. The field of anthropogenic impact has such characteristics as absent, insignificant, significant and strong (Fig. 3b).

Other fields of this form (formation, association, dominants of A, B, C, D levels, size of the sample plot, microrelief, thickness and composition of the forest floor, tree crown cover, field identification of soil) do not have domain values. Manual input of these characteristics is provided.

4) Geological and geomorphological observations. The form contains the above-mentioned general fields (number of study and general relief), fields of microrelief and anthropogenic impact. If needed, students can also enter additional thematic information in a separate field. During this training section, students can record the places of development of erosion processes, enter the points of description of geological exposures with their mobile devices. It was decided that all the detailed characteristics of geological and geomorphological processes will be written in a paper form.

5) Hydrological station. The data on the water bodies are collected at hydrological stations. Accordingly, the form developed for these tasks contains such fields as number of hydrological station, water temperature, water transparency and water color. These parameters should be entered manually.

Traditional paper forms for studying the components of nature are inferior to electronic forms in the ease of working with them. They take more time for data collection and cannot provide an accurate georeferencing of the location of fieldwork. However, for soil studies a technical disadvantage is that a description of the soil profile can only be added as a text file or a photo, which implies the initial use of a paper form. It should also be noted that the process of pre-creation of the database is quite time-consuming. The database itself is not universal, since the values of the drop-down lists in electronic forms correspond to the physiographic conditions of the area and do not cover all possible options.

The annual use of electronic forms during the physiographic part of the first-year students' practical training will allow filling databases on each component of nature for a larger study and expanding options for educational work with students. In the future, these data can be visualized in map form using desktop GIS, for example, ArcGIS. This will help visually demonstrate the results of practical training, comprehensively study the physiographic conditions of the area and the laws of their formation, as well as monitor changes that occur due to the influence of natural and anthropogenic factors (Fig. 4).

Conclusions and research perspectives. In the research, we have considered the experience of practical training of students of geographical departments with the use of mobile GIS in Ukrainian and foreign universities. In most cases, mobile GIS are used as a convenient tool for collecting primary data, and further analysis is performed in desktop GIS. The implementation of mobile GIS into practical training of future geographers contributes to the formation of cartographic and geoinformation competencies and helps students master modern approaches to the organization of various types of field studies. These are crucial aspects for training of students of all educational programs in specialty 106 Geography.

For the tasks of the physiographic part of the educational natural science training of first-year students of specialty 106 Geography of V. N. Karazin Kharkiv National University 4 electronic data collection forms have been developed. They are soil profile description, forest phytocenosis description, geological and geomorphological observations, and hydrological station. Due to the wide functionality of Collector for ArcGIS, in particular, the ability to work offline, this mobile application and ArcGIS Online were used to develop forms. To optimize the work with individual text fields in electronic forms, we created domain values that allow students to select a certain option from the drop-down list.

One of the prospects of the research is to increase the number of electronic forms to meet the needs of all sections of the physiographic part of the first-year students' practical training. Thus, for the biogeographic section, data collection forms for transect survey and for descriptions of herbaceous biocenoses should be created. It is also advisable to include in the work other basic maps, which should be developed additionally on a larger scale for the purposes of the research (e.g., biotope maps, landscape maps, geological and geomorphological maps).

Unfortunately, since February 24, 2022, due to the military aggression of the Russian Federation, martial law has been introduced in Ukraine. That is why we have not been able to test the created electronic forms during summer practical training or through independent research in the study area. This remains a relevant task for the future. At the same time, modern challenges such as the COVID-19 pandemic and the hostilities have led to the widespread introduction of distance education in Ukraine, so it is advisable to adapt data collection forms for independent use. Then students will be able to collect field data at their places of stay in case of distance practical training.

A promising area is the retrospective analysis of the results of long-term studies at Gaidary educational and scientific base, which can be performed by

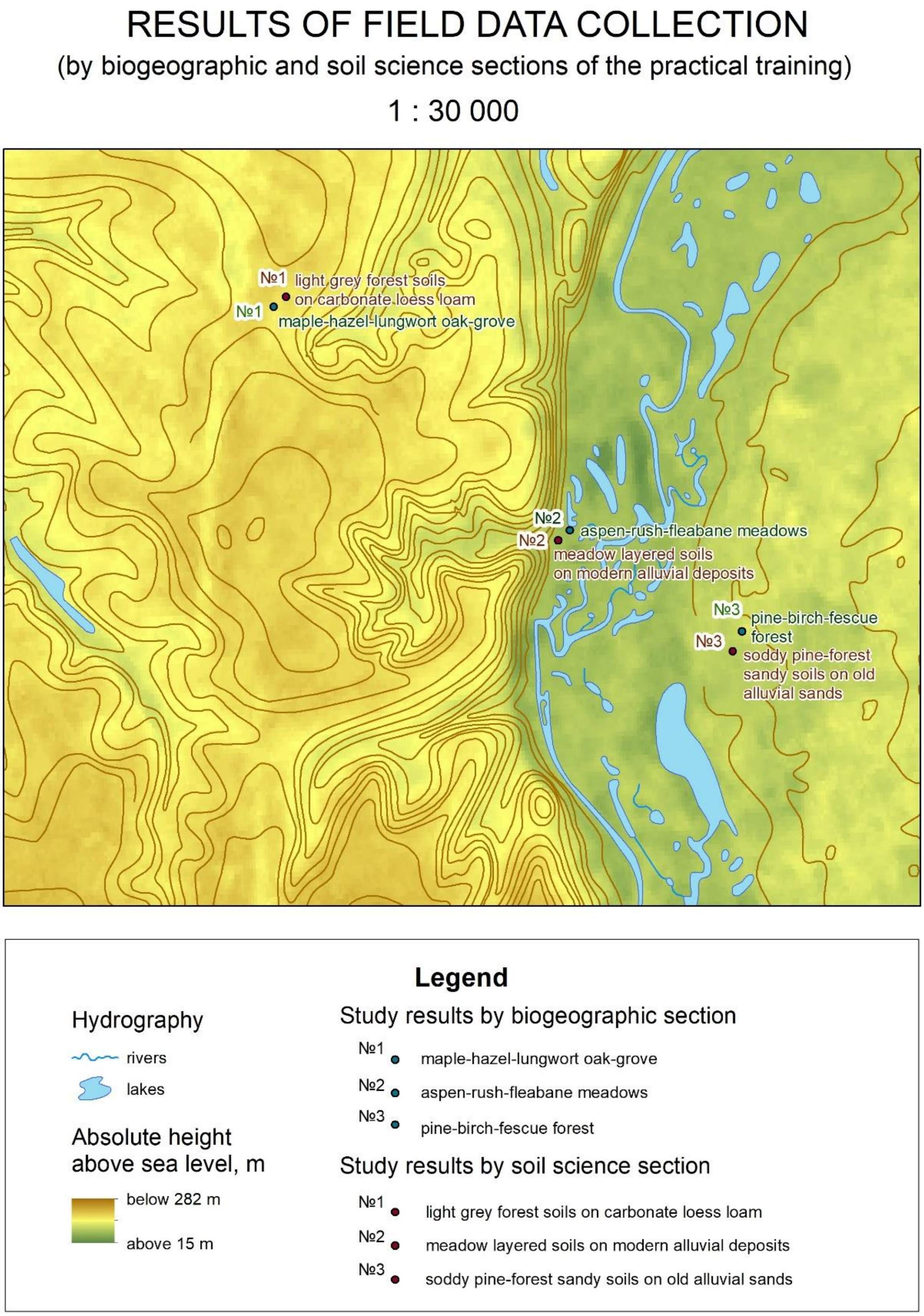

Fig. 4. Visualization of the results of field data collection by biogeographic and soil science sections of the practical training (created by the authors, scale changed)

digitizing paper data collection forms from previous years. Since field materials are stored at the Department of Physical Geography and Cartography for many years, and several student groups carry out studies simultaneously during a certain training section, the amount of data collected is significant, and their analysis may become the subject of a separate study.

Bibliography

1. *Бодня О. Ландшафтне картографування НПП «Слобожанський» засобами мобільних, настільних та веб-додатків ArcGIS / О. Бодня, О. Сінна, І. Олійников, А. Овчаренко // Проблеми безперервної географічної освіти і картографії. – Харків : ХНУ імені В.Н. Каразіна, 2016. – Вип. 23. – С. 15–21.*
2. *Лунячек В. Е. Оптимізація методики гідролого-геоморфологічних досліджень як інструменту формування спеціальних компетентностей сучасного фахівця-географа / В. Е. Лунячек, О. І. Сінна, К. Б. Борисенко, В. С. Попов // Проблеми безперервної географічної освіти і картографії. – 2019. – Вип. 29. – С. 6–16. DOI: https://doi.org/10.26565/2075-1893-2019-29-01*
3. *Навчальна природничо-наукова практика для студентів 1 курсу спеціальності «Географія» (с. Гайдари, Зміївський район Харківської області) кафедри фізичної географії та картографії Харківського національного університету імені В. Н. Каразіна [Електронний ресурс]. – Режим доступу : https://physgeo.univer.kharkov.ua/education/practice/практики-студентів-1-курс/*
4. *Навчальні практики природничо-географічного факультету ЦДПУ імені В. Винниченка [Електронний ресурс]. – Режим доступу : https://www.cuspu.edu.ua/ua/kafedry-heohrafii-ta-heoekolohii/osvitnia-diialnist/praktychna-pidhotovka/navchalni-praktyky*
5. *Практика студентів географічного факультету Львівського національного університету імені Івана Франка в Ойцовському національному парку [Електронний ресурс]. – Режим доступу : https://lnu.edu.ua/zavershylas-praktyka-studentiv-heohrafichnoho-fakultetu-v-ojtsovskomu-natsionalnomu-parku/*
6. *Практики студентів кафедри фізичної географії та картографії Харківського національного університету імені В. Н. Каразіна [Електронний ресурс]. – Режим доступу : https://physgeo.univer.kharkov.ua/education/practice/*
7. *Прасул Ю. Досвід організації ґрунтознавчо-біогеографічного розділу навчальної природничо-наукової практики студентів-географів / Ю. Прасул, О. Сінна // Проблеми безперервної географічної освіти і картографії. – Харків : ХНУ імені В.Н. Каразіна, 2016. – Вип. 24. – С. 91–95.*
8. *Проєкт «Товтрова стежка. Дністровська ділянка»: від теорії до практичної реалізації [Електронний ресурс]. – Режим доступу : https://meridian.kpnu.edu.ua/2020/07/30/proiekt-tovtrova-stezhka-dnistrovska-dilianka-vid-teorii-do-praktychnoi-realizatsii/*
9. *Bârliba F. C. The Advantages of Using Mobile GIS Technology / F. C. Bârliba, I. C. Cheorghescu, A. Moscouici // Research Journal of Agricultural Sciences. – 2017. – Vol. 49 (4). – P. 20–28.*
10. *Department of Geography of National University of Singapore [Електронний ресурс]. – Режим доступу : https://fass.nus.edu.sg/geog/*
11. *Department of Geography of Tokyo Metropolitan University [Електронний ресурс]. – Режим доступу : https://www.ues.tmu.ac.jp/geog/en/index.html*
12. *Dodd M. Where Are My Quadrats? Positional Accuracy In Fieldwork / M. Dodd // Methods in Ecology and Evolution. – 2011. – Vol. 2 (6). – P. 576–584. DOI: https://doi.org/10.1111/j.2041-210X.2011.00118.x*
13. *ESRI. ArcGIS Collector. [Електронний ресурс]. – Режим доступу : https://www.esri.com/en-us/arcgis/products/arcgis-collector/resources*
14. *Field programs of Department of Geography of University of Calgary [Електронний ресурс]. – Режим доступу : https://arts.ucalgary.ca/geography/current-students/undergraduate/field-programs*
15. *GIS for Data Collection // Field Studies Council. – Режим доступу : https://www.field-studies-council.org/resources/16-18-geography/gis/gis-for-data-collection/*
16. *Huang Q. Programming of Mobile GIS Applications [Електронний ресурс] / Q. Huang // The Geographic Information Science & Technology Body of Knowledge (1st Quarter 2020 Edition), John P. Wilson (ed.). – 2019. – Режим доступу : https://gistbok.ucgis.org/bok-topics/programming-mobile-gis-applications DOI: https://doi.org/10.22224/gistbok/2020.1.2*
17. *Jolma A. Free and Open Source Geospatial Tools for Environmental Modeling and Management / A. Jolma, D. P. Ames, N. Horning et al. // Developments in Integrated Environmental Assessment. – Vol. 3. – Elsevier, 2008. – P. 163–180. DOI: https://doi.org/10.1016/S1574-101X(08)00610-8*
18. *Marra W. A. Using GIS in an Earth Sciences Field Course for Quantitative Exploration, Data Management and Digital Mapping / W. A. Marra, L. Grint, K. Alberti, D. Karssenberg // Journal of Geography in Higher Education. – 2017. – Vol. 41 (2). – P. 213–229. DOI: https://doi.org/10.1080/03098265.2017.1291587*
19. *Nowak M. M. Mobile GIS Applications for Environmental Field Surveys: A State of the Art / M. M. Nowak, K. Dziób,Ł. Ludwisiak, J. Chmiel // Global Ecology and Conservation. – 2020. – Vol. 23. DOI: https://doi.org/10.1016/j.gecco.2020.e01089*
20. *Pánek J. Gaining a Mobile Sense of Place with Collector for ArcGIS / J. Panek, M. Glass // Journal of Geography in Higher Education. – 2018. – Vol. 42 (4). – P. 603–616. DOI: https://doi.org/10.1080/03098265.2018.1515190*
21. *Vojtek M. Potential of Using Mobile Geoinformation Technologies (GPS/GNSS) in Teaching Geography Students / M. Vojtek, G. Repaska, K. Vilinova, J. Vojteková // Proceedings of the 6th International Conference on Cartography and GIS (Albena, Bulgaria, 13-17 June 2016). – 2016. – Vol. 1. – P. 127–135.*

Authors Contribution: All authors have contributed equally to this work

References

1. *Bodnia, O., Sinna, O., Oliinykov, I., Ovcharenko, A. (2016). Landshaftne kartografuvannya NPP «Slobozhans`ky`j» zasobamy` mobil`ny`x, nastil`ny`x ta veb-dodatkiv ArcGIS [Landscape mapping of national park «Slobozhansky» using mobile, desktop and web applications ArcGIS]. Problems of Continuous Geographic Education and Cartography, 23, 15–21 [in Ukrainian].*
2. *Luniachek, V., Sinna, O., Borysenko, K., Popov, V. (2019). Opty`mizaciya metody`ky` gidrologo-geomorfologichny`x doslidzhen` yak instrumentu formuvannya special`ny`x kompetentnostej suchasnogo faxivcya-geografa [Optimization of the method of hydrological and geomorphological research as an instrument in the formation of a modern geographer`s special competences]. Problems of Continuous Geographic Education and Cartography, 29, 6–16 [in Ukrainian]. DOI: https://doi.org/10.26565/2075-1893-2019-29-01*
3. *Educational natural science practical training of first-year geography students (Gaidary village, Zmiiv district of Kharkiv region) of Department of Physical Geography and Cartography of V. N. Karazin Kharkiv National University. Available at : https://physgeo.univer.kharkov.ua/education/practice/практики-студентів-1-курс/ [in Ukrainian]. – 28.06.2022*
4. *Practical training of Department of Natural and Geographical Sciences of V. Vynnychenko Central Ukrainian State Pedagogical University. Available at : https://www.cuspu.edu.ua/ua/kafedry-heohrafii-ta-heoekolohii/osvitnia-diialnist/praktychna-pidhotovka/navchalni-praktyky [in Ukrainian]. – 28.06.2022*
5. *Practical training of students of Faculty of Geography of Ivan Franko National University of Lviv in Oytsovsky National Park. Available at : https://lnu.edu.ua/zavershylas-praktyka-studentiv-heohrafichnoho-fakultetu-v-ojtsovskomu-natsionalnomu-parku/ [in Ukrainian]. – 28.06.2022*
6. *Practical training of students of Department of Physical Geography and Cartography of V. N. Karazin Kharkiv National University. Available at : https://physgeo.univer.kharkov.ua/education/practice/ [in Ukrainian]. – 28.06.2022*
7. *Prasul, Yu., Sinna, O. (2016). Dosvid organizaciyi g`runtoznavcho-biogeografichnogo rozdilu navchal`noyi pry`rodny`cho-naukovoyi prakty`ky` studentiv-geografiv [Experience in organization of soil science–biogeographical part of educational natural science practical work of students-geographers]. Problems of Continuous Geographic Education and Cartography, 24, 91-95 [in Ukrainian].*
8. *The project «Tovtrova path. Dniester site»: from theory to practical implementation. Available at : https://meridian.kpnu.edu.ua/2020/07/30/proiekt-tovtrova-stezhka-dnistrovska-dilianka-vid-teorii-do-praktychnoi-realizatsii/ [in Ukrainian]. – 28.06.2022*
9. *Bârliba, F. C., Cheorghescu, I. C., Moscouici, A. (2017). The Advantages of Using Mobile GIS Technology. Research Journal of Agricultural Sciences, 49 (4), 20–28.*
10. *Department of Geography of National University of Singapore. Available at : https://fass.nus.edu.sg/geog/ – 28.06.2022*
11. *Department of Geography of Tokyo Metropolitan University. Available at : https://www.ues.tmu.ac.jp/geog/en/index.html – 28.06.2022*
12. *Dodd, M. (2011). Where Are My Quadrats? Positional Accuracy In Fieldwork. Methods in Ecology and Evolution, 2 (6), 576–584. DOI: https://doi.org/10.1111/j.2041-210X.2011.00118.x*
13. *ESRI. ArcGIS Collector. Available at : https://www.esri.com/en-us/arcgis/products/arcgis-collector/resources – 28.06.2022*
14. *Field programs of Department of Geography of University of Calgary. Available at : https://arts.ucalgary.ca/geography/current-students/undergraduate/field-programs – 28.06.2022*
15. *GIS for Data Collection // Field Studies Council. Available at : https://www.field-studies-council.org/resources/16-18-geography/gis/gis-for-data-collection/ – 28.06.2022*
16. *Huang, Q. (2019). Programming of Mobile GIS Applications. The Geographic Information Science & Technology Body of Knowledge (1st Quarter 2020 Edition), John P. Wilson (ed.). Available at : https://gistbok.ucgis.org/bok-topics/programming-mobile-gis-applications – 28.06.2022. DOI: https://doi.org/10.22224/gistbok/2020.1.2*
17. *Jolma, A., Ames, D. P., Horning, N., Mitasova, H., Neteler, M., Racicot, A., Sutton, T. (2008). Free and Open Source Geospatial Tools for Environmental Modelling and Management. Developments in Integrated Environmental Assessment, 3, 163–180. DOI: https://doi.org/10.1016/S1574-101X(08)00610-8*
18. *Marra, W. A., Grint, L., Alberti, K., Karssenberg, D. (2017). Using GIS in an Earth Sciences Field Course for Quantitative Exploration, Data Management and Digital Mapping. Journal of Geography in Higher Education, 41 (2), 213–229. DOI: https://doi.org/10.1080/03098265.2017.1291587*
19. *Nowak, M. M., Dzióbk, K., Ludwisiak, Ł., Chmiel, J. (2020). Mobile GIS Applications for Environmental Field Surveys: A State of the Art. Global Ecology and Conservation, 23. DOI: https://doi.org/10.1016/j.gecco.2020.e01089*
20. *Pánek, J., Glass, M. (2018). Gaining a Mobile Sense of Place with Collector for ArcGIS. Journal of Geography in Higher Education, 42 (4), 603–616. DOI: https://doi.org/10.1080/03098265.2018.1515190*
21. *Vojtek, M., Repaska, G., Vilinova, K., Vojteková, J. (2016). Potential of Using Mobile Geoinformation Technologies (GPS/GNSS) in Teaching Geography Students. Proceedings of the 6th International Conference on Cartography and GIS (Albena, Bulgaria, 13-17 June 2016), 1, 127–135.*

Досвід і перспективи застосування мобільних ГІС для навчальних практик студентів-географів

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Статтю присвячено аналізу досвіду застосування мобільних ГІС для навчальних практик студентів-географів, висвітленню первинних розробок за цим напрямом і перспектив його розвитку на факультеті геології, географії, рекреації і туризму Харківського національного університету імені В. Н. Каразіна. Актуальність цієї теми зумовлена необхідністю визначення особливостей застосування мобільних ГІС-додатків у ході проведення навчальних фізико-географічних практик студентів, а також обґрунтування методики створення електронних форм для польового збору даних. Мобільні ГІС мають низку переваг над традиційними засобами збору первинних даних: висока точність, зручність роботи, удосконалена деталізація атрибутів, автоматизація процесу завантаження результатів польового опису в настільну ГІС. У контексті навчальних практик використання мобільних ГІС дозволяє оптимізувати час на збір даних, сприяє формуванню у студентів-географів картографічної та геоінформаційної компетентностей, опануванню сучасних підходів до організації різних видів польових досліджень. Аналіз досвіду показав, що зарубіжні й вітчизняні університети активно використовують ці застосунки для практичної підготовки студентів. У дослідженні здійснено розробку електронних форм збору польових даних для фізико-географічної частини навчальної природничо-наукової практики студентів 1 курсу спеціальності 106 «Географія» Харківського національного університету імені В. Н. Каразіна. На основі додатку Collector for ArcGIS створено 4 електронні форми: опис ґрунтового розрізу, опис лісового фітоценозу, геолого-геоморфологічні спостереження, гідрологічний пост. Для оптимізації роботи для окремих текстових полів в електронній ГІС-формі створено доменні значення, що дозволяють обирати з випадаючого списку певну географічну характеристику, що відповідає території проведення практики. Перспективами дослідження є збільшення кількості електронних форм для забезпечення потреб усіх розділів практики студентів 1 курсу, що передбачають збір польових даних, та подальша апробація цих форм.

Ключові слова: *мобільні ГІС, польовий збір даних, навчальні практики, підготовка студентів-географів.*

Внесок авторів: всі автори зробили рівний внесок у цю роботу

Надійшла 30 червня 2022 р.
Прийнята 13 жовтня 2022 р.