Information didactic application as a tool for distance geographical education in higher education institutions

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Abstract. Educational information and communication technologies (ICTs) allow the enhancement of the visualization of geographical information by integrating different data formats and technological methods of working with them: numerical and textual data formats, animation, graphics, multimedia files hyper-texts, etc. The usage of ICTs makes the presentation of subject material more understandable and accessible. In the case of distance education, automated test software applications are generally becoming the main means of control and assessment. Automated test software applications use the capabilities of network and multimedia technologies, which affects the efficiency of the survey procedure and the visual clarity of the tasks set in the test questions. The purpose of this article is to present a convenient tool for testing subject knowledge in the form of the information didactic application «Geographical Minimum». The application’s main feature is to facilitate the procedure for monitoring and assessing students’ subject knowledge. The Geographical Minimum application is designed to be used in testing and simulator modes for self-preparation and consolidation of acquired knowledge, etc. The simulator mode is configured separately by adjusting the application code. The application integrates the ability to work with geographical maps and knowledge of geographical nomenclature within the academic disciplines. The didactic application is developed by the methodology of a statistical test system, in which prepared test tasks are offered to the user in a pre-established or random order. The information and communication platform in the case of a test application can be any available device, namely, personal computers, tablets, or smartphones with Internet access. Internet access is necessary to maintain communication and exchange data between participants in the learning process. The application itself is easy to download, and install and can be used offline as well. In general, users are positive about the app «Geographical Minimum» application for diagnosing geographical knowledge is a simple technology that does not require a thorough knowledge of computer programs, and which any teacher, if desired and technically capable, can begin to use in their teaching activities.

Keywords: educational information and communication technologies, ICT, didactic teaching tools, information didactic application «Geographical minimum»

Інформаційний дидактичний застосунок як інструмент дистанційної географічної освіти у закладах вищої освіти

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Анотація. Освітні інформаційно-комунікативні технології (ІКТ) дозволяють посилити візуалізацію предметної географічної інформації за рахунок інтеграції різних форматів даних і технологічних прийомів роботи із ними: числові та текстові формати даних, анимація, графіка, файли мультимедіа та гіпер-тексти тощо. Використання ІКТ робить подачу тематичного матеріалу зрозумілишою і доступнішою. У разі дистанційної освіти автоматизовані тестові програмні додатки взагалі стають основним засобом контролю і оцінювання. Автоматизовані тестові програми використовують можливості мережевих та мультимедійних технологій, що впливають на оперативність процедури опитування та візуальну зрозумілість поставлених задач в тестових питаннях. За мету в даній статті обрано презентацію зручного інструменту перевірки предметних знань у формі інформаційного дидактичного застосунку «Географічний мінімум». Головна особливість застосунку – полегшення процедури моніторингу і проведення оцінювання предметних знань здобувачів освіти. За рахунок технології «Географічний мінімум» розроблено для використання у режимі тестування та режимі тренажеру під час самоопідготовки і закріплення набутих знань тощо. Режим тренажеру окремо налаштовується залежно від фізичної та інтелектуальної готовності учня. Застосунок «Географічний мінімум» використовує для використання у режимі тестування та режимі тренажеру під час самоопідготовки і закріплення набутих знань тощо. Режим тренажеру окремо налаштовується залежно від фізичної та інтелектуальної готовності учня.
Introduction

The challenges of recent years, shaping the directions of development in the education sector, have necessitated the implementation of distance learning and support for the educational process through various information and communication tools. Educational information and communication technologies (ICT) enhance the visualization of subject-specific geographic information by integrating different data formats and technological approaches to working with them. It can be numerical and text data formats, animation, graphics, multimedia files, and hyperlinks, among others. The usage of ICT makes the presentation of thematic material more understandable and accessible. The teaching of geographical disciplines, among other things, fosters spatial thinking in learners, and information and communication tools, through the integration of informational and multimedia technologies, allow the combining of traditional forms of teaching geography with educational innovations. Information and communication tools are beneficial at almost any stage of learners' educational and cognitive activities.

Educational ICT and the processes of their implementation in higher education institutions (HEIs) have been the subject of numerous studies. In particular, the works of Topuzov M., Braslavská O., Roja I., Kanska V., Kansky V., Kryukova Ye., Holuba T., Bolyubash N., Myasnikova T., Tryus Yu., Stepanyuk A., Myronets L., Sheremet I., Husieva H., Vasylenko K., Kukharenko V., Ruiz-Palmero J., Fernández-Labelcote J.M., Sánchez-Rivas E., and others address issues related to the use of computer platforms and mobile devices for distance and blended learning, the implementation of networked multimedia technologies, VR technologies, and overall informatization of the learning process for natural sciences. The study of theoretical and applied developments regarding the use of digital technologies in higher education institutions, both domestic and foreign, indicates that teaching specialized courses using ICT tools ensures quality education, along with adapting it to the individual abilities and opportunities of higher education students.

This article aims to present a convenient tool for assessing subject knowledge in the form of an information didactic application called «Geographical Minimum.» The main feature of the application is to facilitate the monitoring and evaluation of the subject knowledge of education seekers. The validation of the effectiveness and functionality of the didactic application for diagnosing subject knowledge was carried out directly during the academic semesters of 2020-2021 at the Geography Faculty and the Institute of International Relations of Taras Shevchenko National University of Kyiv. The application’s functionality was checked in the form of control testing of current knowledge in groups of education seekers specializing in 103 – Earth Sciences, 014 – Secondary Education (Geography), 106 – Geography, and 291 International Relations, Social Communications, and Regional Studies.

In the didactics of geography, educational-cognitive activity (learning) is considered a combination of the processes of perception, thinking, and memory, along with their functions and consequences. The learning structure has several components, including motivational, content-operational, and control-evaluative. All components of educational-cognitive process are significant didactic elements in organizing educational-cognitive activity. The motivational component of learning geography involves education seekers understanding the goals and tasks of educational-cognitive activity, along with planning the holistic learning process. Motivation for learning determines the whole set of needs and interests that stimulate active cognition. The content-operational component of educational-cognitive activity involves the actualization of knowledge, skills, and abilities necessary for mastering new material (Bondar, 2005; Kamenieva, 2018; Maksymenko, 2013).

An important component of learning geographical disciplines is the control-evaluative component,
aimed at establishing quantitative/qualitative standardised, concise, and time-limited examinations of subject knowledge. Tests, in subject didactics, are considered a method of diagnosing subject-specific geographical disciplines. In this context, test control is a reasonable component in the educational process of teaching geographical disciplines. This component in subject knowledge through controlling the levels of mastery, expressed in feedback on the process of acquiring knowledge and skills of education seekers in surveys and quizzes is the diagnostic function of testing. The creation and implementation of subject tests are based on the availability of convenient tools for quick and objective assessment of samples of surveyed education seekers (Fetisov, 2011; Hurevych, 2013).

It is considered that, in terms of objectivity and speed of diagnosis, tests surpass all other forms of assessing subject knowledge (Kukhareenko, 2016). Systems for assessing subject knowledge that were in place at the time of widespread implementation of distance learning have significant drawbacks, including a conditionally approximate nature, existing subjectivity in evaluation, manual processing of assessment results, routine test preparation, and consequently, low processing speed and return of results, which, overall, can lead to a loss of evaluation objectivity.

Automation of the processes of assessing subject geographical knowledge through the development and implementation of electronic testing programs or systems allows for optimizing the assessment processes and reducing routine in conducting assessments, exams, and interim subject knowledge checks. It automates the processing of obtained results, facilitates and enhances the quality of assessment processes, and ensures objectivity in knowledge assessment (Ruiz-Palmero, 2020; Braslavskva, 2023; Stepaniuk, 2023). In the case of distance education, automated testing applications become the primary means of control and evaluation (Bykov, 2008; Kukhareenko, 2016). It is also worth noting that automated testing programs leverage the capabilities of network and multimedia technologies, influencing the efficiency of the testing procedure and the visual clarity of the tasks presented in the test questions.

Materials and Research Methods

The application «Geographical Minimum» was developed for usage in testing mode and as a simulator during self-preparation and reinforcement of acquired knowledge, etc. The simulator mode is separately configured by adjusting the application’s source code. The application integrates features for working with geographical maps and knowledge of geographical nomenclature within educational disciplines. Initially, the didactic application was developed for monitoring subject knowledge in the study of the physical geography of Europe, Africa, and South America.

The didactic application «Geographical Minimum» was developed according to the methodology of a statistical testing system, where prepared test tasks are presented to the user in a predetermined or random order (Fetisov, 2011). The informational geographic basis for development includes educational materials for preparing the natural conditions and resources of Europe, Africa, and South America (Demianenko S., 2021; Olishevska Yu., 2019, 2020). Nomenclature geographic lists are aligned with the topics and reinforced with physical and geographical maps of world regions. Physical and geographical maps of Europe, Africa, and South America, visualizing the selected geographical information for thematic knowledge control were created by the authors using the desktop mapping tools of the ArcGIS geographic information system, developed and maintained by ESRI, using open spatial data specifically tailored for the test application (Fig. 1).

The informational application for testing subject knowledge was developed using the Object Pascal programming language within the Delphi integrated development environment for rapid application development (RAD) on the Windows operating system. Delphi was chosen for its integrated set of visualization tools for quick program development. RAD Delphi supports the development of user interfaces and connectivity to databases/libraries of visual components (VCL – Visual Component Library), which contain standard objects for building user interfaces, including graphical objects, dialogs, multimedia objects, database management objects, and more. The Delphi programming environment is known for its accessibility in creating interactive electronic forms that operate in the Windows OS (Sydorov M.V.-S., 2012).

The development of software applications in Delphi occurs during the stages of visual construction and algorithmic description of the product. The visual construction stage focuses on building screen forms (Form) by adding necessary components (windows, buttons, active checkers, etc.) using form constructor tools during application design development (configuration/placement of components on the form, label styles, background colors, elements, etc.). The descrip-
tion of the application’s algorithms is stored in a text file, outlining the complete sequence of actions that will occur with the components (buttons, windows, checkers, etc.) of the form. This component in the Delphi environment is called a module (Unit). Typically, each form corresponds to one module: the form creates the interface of the future software application, while the module describes the events that can occur with the components of the form. In the user view, the set of screen forms along with their algorithmic description appears as a set of installers (.exe). The set of installers forms the basis of the «Geographical Minimum» application and includes tools for testing (user installer file) and tools for checking and evaluating current knowledge (checker installer file) (Fig. 2).

Results and analysis

The developed educational application «Geographical Minimum» enables remote knowledge testing during or beyond the study sessions. The information and communication platform for automated diagnostics of geographical nomenclature knowledge in the course of the physical geography of continents and oceans is effective both in remote and traditional formats of the educational process. Any available devices, such as personal computers, tablets, or smartphones with internet access, can serve as the information and communication platform for the test application. Internet access is required for communication and data exchange between participants in the educational process. The application is easy to download, install, and operate in offline mode. The offline mode of the application is advantageous as a training simulator for reinforcing subject knowledge.

Communication and data exchange (results) between participants can occur through email services and social networks such as Telegram or Viber. The information test application is provided in the form of installer files, which can be downloaded and installed on the information and communication platform for operation. The application is user-friendly, easy to understand, and importantly, it provides complete autonomy in assessing knowledge of the physical geography.
of continents and oceans. It allows receiving feedback from students who take the test either during or outside study hours. Using the test application in geography courses for bachelor’s degree programs helps simplify and improve feedback with the group of respondents.

The test itself, which is the educational basis for the electronic application, belongs to criterion-oriented test tasks designed to check specific knowledge and skills of education seekers specified in the working educational programs of disciplines. The test control of students’ knowledge using the «Geographical Minimum» application performs important didactic functions. One of them is the educational-cognitive function, where students mobilize intellectual abilities during preparation for tasks and the test, focusing on their knowledge and skills for their specification and generalization when answering quiz questions – knowledge of the geography of natural objects and phenomena, searching, and spatial localization of certain objects on maps.

Among other didactic functions of the test underlying the «Geographical Minimum» application, the following are noteworthy: educational, upbringing, checking, evaluative, and motivational-orienting. The upbringing didactic function of the test with knowledge of geographical nomenclature lies in the formation of skills to concentrate attention and direct efforts to master the geographical minimum of objects and phenomena characteristic of certain continents, as well as knowledge of the geography of specific parts of the world. In addition, the upbringing didactic function reinforces the motivational-orienting function when creating motivation for improving results in mastering the course. The checking didactic function of the embedded test is realized by checking students’ learning achievements during thematic control and assessment in the educational process of studying the course of the physical geography of continents and oceans. The evaluative function involves determining the assessment of students’ learning achievements by numerical indicators of testing.

Overall, students perceive working with the application positively. Using it during knowledge diagnostics allows them to break away from the routine of questioning and answer questions in a gamified form. The «Geographical Minimum» application for diagnosing geographical knowledge is a simple technology that does not require perfect knowledge of computer programs and can be applied by any teacher, given the desire and technical capabilities, in their pedagogical activities. It’s worth noting that the number of questions can be adjusted, meaning the difficulty level of the test can be changed.

The screen form of visualization of test tasks in the electronic application «Geographical Minimum: Africa» is presented in the figure below (Fig. 3).

The software screen form of the test application, created with the tools of the object-oriented Delphi programming language, includes all the necessary elements for automated control of the testing process (or training):

- A programmed button to start the test.
- A programmed button to proceed to the next task (which also serves as the button to record the system’s specific response in the report).
- Operational window for entering the last name.
- Operational window for task visualizing test question string.
- Operational window for visualizing the test progress – the numerical expression of the test question number.
- A programmed button to center the cartographic image, along with the ability to manipulate with the «mouse» or touchpad device. This allows for convenient movement of map images on the test screen and navigation/search of object geolocations on the map. The «Center» button and the computer manipulator’s cursor «mouse» are used for general navigation during testing (the map can be moved to the desired position by fixing the «mouse» cursor on the screen and dragging the image).
- A programmed button to generate a report; if needed, the last saved report can be generated again.

It is worth noting that when pressing the button to confirm the answer option of the last task in the survey array on the test form, the student automatically receives the survey results in the form of the number of correctly completed tasks (recording the result string in the «STRING» format).

At the end of the test, the student receives a grade in points by generating a report in the test screen form and sending it to the teacher. The exchange of reporting information occurs through postal services or social media chats (especially Telegram, and Viber).

Embedded in the test screen form, the reporting form of the test application «Geographical Minimum» generates a record of the results – «STRING» (Report button) in the form of a separate window in the test application. This record is copied, and the result is sent to the teacher for review and evaluation. The teacher receives the result in the form of a report string – «STRING» (for example, the next line of program code for the result:

```
begin 51810660509695003985539355100615
26150061369818282685882696911021835923213
00583668050698526365695502095219863305290
058952883289010296016445311485311_end_Last-
Name» through the mail/communication service and calculates the result in the program’s control screen «Result» (Fig. 4).

The software control screen in the test application «Geographical Minimum» whose installer (.exe) is available and developed for the examiner, contains separate blocks:
- Screen block of the operating window to insert and read the test report.
- Screen block of the operating window for visualizing the result calculation.

The software control screen for the examiner is also user-friendly and consists of a set of elements to control the form, including:
- Programmed «Paste» button for inserting the sent report string for verification.
- Programmed «Analysis» button to initiate calculation.
- Operational window for visualizing the result.

The verification report window in the «Result» screen form organizes the report in two parts:
- Correct answers – the total number and number of tasks for which correct answers were given.
- Incorrect answers – the total number and number of tasks for which incorrect answers were given.

Fig. 4. General view of the window with a report in the form of a line of results and the form for analyzing test results.
In addition, the report on the results specifies the respondent’s last name, the total duration of the test in minutes, and the start and end times of the test. The test application was piloted during the theoretical training of higher education students at the bachelor’s level in the academic years 2020-2021, 2021-2022, and 2023-2024, with the last one being a year of active military aggression by Russia against Ukraine. In particular, students of the 3rd year of IMW within the discipline «Physical Geography of European and North American Countries» participated in the knowledge assessments (test on the geographical minimum of Europe), students of the 3rd year of IMW within the discipline «Physical Geography of Latin American Countries» took part in the assessments (test on the geographical minimum of South America), and students of the 2nd year of the geographical faculty within the discipline «Physical Geography of Africa, South America, and Antarctica» participated in the assessments (tests on the geographical minimum of Africa, South America). Additionally, students of the 2nd year of the geographical faculty within the discipline «Geography of South America, Africa, and Antarctica» participated in the assessments (tests on the geographical minimum of Africa, and South America). A total of 61 students were surveyed. The average time for completing the test, which consisted of 30 questions each, was 18 minutes. During the tests, 25% of the surveyed students achieved perfect results, answering all questions correctly, while 25% had 1-2 incorrect answers out of 30 questions, and 50% had 6-10 incorrect answers.

Students had the opportunity to provide constructive criticism of the application. All participants in the testing acknowledged the positive features of the test application, such as:
- Ease and clarity of program usage.
- Simplicity of the interface.
- Speed of the test task completion process.
- Utility of the application, and more.

However, students also identified certain drawbacks of the test application, with the most relevant ones being:
- Lack of map scaling capability (ability to zoom in or out on the map).
- Absence of highlighting for the selected object variant (highlighting in a different color).
- The need for additional explanations from the teacher when using the program, and more.

**Conclusions**

The implementation of information and communication technologies in the educational process at the Geographical Faculty of Taras Shevchenko National University, Kyiv finds broad application. Information and communication technologies for teaching at the geographical faculty are used as the means to optimize the educational process in both general geographical disciplines and specialized courses. The automation of the teaching process in fundamental and specialized geographical disciplines can be considered as a modernization of the educational process. In particular, the integration of information and communication technologies into the educational process is a way to enhance the innovation and effectiveness of educational programs at the geographical faculty of Taras Shevchenko National University.

Summarizing the practical experience with the informational testing application for diagnosing geographical knowledge, it is worth noting that the developed test allows for the automation and simplification of control and assessment procedures. This applies to geographical knowledge within the disciplines of the physical geography of continents and oceans cycle. The testing application is effective in terms of time savings and the objectivity of the assessment itself. It is important to highlight that this tool can also be used as a simulator for studying geography. The testing application is a convenient and understandable tool that does not require special technical knowledge for use. The entire functionality of the software application is adapted to the standard capabilities of users’ personal information and communication tools (learning platforms).

**References**

Bilyk, V., Matvienko, O., Zinko, O., Hanushchyn, S., & Vasylenko, K. (2021). Cognitive Technologies in Pedagogical and Natural Science Training for Future Psychologists in Post-Pandemic Education. Post-modern Openings, 12(1Sup1), 323-334. [https://doi.org/10.18662/pov/12.1Sup1/288](https://doi.org/10.18662/pov/12.1Sup1/288)


Braslawska, O., Rozhi, I. (2023). Rol informatiino-komunikatsiinykh tekhnolohii u profesiiini pidhotovtsi mai-


Stepaniuk, A., Myronets, L. (2023). Informatsiini prystroi yak zasoby dystantsiinoho vyvchennia shkolnoho kursu biolohii [Information devices as means of dic-

Sydorov M.V.-S. (2012) Elementy prohramuvannia u sere-
gy.knu.ua/sites/default/files/course/materials/mycourse-
sedelphi.pdf (in Ukrainian)

Topuzov M. O. (2013) Rozrobka zimstiu osvitnikh posluh informatsiynykh tekhnolohii u protsesi realizatsii orh-

анизатсино-економичного механизму информати-
zatsii vyshchoi shkoly [Development of the content of information technology educational services in the process of implementing the organizational and economic mechanism of informatization of the higher school]. Visnyk Kyivskohonatsionalnoho universytetu tekhnolohii ta dyzainu. Kyiv: KNU, 4. 186–190