

# INFORMATION AND COMMUNICATION TECHNOLOGIES IN GEOGRAPHICAL EDUCATION – A NEW CHALLENGE IN CONNECTION WITH THE EDUCATION REFORM IN POLAND

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## Abstract

Information and communication technologies (ICT) are needed at all stages of education. This statement at the beginning of the 21st century is no longer debatable. There is general agreement that access to computers and software will help to increase the preparation of students for life in the information society. In Poland, the progress in this area is dynamic, so we can observe the development of skills enabling the use of mobile devices: a new generation of tablets, smartphones, multibooks, miniprojectors and the latest software. Empirical research confirms the constantly growing importance of ICT in educational practice. A computer, a smartphone or the Internet are important elements of the work of many Polish teachers and students. Thanks to them there is not only easier access to information, but also an increasing hope for more substantive interest in them among teachers and consequently also students. The activities of Polish teachers in the area of more widespread use of ICT are enforced first of all by the provisions of the core curriculum - the ministerial document, which serves as a guideline for the work of teachers in schools.

The aim of the article is to discuss various aspects of the presence of ICT, in particular geoinformation technology and GIS (Geographic Information Systems), in geography education in the context of current challenges related to the educational reform in Poland and the adoption of a new core curriculum in geography for primary and secondary schools.

Keywords: ICT, GIS, Geographic Information Systems, the geoinformation technology, geography education, school, the core curriculum.

## 1 INTRODUCTION

Currently, the biggest challenge for a Polish school may be seen in a contemporary student belonging to the so-called digital generation or net generation (NetGens), who has different opportunities for development than his peers a dozen or a few years ago. Young people are referred to as Net Generation, Millennium Generation, Generacion Y, iGeneration, and in recent years also Generation Z. Students function perfectly in the virtual world, and their successes are determined by completely new skills, alien to their peers years ago. Not only do they listen to different music and watch different films than their teachers, but above all they use different communication tools. "Net-generation" (network generation) is accustomed to many stimuli and bored in the traditional classroom. It is shaped by a culture of image, which influences emotions; the "culture of printed text", which mainly affects the intellect, is increasingly alien to it. Working with such students is a huge challenge for teachers, who are not always properly prepared to use new technologies. Some of them are explicitly referred to in literature as "digital immigrants", unlike students who are called "digital natives" [1]. Young people from the generation of digital natives are more practical than previous generations [2]. That is why schools, taking up these new challenges, introduce information and communication technologies (ICT) into educational practice; ICTs are also more and willingly used by geography teachers.

At the beginning of the 21st century, it is impossible to imagine geography lessons without the use of ICT-based tools and techniques. Many geography teachers use computer equipment, a projector and a multimedia board, use an electronic register; and more and more often use content from various portals and educational platforms during their lessons. The growing importance of information technology in everyday life has led some geography teachers to take action to use ICT in their lessons in order to develop a variety of skills. Certainly, the online teaching supplements to school textbooks,

created on a large scale by competing educational publishers, were of great importance in this respect.

Skills important for functioning in the digital age are also developed by students in the network outside the school [3]. These are: innovation, problem-solving skills, cooperation, communication, active experimentation and the use of the latest information and communication technology (ICT). Therefore, it is also extremely important to prepare teachers to work in schools of the 21st century and with young people of the so-called digital generation, in terms of the above mentioned skills as well as creativity and functioning in a diverse, sometimes multicultural environment [4].

Certainly, for many teachers so far uninterested in ICT or GIS content, they will be a serious challenge in the coming years of implementation of the new core curriculum. The questions that should be asked in this situation are: what is the place of ICT-related content (including GIS tools) in the recently adopted core curriculum in geography?, and: do Polish geography teachers already use ICT in school education and to what extent? Therefore, it is also worth considering the most important challenges faced by Polish teachers.

## **2 METHODOLOGY**

The core curricula in geography were the basic sources analyzed in this study [5], [6]. Other analyzed sources of materials include publications of geography teachers and educators referred to in the literature, who discussed education conducted with the use of ICT in recent years. One of the most important sources of information were studies published in volumes of KEG PTG (works of Geographical Education Commission Polish Geographical Society (e.g. [7], [8]), which reviewed the use of ICT in geography education at different levels of education at the beginning of the 21st century.

Selected publications provide the necessary data, therefore in the qualitative methodology they are referred to as "secondary sources", created in a different place and time than the events described and interpreted here [9]. They are also "public documents", because everyone can access them thanks to their presence on the Internet [10]. The applied method, i.e. the analysis of existing documents, is accompanied by a conviction about the methodological reliability of the conducted exploration of empirical data, interpreted on the basis of theoretical concepts selected adequately to the subject matter being addressed.

## **3 RESULTS**

This chapter presents the results of the analysis of records concerning geoinformation technologies and GIS in the new core curricula of geography. It also includes the results of studies on publications in which the authors undertook research on the use of ICT in geography education in Polish schools.

### **3.1 Geoinformation technologies and GIS in the new core curriculum of geography**

In connection with the reform of the educational system in Poland in 2017, new core curricula were developed [5], [6].

The initial assumption of the core curriculum in geography in both primary and secondary schools is to assume that the main educational goal of geography is to integrate the student's knowledge of the natural environment with socio-economic and humanistic knowledge. The new core curriculum is particularly conducive to the development of skills. Many provisions of the core curriculum oblige students to develop the ability (crucial for understanding the relationship between nature and man) to determine the relationships and dependencies occurring between particular elements of the geographical environment. Other, very important skills, the shaping of which makes it possible to record the new core curriculum, include:

- critical and creative thinking - formulating hypotheses, verifying them and solving problems;
- evaluation and valuation of phenomena, formulation of statements about regularities, making generalizations, anticipation, forecasting.

The new core curriculum also provides a framework for the introduction in geography education of the basics of practical knowledge useful in everyday life [11]. Its provisions are intended to contribute to a deeper understanding of the sense and conditions for the implementation of the principle of sustainable development, inter alia, by learning examples of rational management in the geographical environment, its assessment in the place of residence, sense of responsibility for creating spatial order in the places of one's life.

Special attention in the core curriculum has been paid to the use of information, communication and geoinformation technologies (GIS) in learning about the world, acquisition and creation of spatial data sets, their analysis and presentation. The use of geoinformation technologies and GIS applications definitely expands the student's cognitive sphere, and in connection with selected elements of physical and socio-economic geography makes geography a modern field of knowledge. Provisions concerning geoinformation technologies and GIS are present both in general requirements, i.e. learning outcomes of geography education, as well as in specific requirements - teaching contents (Tab. 1). Geoinformation technologies and GIS are also extensively covered in the description of conditions and methods of implementation, which are an integral part of the new core curriculum. It is worth stressing that in the previous core curriculum there were no such provisions listed under detailed requirements [12].

Table 1. Information technologies and GIS in the core curriculum of geography: from 2017 and 2018.

<p><b>CC 2017</b> <b>Geography</b> primary school</p>	<p>The learning objectives of geography education should be achieved through:</p> <ol style="list-style-type: none"> <li>2) treating maps (including digital maps) as a primary source of information and help to develop geographical thinking skills;</li> <li>3) using information and communication technologies to acquire, collect, analyse and present information about the geographical environment and human activities.</li> </ol>
<p><b>CC 2018</b> <b>Geography</b> postprimary school BASIC CURRICULUM</p>	<p style="text-align: center;"><u>Learning objectives - General requirements</u></p> <p>II. Skills and application of knowledge in practice. Use of plans, physical-geographic and socio-economic maps, photographs, aerial and satellite photographs, drawings, diagrams, charts, statistical data, source texts, <b>information and communication technologies and geoinformation technologies</b> to acquire, process and present geographic information.</p> <hr/> <p style="text-align: center;"><u>Teaching content - Specific requirements</u></p> <p><b>Sources of geographic information, geoinformation technologies and methods of spatial data presentation....</b></p> <p>Student.</p> <ol style="list-style-type: none"> <li>6) <b>demonstrates the usefulness of photography and satellite photographs</b> for obtaining information on the geographical environment and can interpret their content;</li> <li>7) determines geographical coordinates using a <b>GPS receiver</b>;</li> <li>8) gives examples of the use of <b>GIS tools to analyse the spatial diversity of the geographical environment</b>.</li> </ol> <p>VIII. ...Student: uses <b>digital maps</b> available on the Internet in the analysis of the settlement network of selected regions of the world.</p> <p>XIV. Regional diversity of Poland's natural environment.... Student.</p> <ol style="list-style-type: none"> <li>10) using statistical data and <b>GIS application</b>, analyses the state of the environment in Poland and his own region and presents the conclusions drawn from it;</li> </ol> <p>XIV. ...Student:</p> <ol style="list-style-type: none"> <li>14) plans, together with other students, the route of the trip taking into account selected groups of tourist attractions in the town or region, and implements it in the field, using a map and a <b>GPS receiver</b>.</li> </ol>

<p><b>CC 2018</b> <b>Geography</b> postprimary school <b>EXTENDED CURRICULUM</b></p>	<p style="text-align: center;"><u>Learning objectives - General requirements</u></p> <p>I. <u>Geographical knowledge.</u> 4. Acquaintance with <b>geoinformation tools of geographic data analysis.</b> 5. Understanding the possibilities of using <b>geoinformation technologies</b> in learning about the world and identifying complex problems of the geographical environment.</p> <p>II. <u>Skills and application of knowledge in practice.</u> 3. Drawing basic maps with the <b>use of GIS tools.</b> Use of <b>GIS tools</b> in the analysis and presentation of spatial data.</p>
	<p style="text-align: center;"><u>Teaching content - Specific requirements</u></p> <p>I. Geographic research methods and <b>geoinformation technologies</b>: interviews, surveys, analysis of cartographic sources, <b>use of information, communication and geoinformation technologies to acquire, create collections, analyse and present spatial data.</b> Student.</p> <p>3) uses selected cartographic methods for the presentation of quantitative and qualitative characteristics of the geographical environment and their analysis with the <b>use of GIS tools</b>;</p> <p>4) <b>uses a GPS receiver</b> for documentation of observations;</p> <p>5) uses <b>information, communication and geoinformation technologies</b> to acquire, store, process and present geographical information;</p> <p>V. Dynamics of geological and geomorphological processes... Student.</p> <p>8) sees regularities in the distribution of geological phenomena and processes on Earth, using <b>geoinformation technologies.</b></p> <p>XV. Socio-cultural diversity of Poland.... Student:</p> <p>8) analyzes the spatial differentiation of electoral preferences of Poles, using <b>geoinformation technologies</b> and discusses the reasons for this differentiation;</p> <p>XVI. Elements of geographical space and relations between them in their own region - research and field observations. Student.</p> <p>4) on the basis of observations and available source materials (e.g. local zoning plan, <b>geoportal, satellite images</b>) distinguishes the main functions and assesses the use of the land around the school;</p> <p>5) using GUS data and <b>GIS tools</b>, analyses the structure of agricultural land use in rural areas or built-up and urbanized land in the urban areas of its own region;</p> <p>XVIII. Environmental problems of the modern world.... Student:</p> <p>6) uses satellite and aerial photographs <b>and geoinformation technologies to locate and determine the extent of natural disasters.</b></p>

Sources: [5],[6].

On the other hand, in the guidelines to the implementation of the core curriculum in geography, one can read that a special role is assigned in postprimary school to the use of geoinformation technologies (including GIS) in learning about the world and detecting complex problems of the geographical environment. The use of geoinformation technologies and GIS applications makes geography a modern discipline and definitely expands the student's cognitive potential. The skills developed through the use of geoinformation technologies are: searching for selected locations on the map, searching for data and information in geoportals, retrieving information and documents from various sources, using the map (map navigation), analysis of aerial and satellite photographs, evaluation of the topicality and reliability of data, use of applications from Internet resources, determining connections and coexistence in space and the use of the information and data obtained to prepare a multimedia presentation.

### 3.2 Use of ICT by geography teachers

Research on the use of ICT and GIS applications in geography education confirms that geography teachers use these technologies, although practices are not as common as one would expect. The use of new media and geoinformation technologies by geography teachers has not radically changed the ways in which they conduct lessons, although it has also had an impact on the experience of their didactic and educational competences [13].

It turns out that a significant part of teachers have access to computers or multimedia equipment, but they are not able to use it. As reported by [14], the results of an on-line survey conducted by the Ministry of Education in 2012 among 5716 teachers, indicated their readiness to use ICT and their belief in the need to use e-textbooks in the didactic process. For the majority, it would be an additional tool, complementing traditional textbooks; 15.6% of the teachers surveyed said that they were well prepared to use them, so that they did not need training or instructions to use e-textbooks. Only eight teachers said that they would not use modern technologies. Most of the teachers participating in these surveys were already operating in the digital world and were using platforms offering open educational resources, such as Scholaris. For 60% of teachers, they were an everyday work tool, and only 3% did not use them at all [14].

All-Poland surveys conducted among geography teachers working in public secondary schools show that 92% of the respondents use the Internet as a source of information for lessons, and 87% of the respondents were able to indicate reliable and up-to-date Internet sources of geographic information to the student. The use of the PowerPoint presentation package is very popular; the software is used to prepare multimedia presentations. Nearly 80% of respondents prepared lesson materials in this form on their own, more than 70% reproduced ready-made presentations downloaded from the Internet during classes. Excel, a computational and graphical program, is also quite a common tool, with the help of which teachers prepared compilations of numerical material, mainly in the form of graphs, diagrams, etc., used to supplement the content of geography lessons with visual data. This programme was used by 51% of the respondents. Nearly half of the teachers used free and publicly available software for creating tests in their practice. About 42% of the respondents had an interactive whiteboard in their classrooms, which was used during the lessons. Nearly 32% of teachers used the educational platform Librus, an important element of which is, among others, the electronic register. Although the platform offers many opportunities to use it in the educational process, it is mostly used as a tool to support the organization of school work (grading, attendance calculation, communication with parents) [15].

The use of GIS tools is an important element of the work of a geography teacher. The vast majority of geography teachers agree that the introduction of GIS in schools would bring many benefits for students as well as the status of school's geography. The impact of GIS on increasing motivation to learn and develop spatial thinking skills is stressed. At the same time, many studies confirm the existence of numerous barriers to the implementation of GIS in school geography education. The most important of these are the lack of appropriate teachers' competences and low motivation to expand them, the lack of publications containing lesson plans integrated into the current core curriculum and using GIS, and the lack of time in the core curriculum allocated for teachers to teach students about GIS tools [16]. Teachers need support in the form of publications and training offered by academic centres, publishing houses, educational institutions or companies producing and implementing Geographical Information Systems. A properly prepared offer addressed to teachers would be an incentive for teachers to develop their competences. The aforementioned research conducted in secondary schools shows that 32% of the geography teachers surveyed use Geographical Information Systems (GIS) [15]. The EduGIS Academy Project implemented in Poland is probably the main factor that influenced the dissemination of GIS technology in teaching to date; the project aims at the popularization of the use of geoinformation technologies in teaching natural sciences in middle schools and secondary schools. The EduGIS Academy Internet platform offers, among others, ready-made scenarios of geography and nature lessons using GIS. External entities - software producers offering various GIS products and implementing educational projects addressed to schools, such as ESRI Polska [17] – are also actively involved in promoting the use of GIS in the education of children and young people. However, in the research conducted by the Łódź centre [18], students expressed doubts about the impact of the application of GIS on a better understanding of the problems under consideration. Students signalled that e.g. using Quantum GIS causes them significant difficulties and without clear instructions from the teacher they would not be able to solve the problems on their own. In recent years, a free manual for beginners of Quantum GIS open source software [19] has appeared on the Internet. Thus, the barrier of GIS software purchase costs and training in its use should be eliminated.

Among the teachers surveyed, 31% used public websites addressed to teachers. Popular websites publish both factual and methodological materials for teaching, as well as formal and organisational information concerning the functioning of the school system. Nearly 25% of the respondents used the MOODLE online educational platform, but mainly for self-education purposes, as it contains training materials for teachers and examiners, as well as information on external exams. However, as a tool for working with students, the platform is used occasionally [15].

Only about 25% of teachers used computer programs in their educational work. Multimedia packages and programs offered by school publishers constituted the basic help used by the respondents. These materials are available to those teachers who use textbooks of particular publications. This is a form of support for loyal teachers and an additional incentive to choose the textbooks of a particular publishing house. Some teachers also used multimedia programs received within the framework of educational projects implemented by various institutions, e.g. the nationwide project "Nature in a secondary school", financed from EU funds. Only a small part of the respondents used multimedia tools independently selected from a wide market offer. These were mainly atlases and multimedia encyclopaedias, interactive maps and charts. Slightly more than 13% of teachers used graphics software to prepare lesson material. The most popular of them were: Corel DRAW, Paint, Photoshop, and Irfan View. The most common application of graphic programs was the processing of photographs and ready-made drawings, only in sporadic cases teachers created their own graphic designs for lessons, e.g. maps or diagrams.

Only a dozen or so out of 300 teachers surveyed applied in practice the e-learning method at a very basic level, with the use of non-specialist tools. For example, tasks for students and teaching materials were sent by the teacher via e-mail. Few respondents used e-learning platforms in distance learning [15].

When asked about the availability of ICT during teaching, 70% of the respondents answered that they had very good access, 25% had limited access, and 5% did not have access to ICTs during teaching at all. The main reasons for the restrictions were: lack of equipment, lack of Internet access or inefficient connection, limited access computer suites (e.g. once a week or even only once a month) and other multimedia equipment (projectors, interactive whiteboards, television sets), outdated, inefficient computer software. Some teachers used their own computer equipment during the lessons because the schools did not provide sufficient equipment [15].

The results of research on the effectiveness of ICT use in geography education offer interesting insights. Observations of computer-aided learning allow us to notice its significant impact on increasing the effectiveness of the process of teaching - learning geography. Students who worked with computer software achieved on average 10% higher results in relation to their peers learning with traditional methods. It was found that the use of computers increases the degree of understanding of concepts, terms and explaining geographical theories by more than 16%; the degree of mastery of substantive (formal) skills by 22%; and the degree of mastery of cognitive skills and the ability to value by as much as 69%. What is important, it has been proven that computer-aided learning is more effective in teaching skills than in the case of knowledge. On the other hand, the use of an interactive whiteboard and a multimedia projector during lessons has a positive impact on educational effectiveness in relation to learning objectives, especially in the area of the skills taught [20].

Research on the use of the Internet and multimedia, conducted in middle schools and primary schools, yielded similar results to those mentioned above. The positive impact of new technologies on the process of learning through, among others, the use of the Internet and multimedia was found to be positive: faster acquisition of knowledge by students, better understanding of difficult issues, variety of lessons, arousing interest and involvement of students in the course of the lesson, stimulating activity of students, e.g. while performing tasks on an interactive board, encouraging learning, increasing interest in geography as a science, as well as acting on imagination, developing creative thinking and creativity of students and developing the ability to use and select source materials [21].

Educational platforms are a tool supporting a teacher who uses ICT in working with students. One of them is Edmodo - a widely available social networking medium, popular in many countries. Due to its accessibility, safety of use and attractiveness for students, its advantages far outweigh the few disadvantages, therefore it should be more widely used by geography teachers. The use of Edmodo is conducive to better evaluation of work by the teacher than traditional teaching [22].

The authors are convinced that e-learning teaching and e-learning education will also be applicable to a greater extent than before [23].

### **3.3 New challenges for geography teachers**

The core curriculum of geography, taking into account GIS and geoinformation technologies to such a large extent, enforces a new quality of education. Certainly, in the initial period, the introduction of new content will be a very big challenge for geography teachers. Perhaps it will also require them to upgrade their own education at courses or postgraduate studies. However, in accordance with the

idea of lifelong learning (LLL), this constant improvement and updating of both knowledge and methodological approaches is inscribed in the teaching profession. Changes in the core curriculum may also contribute to the personal development of teachers, forcing them to some extent to improve their skills in searching for ways to learn about and explore the geographical environment. New technological tools and digital products, which can be used by teachers in teaching, should facilitate cognition, as well as make it possible to see the content which they pass on to students, and improve understanding of phenomena and processes taking place in the environment at different spatial scales.

This improvement is possible through participation in various workshops, courses, postgraduate studies. Regardless of the above, success in the implementation of the assumptions and provisions of the core curriculum depends on the willingness of each teacher to improve and upgrade their own education, which can be additionally augmented by legal documents.

#### 4 CONCLUSIONS

The use of ICT, geoinformation technologies and GIS applications makes geography a modern discipline and definitely expands the student's cognitive potential. For many geography teachers, the core curriculum content in this area poses a new challenge as they have to make an effort to supplement their knowledge and to acquire or improve skills useful for conveying this content to students. The ability to use modern information and communication technologies, including search for and use of information, included in the core curriculum of geography is considered by the authors of the core curriculum as one of the most important challenges faced by the student and teacher. Introducing these issues to the objectives and content of the core curriculum of geography – as a mandatory provision - will make it possible, more fully than before, to adapt geography education to the challenges of civilizational and technological development of the 21st century.

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