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GIS IN POLISH HIGHER EDUCATION – A DISCUSSION

GIS W POLSKIEJ EDUKACJI WYŻSZEJ – DYSKUSJA

For more than 20 years attempts have been made to implement the general Geographic Information Systems (GIS) into the system of higher education in Poland. Initially, these were isolated subjects – mainly in the case fields of geography, surveying, military studies, natural sciences, and later spatial management studies, and humanities. They attracted growing interest of students. In the next stage, specializations emerged to offer more teaching hours dedicated to the GIS – the state of geoinformation education in the first decade of the 21st century was presented in the *Annals of Geomatics* (Gaździcki, 2009). At that time, their authors used various names for the new specializations, such as geoinformation, geoinformatics or geomatics. The students received titles appropriate for the major they graduated, e.g. a master's degree in geography with a specialisation in geographic information systems at the Jagiellonian University, geoinformatics and remote sensing or cartography at the University of Warsaw (UW), geoinformation at the Adam Mickiewicz University in Poznan (Kozak, Werner, Zwoliński 2009), geomatics at the Academy of Mining and Metallurgy (AGH) in Krakow (Eckes 2009), geoinformation and mobile technologies at the University of Gdansk (UG) (Stępnowski, Moszyński 2009), geoinformatics at the Technical University of Wrocław (Błachowski, Woźniak 2009). The development process of education in this regard could be seen in most state universities in Poland, both at universities and technical colleges. Each sought its own path of development. After some time, the first original curricula were created, though they were not always accepted and launched right away, as was the case with prof. A. Stateczny's project at the Maritime University in Szczecin (Stateczny 2009). Educators involved in geoinformation discussed the need for a new major at conferences and in literature (Gaździcki 2009). Sometimes, as in the case of geographical courses in Polish universities,

a circle of enthusiasts from various schools: the Adam Mickiewicz University of Poznan, the Jagiellonian University (UJ) in Krakow, the Gdansk University, the University of Lodz, the Warsaw University, the University of Nicolaus Copernicus in Torun, the Maria Skłodowska-Curie University (UMCS) in Lublin met several times in 2009 to lobby for the creation of a new training course.

There was no real wider acceptance from the scientific community and authorities for this kind of action. The main fear was competition in an ever-shrinking students' market. The first enrolment process for first degree studies in the field directly related to the GIS was launched in 2012. New courses had various names: geoinformation at the University of Lodz and the Adam Mickiewicz University (UAM) in Poznan, environmental geoinformation at the University of Nicolaus Copernicus, geoinformatics at the Warsaw Technical University and the Maria Skłodowska-Curie University in Lublin. In 2015, admissions for second degree studies were launched in the field of geoinformation at the University of Lodz (UL), while other universities started numerous specializations in the course of master's degree studies related to the GIS.

The time has come to gather a wider group to discuss the current state of geoinformation education in Poland, to share experience, doubts, and plan our future actions. The tasks of organising the conference entitled the GIS in Education were undertaken by a team from the Department of Geoinformation of the Faculty of Geographical Sciences at the University of Lodz, which acquired the Norwegian FSS funds for the implementation of a graduate course and the meeting of educators included in that project¹. We were invited to the Department of Geoinformation of the Institute of Geoecology and Geoinformation at the UAM. The conference was held on 3-4 June 2015 in the hospitable halls of the Department of Geography and Geology at the Adam Mickiewicz University in Poznan. Representatives from state universities who taught geoinformation-related courses were invited. It was organised under the patronage of the legend of Polish geoinformation, the chairman of the Polish Association for Spatial Information, prof. Jerzy Gaździcki. 70 participants represented most state universities in Poland that had launched geoinformation training courses and had a lasting impact on the development of that discipline.

¹ Geographic Information Systems (GIS) – integration of environmental and climatic aspects as an important factor in economic development and the quality of life – innovative MA studies as co-funded by the Norwegian EEA funds coming from Iceland, Liechtenstein and Norway as well as national funds.

They included (in an alphabetical order, including the abbreviation of the names of universities): prof. Krzysztof Będkowski Warsaw University of Life Sciences (SGGW), prof. Stanisław Białousz Warsaw University of Technology (PW), prof. Elżbieta Bielecka Military University of Technology in Warsaw (WAT), prof. Konrad Eckes University of Science and Technology (AGH), dr Leszek Gawrysiak Maria Curie-Skłodowska University in Lublin (UMCS), prof. Iwona Jażdżewska University of Łódź (UŁ), prof. Andrzej Kostrzewski Adam Mickiewicz University in Poznań (UAM), Prof. Grzegorz Kowalewski (UAM), prof. Jacek Kozak Jagiellonian University (UJ), prof. Elżbieta Lewandowicz University of Warmia and Mazury in Olsztyn (UWM), prof. Katarzyna Osińska-Skotak Warsaw University of Technology (PW), prof. Iwona Piotrowska (UAM), prof. A. Stateczny Maritime University of Szczecin (AM), prof. Bogumił Szady Catholic University of Lublin (KUL), dr inż. Przemysław Tymków University of Life Sciences in Wrocław, prof. Piotr Wężyk University of Agriculture in Kraków (UP), prof. Jacek Urbański University of Gdańsk (UG), prof. Piotr Werner University of Warsaw (UW), prof. Zbigniew Zwoliński (UAM). Eight papers and 40 posters were presented during the meeting. A lot of time was devoted to the discussion, during which participants had the opportunity to exchange experience, comments, and ask questions. Statements referred to general issues such as various points of view in respect of the GIS, represented by the participants in the conference and the information society, especially the new generation which easily uses modern information methods and technologies, including the GIS.

The participant still found relevance in the question posed in 1997 by Wright D.J., Goodchild M.F., Proctor J.D. if geoinformation was a separate field of the GIS Science, with its own methodological and methodical foundations, and if so, which group of sciences it might be incorporated into – geographical, computer or others?

Special attention was paid to the aspects of teaching geoinformation at various types of universities and during training courses in Poland. The market of universities that offer the GIS is growing. The difference between education at universities and technical colleges as well as the differences between the GIS training courses, such as geography, surveying, spatial management, history, and geoinformation, geoinformatics or geomatics, were pointed out. The number of people admitted to universities is steadily decreasing (due to the demographic decline 20 years ago). That has resulted in the fierce competition for students among universities. The meeting of such a large group of academic teachers involved in

teaching geoinformation in Poland may start co-operation efforts among universities at various levels.

Students participating in the discussion presented their expectations and professional competences they may gain from the geoinformation studies. Do curricula match up with the standards of professional competence and the job market, can we consider these qualifications recognisable internationally? The need to define the typical levels of the GIS-related jobs was expressed (they are present in the US), so that students may seek employment abroad.

The labour market for the geoinformation graduates is diverse, so notes and examples of institutions/employers we educate our students for were exchanged. Participants discussed the needs of the labour market not only in Poland but also in Europe and in other continents. There was a proposal for tracking the professional careers of the geoinformation graduates in Poland and abroad.

The meeting of the geoinformation enthusiasts also resulted in other numerous proposals that the education process could benefit from. Many proposals concerning the future were presented in relation to:

- the need for developing the teaching staff;
- the need for more textbooks and the need to share not only the scientific but also educational achievements;
- the proposal for creating an association of universities teaching the geoinformation;
- providing opportunities for foreign students, e.g. a common course, a common GIS e-learning;
- linking the educational process with the implementation of the geoinformation projects in the region;
- development of the geoinformation with the such issues as the Building Information Modelling (BIM) systems;
- pressure from various scientific communities to recognise textbooks as a part of scientific achievements;
- spreading the discussion to such institutions as the National Science Centre, relevant departments of the Ministry of Science and Higher Education;
- promotion of the GIS among the general public;
- the inclusion of secondary school teachers in the discussion;
- cyclic GIS Education conference.

The discussion was extremely lively and touched both the current problems faced by the debaters and the tasks awaiting them in the future. For this reason, it is worth quoting – chronologically.

E. BIELECKA – problems of teaching the GIS in the field of geography and creating opportunities for students to find interesting jobs, as raised by prof. Werner, also apply to surveyors. Both disciplines have many graduates, with not all of them working in their learned profession. The knowledge on the GIS undoubtedly gives them this opportunity. However, I disagree with prof. Werner that algorithmisation and programming should be taught in the field of surveying or geography. I think that it should be tackled by IT specialists because we (i.e. surveyors and geographers) use ready-made tools, programs and applications. We should realise, however, how much the GIS needs IT.

P. WERNER – *ad vocem* I want to explain – how scientific research is conducted in the field of geography – I propose a certain methodology of solving a given spatial problem. It may involve a combination of two known methods that have not been combined before. When I send a paper to a renowned international journal, I receive a completely negative review, saying this or that is not correct. And what is that? This is creating an algorithm, I de facto translate this algorithm into a tool system in the Geographic Information System, e.g. as a macro. This is my algorithm. Even the disclosure of steps of known methods and creating a macro out of it is an algorithm.

Geographers may also use their knowledge to design algorithms and tools for the geoinformatics. One example of this would be the innovative choice of certain methods that when combined form a sequence of the GIS software that functions as a subprogram (application, such as the Model Builder ARCGIS). That is the way, in which new functionalities and new algorithms are created. This makes a sequence of actions forming a macro in a scripting language becoming an algorithm.

E. BIELECKA – In this perspective, I agree with you.

J. URBANSKI – I absolutely do not agree with the Professor as the practice shows that most of the tools that we use, those various routines, models, plug-ins have not been created by programmers – with their help at the most – they have been developed by geologists, climatologists, not in Poland, but that's a fact. The programmer is very useful and may turn a given

algorithm into a much more efficient program that may run faster but the core of that problem is in a given field and specialisation of science.

J. GAŹDZICKI – which means that we operate in an interdisciplinary field, in which experts from various fields co-operate.

P. TYMKÓW – I am a trained surveyor and computer scientist. After hearing the presentations and discussions I have a few thoughts: firstly, I feel that the GIS and geoinformatics are treated equally. Secondly, I cannot agree with the prof. Zbigniew Zwoliński that the geoinformation belongs to geographic sciences, the social and economic ones, without mentioning technical sciences. For me as a surveyor and computer scientist this centre of gravity shifts towards technical sciences. In addition, the GIS – as considered in the world – is a science in itself. Finally, let me add one more thing about the specializations that combine various fields. I have heard a hurtful opinion from employers – “Who is a geoinformatics specialist? He’s like a guinea pig – neither a pig, nor from Guinea.” We can discuss this sentence – it may be a computer scientist or a geographer with programming skills, or a surveyor.

J. URBAŃSKI – I’d like to cite someone else’s opinion, the essence of an article published in Nature in 2004, which described the new dynamically growing field called geotechnology by means of a simple sentence stating that geotechnology “is the GIS plus the Remote Sensing plus the GPS”. For me as a scientist, an article appearing in such an important journal is something, on which I can basically refer to.

B. SZADY – as a historian, I would like to appeal to the classical understanding of science, which requires the formulation of the object, aspect, purpose and method – I find it very difficult to define clearly what is studied in the geoinformation.

S. BIAŁOUSZ – there are about 50-150 definitions of the GIS, the problem is that the translation of the English term into the Polish language, the word by word as the Geographic Information Systems, is fundamentally erroneous. What does this error in the GIS involve? At the first lecture, I explain to my students that the word Geographic in the definition of the GIS should not be associated with the discipline of geography but with all data and information located in the geographical space. And all those who deal with anything in the geographic space use these tools and are in this area. I think it has been very wrong that the GIS has been translated so literally, the word for word.

ZB. ZWOLIŃSKI – in my opinion, in order for the geoinformation to be recognised as a scientific discipline, it must meet three conditions: have its own object of study, its own research workshop and concrete practical applications. When it comes to the object of its study, the answer is very simple: the globe, all issues that concern the world that surrounds us, when it comes to the research workshop these are geographic information systems as tools and the application – in this group no one questions the applicability of the geoinformation.

J. GAŹDZICKI – we should bear in mind who it is that we want to teach, users of the geoinformation, creators of information or the managers of these resources that comprise spatial information. We should say it clearly, when we start our teaching.

J. GAŹDZICKI – after hearing the presentations from prof. E. Bielecka and prof. A. Stateczny, I would like to highlight a few important conclusions of these immensely interesting presentations. First – the need, even the necessity, pointed out by prof. E. Bielecka to improve the teaching personnel as the progress is so huge and the GIS technologies are changing so quickly that if the personnel “oversleep”, this teaching will be at risk. Second – the interrelation between the teaching process and the implementation of big-ticket geoinformation projects in the region, mentioned by prof. A. Stateczny of the Maritime University of Szczecin. In addition, it is important to adapt the curriculum to the standards of professional competence and the job market for graduates. If they acquire qualifications that authorise them to perform certain professional activities, their position in the labour market will improve accordingly.

I. JAŹDZEWSKA – we should pay attention to the need to develop a larger number of textbooks as well as the need to not only share our scientific but also teaching experience (with respect to copyrights, of course). Preparing a training course at a high level, with Polish examples, is time-consuming and we should use the experience of other educators, such as the good examples of prof. J. Urbański and prof. S. Białousz. Some GIS subjects have the same scope and we should not waste any time “walking in place”. Educational co-operation will be beneficial for both academic staff and students.

K. OSIŃSKA-SKOTAK – in my opinion there is no significant difference between education in universities of different types, e.g. universities and technical colleges. The basics are always the same, only the emphasis on certain elements is different. For example, prof. K. Eckes of AGH talked about the

level of detailing, accuracy and precision that guides surveyors, and there are also standardisation, formalisms, to which surveyors attach great importance but the teaching process is similar. It is commonly claimed, too, that geodesy only involves data acquisition and surveyors do not analyse or process any data. Professor, let me disagree with that opinion, surveyors also have to process and analyse data as it is the case at universities, they just focus on the technological aspects. The second thing that was highlighted in the discussion was the competition among universities – the thinking that we have to teach geoinformatics/geoinformation, unless others take that from us. If we keep thinking that way, every educator will have to start learning certain things from scratch – things that are already done and well-known. If a variety of teams fail to co-operate, we will not quickly gain this foreground knowledge.

J. KOZAK – we are aware that we should co-operate and exchange experience but we are also rivals when it comes to students, especially at a time when their numbers in Poland are significantly reduced. All the more deserving is the praise for the initiator of that meeting. I think the fact that we have met, we are talking and exchanging our experience, and opening to new ideas is of great value. Recall what prof. J. Gaździcki said about there being a difference between producing data and using it. I do not fully agree with the previous speaker, that both (universities, universities of natural sciences and technical universities) do the same thing. There is, however, a division between technical colleges that acquire and create data and the universities that try to use the data in various fields. It seems to me that this division is essential but also differentiating. Of course, we also learn data acquisition at the universities but the main emphasis is put on using the data for various environmental analyses that interest us as scientists. This is the issue that the “GIS in science”, that has just been organised for the fourth time in Poland, is devoted to. As a voice in the debate, I would like to add that I see a difference and that there are certain spheres of influence that we somehow share among ourselves in order not to step on one another’s toes. The division may not be strictly defined but it seems to me that it is nevertheless present.

K. OSIŃSKA-SKOTAK – I do not entirely agree with this statement, although as far as surveying and cartography are concerned I agree but there are also other training courses in technical universities, such as those related to environmental protection or transport, where data is not only acquired but also processed, modelled and analysed. I am therefore convinced, that the division is more related to the discipline we are involved in. Indeed,

surveying and cartography is primarily tasked with collecting data but the emphasis in other training courses is put on processing and application.

J. GAŹDZICKI – we should not overemphasise the differences between technical and non-technical universities. These are really secondary divisions. What is important is that we co-operate when we see two markets that we are dealing with. Prof. J. Kozak spoke about the market of students and those who are educating. Of course, we also have the labour market where our graduates end up. It seems to me that we have so far focused on the first one of those, we have been talking and exchanging ideas about how to teach. However, we lack information about what happens to our graduates, the discussion about the labour market. Allow me to appeal to all debaters to consider the problems of the labour market.

P. WERNER – I am very interested in the plans presented by prof. Eckes in the scale of 1:500 scale, especially the related extent of detailing and precision. I have been co-operating for some time, as a part of the spatial management training course at the University of Warsaw, with architects who teach spatial thinking and imagination, trying to tie it with landscaping. I have been talking with them about something that has been developing for a decade all over the world, namely the Building Information Modelling (BIM). This is exactly what the professor said, the difference being that they speak about the concept and standards in architecture that start at the building design stage and last for the whole period of its life – the whole lifespan of the building. I believe that its development will be as dynamic as the one of the GIS, and we should take interest as a part of our spatial management and surveying studies.

G. KOWALEWSKI – I'm happy with this conference, as there are so many various points of view concerning the GIS, not only the geographic one. It seems to me, however, that there is a fundamental difference between technical colleges and universities, and it mainly involves the scale of their studies. Prof. Eckes talked about large-scale maps, and geographers usually deal with a slightly bigger area. Regarding the discussion about employment for the geoinformation students, I would like to point out the need for their presence in institutions of education. Most teachers are graduates from universities that had not been teaching the GIS yet, and they have to deal with a digital generation that was discussed by prof. I. Piotrowska. We are far behind in teaching them to use the GPS, Google Earth, etc. I can see a gigantic role for geographic centres at universities. We need post-graduate training for teachers and future teachers in order

to introduce children into this digital world that is entering their world anyway.

J. URBAŃSKI – I would like to point out that we educate future employees not only for Poland but also the European Union. It seems to me that many of our graduates will be working outside of Poland. Those skilled in the field of the geotechnology will find employment abroad as there is greater demand for them there. I think that the problem arises from a very large diversity of names of specialists we educate. Perhaps it would be a good idea to define the typical levels of professions related to the GIS, that are dubbed in many countries, such as the United States as a GIS technician or a GIS analyst. Should we succeed in determining in a very general, informal, way, what for example a GIS analyst should be able to do, we would make it far more transparent for foreign employers. Let me also call for writing geotechnology textbooks as there are authors of several textbooks in this room but their number in relation to the number of students is scarily low.

J. GAŹDZICKI – I would like to concur with prof. Kowalewski, that we should not be confined exclusively to academic teaching. First of all, we should consider promoting the knowledge and skills to the extent of spatial information. Ladies and gentlemen, this applies to almost the whole society, so this is a gigantic task we have to perform. We have to start with teaching people how to use navigation and find geographic information in the Internet. We need appropriate methodology, materials, and curriculums.

I. PIOTROWSKA – I would like to inform you that the Didactics and Environmental Education Lab UAM is responsible for the implementation of the Educational Module for preparing students to become teachers of geography and nature. It includes subjects called Multimedia in geography and nature education, including the GIS, that were introduced many years ago. The students' task is to design classes for elementary, secondary and high school students held in computer labs using a variety of the GIS software, including free software, available regardless of the financial condition of the school. Should our graduates start teaching after such studies, they will be appropriately prepared to include the GIS and to educate the young, digital generation, whose natural interest in communication and information technologies should be used in the educational process. The civilisation leap is so huge that we should include subjects that emphasise the GIS in the curriculums of other training courses that prepare students to be teachers.

P. ΤΥΜΚÓW – I have an analogy: as far as I am concerned, geoinformation/geoinformatics is like a country set for partition, eyed by a number of powers such as geography, surveying and computer science. Each one introduces its own “green guys” into it in order to take more on one’s own. This has to result in a crisis. I would call for independence.

L. GAWRYSIAK – referring to the discussion on education and the labour market, I would like to point out that as I am analysing the curriculums presented by representatives of other universities, I have the impression – excuse me – that they were written not for the labour market but to find employment for the employees of the university. We have taken a different approach, despite the authorities pressuring us to analyse the labour market not only in Poland as it is pretty stagnant but also in the US and Canada where there is a lot of jobs. We need to instil this in young people. They have to study with an attitude that there is work – not for PLN 1600 (EUR 400), and if need be, they will have to pack up and leave for Ontario or Melbourne.

P. WEŻYK – all in all, I do not know if we are university or technical college as we teach very technical things at the Faculty of Forestry at the University of Agriculture in Krakow. We – in the field of forestry and nature – use the term “Geomatics”. I am glad that there are such interesting voices in the discussion but I would like to tackle a different issue: “what to do to allow students/graduates to migrate among our schools?”, “how do we recognise curriculums, minimums at various universities?”. The labour market – and I have just the opportunity every day to look at it – is changing very rapidly. The current projects assume that we are prepared for everything and have a team of universal people. So let’s give students a chance to be able to change their courses of study. If they need to, let’s say, switch from forestry to geography after two years, let’s make it possible. Let’s not leave them in our splendid aquariums. Moving within study levels in our universities does not solve it. Maybe we should start – as proposed earlier by prof. J. Urbański – to talk about the levels of recognition for our qualifications but in an international context. Let’s provide students from abroad with opportunities to study with us en masse. Let’s create a common training course – a common GIS e-learning. Let’s form an association of universities teaching the GIS, so that we can offer various field of the geoinformation. This is already happening in the world – for example in Sweden one can defend a doctorate in the field of the geoinformation using the Moodle system. This is what the Taiwanese and the Chinese, who come to Sweden to study and still study on-line, do. We should be talking about such matters, so we can beautifully differ in our geodiversity.

E. LEWANDOWICZ – a reference to the discussion about the labor market. We have information that our surveying and cartography graduates as well as the postgraduates pursue their surveying careers, start their own companies and work in administration. The profession also welcomes geographers. My praise to you, teachers in the field of geographic training courses, that you educate the students so well that they find employment in surveying companies. They sometimes are better in navigating the GIS software than the surveyors. The Director of the Department of Surveying and Cartography of the Marshal's Office in Gdansk wanted to hire surveyors to work in the Regional Surveying and Cartographic Documentation Centre, in the Land Information Systems Lab but he hired graduates of geography instead. They had demonstrated a greater ability to work with the GIS applications, they had been better. Geographers also work in county surveying offices, working on the base map. They learn surveying quickly but they have problems with their careers, they have to improve their educational background in order to gain documents and professional qualifications. Our surveying and cartography graduates as well as geography graduates work together in various companies, such as TomTom which creates navigation applications. We are teachers from a variety of universities and our graduates meet at work and work together.

S. BIAŁOUSZ – I would like to share with you the experience of teaching in the field of the land management and administration. At the Cardinal St. Wyszynski University a new e-government specialization was opened. I was invited there to lecture the geoinformation for 15 hours and conduct the same number of classes. What can be taught in such a short time, especially without access to a lab? Lectures were conducted in the traditional manner. I also presented to the students, by changing some classes into the lecture, an overview of maps, from a 1:250,000 NATO operations map to the 1:500 base map, an overview of aerial and satellite images useful for the administration as well as a review of thematic maps important in administration. As a part of the classes, following some work on aerial images and chosen maps, I asked the students to visit their municipalities' websites and see how their municipalities are presented there. Is there a map next to the mayor's portrait? Then, they were to find the "planning" tab and locate the document called the study of conditions and directions in spatial development, the so-called municipal study. They had to search for the resolution of the City Council approving the study, along with attachments: descriptions and graphics. The text attachment is usually quite long but I told them -read it in its entirety as you live in the municipality and do not know anything about it. Print only what interests you. But print

the whole graphical attachment to the study and see what the municipality proposes for the surrounding of your house. The next task for the students was similar. They had to go to the Local Development Plan website and find the fragments of documents related to the vicinity of their houses and see the designation of the area. Incidentally, we discussed the subsequent steps of the planning process, the role that spatial data plays and the opportunities for citizen participation in the planning process. The next class involved working with a geoportal. I told the students: go to the geoportal.gov.pl, open ortho layers of the land registry, zoom in until you can see your plot with a number and print it. Then open the Topo tab where the BDOT is located, not the topographic map. Zoom in on the map until the number of your house appears. Print this image, go out into the street and check if the numbers are correct. The students were very interested in this form of classes, they brought beautiful prints. They got closer to the municipality they lived in. It turned out that they did not know that such documents were readily available to the residents and useful for the administration. Therefore I encourage those of you who have smaller numbers of classes to conduct them in this way.

K. BĘDKOWSKI – allow me to refer to the natural curiosity of children and youths, their strive to learn about the world. This example comes from India where a large monitor, a computer and a mouse was installed in a town that had not learned about computers yet. A few months later results were checked. And what happened? Local children got to know the operation of the computer. When asked if there was something they needed help with, they answered that the computer could use a better mouse and a faster CPU. It was a prelude to my thought. It seems to me that we – the teachers – will fall behind the technological progress but the youths are far quicker in adopting all the latest technological developments which may result in some trouble on our part. I therefore think that we should pursue this direction when teaching: provide students with certain skills and tools, then provide them with some ideas, a problem to solve, so their natural curiosity and the ability of young people to immediately use technical novelties is aimed at solving these problems.

Zb. ZWOLIŃSKI – I think that call for independence of the geoinformation is not necessary because if it was not independent, we would not be here in such numbers. I am convinced that we should focus on complementing each other. When I start an analysis, I don't think about taking a theodolite or a laser scanner and going out in the field. I wonder what the databases look like, what precision and resolution the data has and if none of these databases meet my expectations, then I think how to acquire the

data myself. This artificial division thus stems from the so-called technical and university approach. I would add that one of the UAM geoinformation graduates worked in a VW car factory where he had the task of managing large surfaces inside the buildings for both production and storage. He has been recently promoted and works at the headquarters in Germany where he is doing the same job.

S. BIAŁOUSZ – after our discussion, I have a reflection. We have a very large collection of information on the projects currently being implemented, about education systems, curriculums, etc. In all this variety and institutions responsible for implementing them, there should be one core. We are all situated around it. Whatever we do, all our reflections start with spatial objects and phenomena. If we want to explore something new, we must first define the object, determine the accuracy, with which we want to locate it. This is what we should do first. Determine what the database should be. If we are using an existing database, we have to assess it from the point of view of the accuracy of positioning objects and their attributes. This looks good, I'm taking this database. This does not work for me, I have to fill in the data or increase precision. This is a very important step in any activities, namely defining the object or phenomena accurately as well as positioning accuracy. Later, these objects and phenomena are described using spatial data. The first part is location, through coordinates or other locators, then comes the semantic description. We have hundreds of millions of pieces of spatial data that we collect in spatial data sets for later use and sharing. These sets include the base map sheet, topographic map sheet, orthophotomap, land registry sampling, geological map, etc. I estimate that just for the city of Poznań this means several thousands of spatial data sets. There are several hundreds of land registry precincts in the city. These collections constitute spatial information. I do not agree with what the specialists from Brussels have written. According to them, there is hardly any difference between data and spatial information. I consider spatial information to be all (the data sets) that describes our space. In order to move around in all this, we have the spatial information infrastructure. In order to use it, we all use computer technologies. This is our common core, around which we are all moving, whether we tackle surveying, geography or planning. Let me remind you that prof. J. Gaździcki said that we could not omit the infrastructure of spatial information in our teaching. We teach it, we have this common core, which informs spatial information, the philosophy of education at different levels. Different for policy-makers, office workers, and different for analysts who will be responsible for important decisions. In this area, we can really shine,

everyone will fit, as this cake is very big. Good competition is inspiring. If there is something good in Kraków, they will want to do the same in Warsaw. If we exchange information, we will all progress, so let's support one another.

I. JAŹDŹEWSKA – to sum up our presentations and discussions, I would like to emphasise that owing to the presence of representatives from such diverse fields as forestry, surveying, geography, history, as well as representatives from military and maritime academies, we have had the opportunity to learn how the GIS is taught, even though the name means something different in technical colleges and universities of various types. Currently there is a number of educational offers that include the GIS for university candidates in Poland. These are simply additional subjects within the framework of training courses, or specialisations integrated into a course, or brand new majors like geoinformation or geoinformatics, that have been launched in the last few years. We should therefore remember that in our discussions and clarify if we mean a separate course or a specialisation within a course. There were suggestions to write more textbooks for students as well as to support one another in teaching. I agree, ideas coming from our curriculums are worth sharing. During the lecture by prof. B. Szady I had a reflection that we should also share materials created by us and our students. It has reminded me of how we were pursuing the administrative division of Poland back in the 1950s. And maybe it is already done, having been stored on someone's hard drive, and we will be creating it again. We should not waste our time repeating such activities. Our students also create interesting data which is usually no longer used. Of course, such exchange should be in accordance with standards such as metadata and copyright. We have a lot of fields for co-operation. We must remember that some of us are more advanced in the geoinformation and others are less advanced, some are more focussed on certain issues, such as the use of LIDAR data. Only through friendly co-operation will we be able to develop.

A. KOSTRZEWSKI – the question of whether the geoinformation is indeed a science with its own subject of research, methodological and methodical foundations is of utmost importance. The fact that this topic is being discussed is encouraging as this applies to every field of science, even the more advanced ones. The issues that have to be determined first are the questions of transdisciplinarity, interdisciplinarity and monodisciplinarity. Where is the geoinformation in this system? In my opinion every scientific discipline has its roots, that is exclusively its own, and the fact that it has something to offer to other disciplines is only a measure of its worth. I

am convinced that in this case the geoinformation is of particular importance. The issue of individualisation of the geoinformation against other fields of science and the issue of transdisciplinarity and interdisciplinarity is this value of the geoinformation. In my opinion cartography has largely remained a tool as it has not succeeded in developing its own unique subject of research. The geoinformation is now at a very important moment in time, deciding to individualise its subject of research. The fact that the geoinformation as a sub-discipline is classified into different scientific disciplines is good.

ZB. ZWOLIŃSKI – as I was summarising the speeches and discussions, I noted a few issues worth mentioning. We should:

- teach the geoinformation at all levels of education, not only at an academic level;
- pay attention to the potential of geographic information systems;
- collect and analyse data at different spatial scales, from a micromap to continents at a global scale;
- collaborate among teams;
- have the core of geographic information systems for each discipline to develop in its own direction;
- improve our staff, ourselves as teachers;
- have less technique and more analyses in the curriculum;
- highlight the role and knowledge of the spatial information infrastructure;
- link teaching to projects, so there is a connection between theory and what awaits our graduates in their professional lives;
- adapt the studies to professional competences;
- define the role of textbooks as our literature is still too modest;
- transition from editing to analytic classes;
- data sources, time and space, also in the historical dimension;
- create interdisciplinary training courses.

L. CHUDZIAK – a teacher at a secondary and high school – I would like to add, that the GIS and other technologies have already entered schools. They have forced the teachers to get training. I would like to share my experience with you. I conduct field classes with kids. One of the exercises is determining north using your watch. Once I wanted the students to perform that task, it turned out that hardly anyone had a watch with hands. Only one out of 30 students had one. Finally, we determined the direction, we succeeded. Then, one of the kids said ‚now we will show you how to find north’. They switched the GPS on in a smartphone, and I was brought down, I understood – to quote a sentence that was already

used today – that we could not use old methods to teach modern kids. My second comment: you presented your educational offer for your students, and I feel bad that I am the only teacher in this group. I think this offer should be intended for a wider range of teachers. My high school graduates often asked me about choosing a training course, “Sir, I find geography interesting but what am I supposed to do to find a job later?”. After this conference, I will be able to tell them about the main training courses that will help them find a job in this technological world. Allow me to ask you to include a wider group of high school teachers among the participants. They are the ones preparing your students. My third comment relates back to one of the slides presented by prof. K. Będkowski showing that “the level of education should be adjusted to the level of students”. I strongly disagree with that, on the contrary, I think that students should adapt to the high standard of education.

B. SZADY – I fully and wholeheartedly support the inclusion of high school teachers in our discussion. This is very important. In reference to comments made by prof. Jażdżewska, I think that sharing processed data is very important. In my presentations at this conference as well as at “GIS in science”, we have been able to learn the results from the research done by participants. They are often shown as web-GIS applications, often interactive. From what I can observe in my own field, the power of development involves integration of data, cross-analysing, finding dependencies, relations, etc. The more data resources we have in various formats, such as gml, shp, etc., the better our research will develop. The idea is not to confine ourselves to visual presentation but instead to open to the possibility of data exchange and downloading. Let me further develop prof. Jażdżewska’s appeal – let’s share not only our publications, not only research conclusions, but also the data itself.

J. KOZAK – Ladies and Gentlemen, once again I would like to emphasise that today’s conference has been very interesting and we have been able to learn a lot. There have been in fact so many interesting topics that it is difficult to form conclusions or focus on anything in particular. There are many interesting things happening in various places, with our colleagues at the AGH in Kraków presented an ice-age reconstruction of the Tatra mountains using various geotechnological possibilities. Many interesting problems also appeared on the GIS Day, we started co-operating with artists at that meeting, those involved with video games, as well as artists in general. This is another trend, which – as it turns out – integrates the GIS to a large extent. During the panel discussion we heard interesting insights from prof. Wężyk, prof. Pyka about the interesting synergies occurring in

this field. Perhaps this community is also missing here. There is a number of things that have been discussed here but there is also a lot of them that have not been addressed.

Let me refer back to our discussion about our involvement in teaching, “how do we benefit as scientists?”: maybe satisfaction should be enough? As far as our teaching publications are concerned, they are not scored or scored low. We have heard an opinion that there is a lack of textbooks. After that, as prof. Będkowski said, and as we all know, there are no scores for textbooks, as far as categorisations are concerned. I think that there are surprisingly many textbooks. That means there are a lot of people among us who are thinking about improving the teaching side of things and making it more efficient. I think that the GIS in Science conference is developing so nicely that we should think about making the GIS in Education cyclical, for us to be able to continue our conversations on these topics.

K. OSIŃSKA-SKOTAK – We have mentioned numerous times that we should promote the GIS knowledge. However, I sometimes feel that the more we promote it, the less popular it becomes. There are still many areas where people do not know what it is used for, they do not even know that spatial data exists. Thus, there is a need for continuing promotion of knowledge about the GIS. I will talk about our experience at the Warsaw University of Technology. Our faculty provides classes for primary and secondary schools as a part of the Festival of Science in Warsaw. While at the beginning there was some resistance from our employees, as time passed many people started to feel satisfaction with the classes and we have had new people joining the project. They watch how thirsty for knowledge the kids are, especially in primary schools and the first year of secondary schools, and they are more and more eager to participate in the festival each year. When we announce enrolment to the classes, they are fully booked in minutes. That’s how much interest there is in it. We also have classes as a part of the PW JUNIOR project for children, and we are surprised how well the smaller children are dealing with challenges. Our students are often taught to think schematically, and young people who see a satellite picture for the first time, when asked “where is a forest?”, just show it. They do not mind that it is red or some other unnatural colour. I therefore think, that this promotion of science is important and there is a demand for it among young people. Kids of today are different, the first question they ask is “Why are we learning this?”, “How can I use it?” If we fail to show them the purpose, they will not learn.

P. WĘŻYK – I would like to thank you for the idea of the conference. I see that we have to meet many times to catch up, so that we start speaking the same language. Let me return to my dreams. I would like to meet you periodically, and such integration, apart from the ideas listed here (professor Jażdżewska is very experienced in this regard) would be supported a lot by the grant and the creation of a platform for Polish GIS campus, so that each one of us would contribute something to its construction. So that our students could, as a part of their electives, choose a training course for some specified ECTS points. So that we can create geodiversity and an opportunity for learning without necessarily changing our schools (this is not easy, especially considering that we also compete). Let's create this opportunity so that our students are better prepared than we were at the beginning of our careers, let's give them a chance to understand various issues, e.g. as a couple of hours of a training course, lecture, some practical issues, analyses and possible solutions. Should any of you decide to accept such a challenge, I am speaking to geographers now, who have geoeducation subjects, and each of us would chip in from our fields, we would create a great Polish geo-campus, which I strongly encourage you to do.

P. WERNER – initially, when professor Wężyk proposed the idea of a "GIS campus", I thought we were doing harm to our universities – by creating competition we limit the influx of students to our schools. But when I looked wider, I saw a consortium of universities, a joined effort that would free of charge transmit certain materials to a common e-learning platform created by several universities that signed an agreement. Such solutions are already in place at the best universities in the world. This is what MOOC is (Massive Open Online Courses) – a platform supported by big names, full-time training courses, lectures. In this context, I can imagine it. We are not very experienced at our faculty, but we have been using blended learning on the moodle platform for more than 10 years. Students have their own accounts and participate in training courses that supplement curriculum classes. In principle we no longer use paper. Each year new employees join the programme with their classes. In this context, the project works well for both students and the staff.

ZB. ZWOLIŃSKI – today's conference would not have happened if the geographers were not in an informal consortium already. In 2009-2010 we-geographers met several times among, which resulted in the creation of the geoinformation training courses in Poznań, Lublin, Łódź, Toruń and other cities. We discussed the naming, the subjects to be taught. Universities were not left to prepare on their own, we co-operated. Please note that

the name of the training course, the geoinformation, only exists in universities, not technical colleges. And in 2009, we also had an intense discussion with professor Stateczny, in the same group, we wanted to include a geoinformation training course. I think such meetings are really necessary and the creation of a wider consortium of the universities that are already involved with geographic information systems should be treated as a trunk with the branches related to respective universities spreading further and developing various geoinformation training courses.

A. KOSTRZEWSKI – I have a proposal for the organisers. Unfortunately, our scientific community, and this applies to all scientific disciplines, is insufficiently outgoing. During the meeting, you have come to many interesting conclusions that should be disseminated. Suitable applications should be submitted to such institutions as the National Science Centre and relevant departments of the Ministry of Science. One of the most important issues is to locate the geoinformation in the Central Commission for Degrees. There should be pressure from various scientific communities for the recognition and inclusion of textbooks in scientific achievements as they are often scientific works.

I. JAŹDŹEWSKA – Ladies and Gentlemen, I would like to conclude by thanking you for this discussion, for the kind words for the initiators and organisers of this conference. You have suggested that we could organise another such a meeting. We will certainly think about it. A few years ago, in 2012, we at the University of Łódź initiated jointly with the University of Gdańsk the conference named the GIS in Science, which was subsequently organised in Lublin (2013), Gdańsk (2014), Poznań (2015) and Warsaw (2016). They enjoy increasing popularity, this year there have been around 150 participants. After the interest that the GIS in Education has sparked, I see the need for it to continue in a year or two. I am very glad that we have got to know one another better, we have integrated, we have had various points of view that have led to a single conclusion that this diversity is our strength.

Summary

The experience of Polish scientists and educators in the GIS has not been as long as mentioned by Michael F. Goodchild who jointly with Ross Newkirk (Goodchild 2006) started the first GIS training course at the University of Western Ontario in Canada in 1975. Discussions on the scope of knowledge included in the GIS have continued at most universities that have offered such classes. In 1988/89, owing to the National Centre for

Geographic Information and Analysis (NCGIA), the 3-volume document of over 1000 pages was put together to include curriculums, student materials and other teaching aids. We have good models and we can use them. Meetings and discussions about the GIS education have been and still are regularly held all over the world (Forer P., Unwin D. 1999). When employees of Polish universities were starting to learn the GIS software and possibilities, Morgan J. M., Fleury B., Becker R. A. (1996) had already identified over 800 higher education institutions all over the world that had offered at least one GIS course. The rapid development of new technologies, methods, the creation of new labour markets has arisen discussions on the contents GIS training in various centres of higher education, e.g. in the Netherlands, the US, and those have been similar to the ones presented in this article (Toppen F. J. 1992) and some issues needed to be resolved in court (DiBiase, D. 2008).

You can see how important these meetings of educators are for exchanging opinions and experience. They have allowed to meet people representing various fields involved in the geoinformation, which may result in co-operation and new educational initiatives, and sometimes, competition.

Finally, we should agree with prof. J. Gaździcki (2009 p. 12) that "It is obvious that the success of any measures to modernise education in the area under consideration depends on the interest of academic communities, involvement of research and academic staff in these endeavours, their will, ambition and willingness to co-operate"