

# Cartography in higher education: changes in the last decades

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**Abstract.** The cartographic and GIScience programmes in higher education are changing continuously, trying to integrate the new developments of information technology and innovations of our domain. The ICA Commission on Education and Training is monitoring the higher education programmes in cartography: this paper is summarizing some special aspects of two surveys (2002 and 2012) of the undergraduate and graduate programmes, concentrating on the geographical differences and the changes due to technical developments.

**Keywords:** education, training

## 1. ICA Commission on Education and Training's survey

The General Assembly of the International Cartographic Association selected three topics in 1964, which were considered vital for the further development of the profession: Training, Terminology and Automation. The Association realised that giving guidance in the developing and standardising of cartographic education would be one of its main tasks. For this purpose, the Commission on Training in Cartography (renamed Education in 1967 and Continuing Education in 1980) was established.

The establishing of the commission coincided with the arrival of the computer in map production (at least in the most developed countries). Before complying with the new challenges, the first step of the commission was to acquire a better insight into the existing diffuse cartographic community, its structure and level of education. The first chairman, *Stephane de Brommer* succeeded in exciting the interest of UNESCO for his commission giving a chance to reach more countries (Ormeling 1987).

The production of *Basic Cartography* volumes was the most important task of the commission and the contributing cartographers in the last decades of the 20<sup>th</sup> century. The four volumes were published between 1988 and 1996 during the chairmanship of Ferjan Ormeling. This series provided a complete course in cartography based on a modern perspective on the subject in terms of data collection and manipulation, information display, and image processing.

After the challenges to implement digital cartography into the higher education of cartography, the rapid development of the internet access had also strong influence: it speeded up the communication, provided access to more information than ever including powerful searching functions. The standardization process in the information technology, the globalization effect of the digital revolution made the cartographic education in different countries rather uniform.

Around 2002, the commission started a survey in order to create a comprehensive list of undergraduate cartography programmes all over the World. It was the proper time to achieve this survey because until that time webpages became relatively easily manageable even in the less developed countries. Although the contributors of the 2002-2003 survey spent a lot of time to establish a comprehensive list and the results were checked by regional members of the commission, the final list cannot be complete. Due to the continuous changes in the higher education, the commission repeated the survey in 2012; this paper gives the first overview of the comparison of the two surveys. The survey data are available on the website of the commission: <http://lazarus.elte.hu/cet/undergraduate/index.htm><sup>1</sup>.

The names of the programmes and courses are varying considerably. The author created five groups using the most common terms: *Cartography*, *Geomatics*, *GIS*, *Surveying/Geodesy*, *Geography*, but there were several programmes with a non-classifiable title (like Urban and Regional Planning, Geo-environmental planning, Applied sciences). Several titles included more than one term (like GIS and Cartography): in such cases, the author took into consideration only the first term of the title.

## 2. Global differences in cartographic education

One of the most difficult elements of the survey was to categorize the programmes and courses, to define what kind of training can come under car-

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<sup>1</sup> The survey data were collected by Gábor Tolnai, a Hungarian PhD student and supervised by the authors.

tography. The main difference between the two surveys is that it was much more difficult to get detailed information (curriculum, category, the length of the training) in 2002 than in 2012.

It is obvious that cartographic trainings where the digital methods are emphasized in the titles (like GIS, geomatics) were started in the most developed countries. Nevertheless, nowadays the content of the higher education programmes in cartography and GIScience are much more similar than 30-40 years ago. Though the globalization, the easily available information on the web helped the standardization, there are recognisable characteristic differences, because the focus is also changing continuously.

## **2.1. European Higher Education Area**

The Bologna Process has transformed the face of European higher education. Indeed, all countries have made significant changes that have enabled the European Higher Education Area (EHEA) to emerge, and which have laid the ground for higher education that is serving an increasing range of societal demands. Higher education structures have been modified, quality assurance systems developed, mechanisms to facilitate mobility established, and a range of issues for the social dimension of higher education identified. The commitment to adopt easily readable and comparable degrees and to establish a two-cycle system are mentioned as the two first action lines in the 1999 Bologna Declaration originally signed by 29 countries. The scale of a project that, on the basis of voluntary cooperation, agrees and implements common objectives for the higher education systems of 47 countries is unprecedented (EACEA 2012).

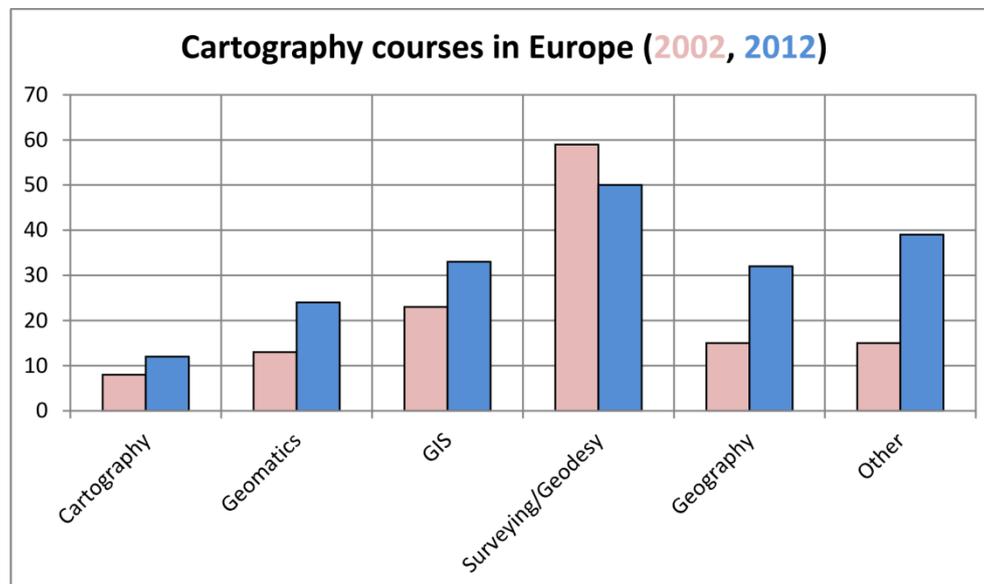
The major aims of the Bologna transition process developed and reconfirmed at the higher educational ministerial meetings were as follows:

- adoption of a system of easily interpretable and comparable degrees;
- adoption of a system essentially based on two main cycles, undergraduate and graduate;
- establishment of a system of credits as a proper means to promoting the most widespread student mobility;
- promotion of mobility by overcoming obstacles to the effective exercise of free movement;
- promotion of European cooperation in quality assurance with a view to developing comparable criteria and methodologies; and
- promotion of the necessary European dimensions in higher education.
- The main objective was to create a European Higher Education Area by 2010, in which the mobility of staff and students and the recogni-

tion of studies will be easier. The new system would place the diversified national systems into a common frame based on three outcome levels.

If we analyse the differences between the 2002 and 2012 data in Europe, it can be seen that the number of cartography related programmes in Europe increased by about 40%. Probably, a part of this increase is not real due to the different method of data collection and the wider availability of data on the university websites. The decrease of programmes in *Surveying/Geodesy* group is characteristic. These surveying courses have not disappeared in the institutes where they were available in 2002; in most cases, the curriculum and the title were changed regularly converting the course into a more complex programme. The number of programmes in the *Other* group has also increased considerably to show the appearance of GIScience-related programmes mostly in engineering. The number of courses in the *Geomatics* group is highest in Europe and in North America. Comparing Europe with other continents, both the number of bachelor and master programmes offered by the higher education institutes are highest here.

The number of European countries involved in the survey increased to 31 from 27 (*Figure 1*).



**Figure 1.** Changes in the number of Cartography and GIScience programmes in the European higher education in 2002 and in 2012.

## 2.2. Asia

The changes in Asia are not so characteristic. The number of programmes increased, and the growth is uniform in each group. That is, new trends cannot be recognized in the last decade. The similarity between Europe and Asia is that each group is well represented, there are no large differences between them. Geography programmes are the most dominant group. They are especially common in the most populous countries (India, China, Japan). The number of unclassifiable programmes concerning the type of the courses is highest compared to the other continents. This clearly shows that the two- or three- (including the PhD) cycle system (which is called Bologna system in Europe) is not yet implemented in this continent or the terminology (e.g. high certificate) is not identical with the Bologna terminology.

Although the author spent a lot of time on collecting the data of this region, the survey is probably not complete for China and in India, where the number of programmes should be higher. However, most of the information on the websites is available only in local languages. Some Central Asian countries, which were part of the former Soviet Union, are also missing in the statistics. The Arabic countries are also underrepresented, as the web access is regularly limited or state-controlled in these countries.

## 2.3. Africa

As the ratio of the ICA member countries is the smallest in the African continent, it is not a surprise that the number of cartography programmes is the lowest here. Checking UNESCO statistics concerning the situation of higher education in African countries, it can be recognized that the lower GDP/capita level does not offer good chances for potential students; some countries do not provide statistical data on their higher education at all (UNESCO 2011). Engineering and science universities that regularly offer cartography programmes require long tradition or a lot of investment; this is why these kinds of higher education institutes are not very common in Africa. The term cartography cannot be found neither in the title of courses nor in the names of the university units (faculty, department) in Africa.

Both the 2002 and the 2012 surveys included the same twelve countries. The relatively low level of Internet access in these countries and the intention to restrict the access in some countries do not give equal chance to the citizens of these countries. Countries with more than one cartography programme are only Nigeria and the Republic of South Africa.

## 2.4. Australia and Oceania

Not surprisingly, Australia is the dominant country in the cartographic education in this region. *Cartography* and *Geomatics* are less used terms than

in any other region. This is the region where the term *GIS* is most frequently used (supposing the trendy term, the Spatial Information Services/Systems, which is quite frequently used in the programme names in this continent, is also included).

The degree levels are regularly BSc/BA and MSc, but there are also some unusual terms like Advanced Diploma, Certificate (various levels), Associate Degree. Compared to Australia, there are only few GIScience and cartography programmes in New Zealand, in Papua New Guinea and in Fiji.

## 2.5. North America

The modern GIS applications were developed in North America and were initiated by geographers in order to help the automatic processing of statistical data, contributing to the analysis of data and providing information for decision making. There is no surprise that the term *Geography* is used as a brand in the US higher education. The programme list of the United States is probably a comprehensive compilation<sup>2</sup> in the project; all federal states of the United States are mentioned (probably the 2002 survey was not so comprehensive as the new one, and this is the reason for the large increase of the number of *Geography* programmes between 2002 and 2012). It is characteristic that a very low number of programmes are named cartography or surveying in the United States. The number of programmes titled *Cartography* was much higher in the 2002 survey; probably, the term was replaced by *Geomatics* in the recent survey. It is interesting that most of the higher education institutes offering these BSc and MSc programmes are universities, and there are only few high schools or colleges offering such programmes in the United States. The situation in Canada is similar, but the ratio of colleges is not so low as in USA.

The current situation in North America and in Europe can predict the increase of the number of these programmes in other continents, especially in Asia and in South America, where the economic development can influence the higher education: economic development can only be possible with the contribution of thousands of well-educated specialists.

In Canada, there are few programmes offered in French language (only in Quebec). The majority is in English: *Geomatics* and *GIS* are much more common there than *Geography* programmes. In Mexico, the offered programmes are limited to *Surveying (Geodetic engineering)* and *Geomatics*.

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<sup>2</sup> US higher education programmes data were collected by Dr. John C. Kostelnick (Illinois State University)

## 2.6. Central and South America

The changes between the 2002 and 2012 data are most radical in this continent. The structure of the programmes greatly differs from that of the other continents: the term *GIS* is not used at all. The number of countries and the distribution of programme levels in 2012 are very similar to the data in 2002. However, there are characteristic trends in the changes of the titles. The number of *Other* group programmes were quite high in 2002, but the number of these programmes was more than halved by 2012. The number of programmes in the other four groups was increased: *Cartography*, *Geomatics*, *Surveying* and *Geography*. *Surveying/Geodesy* is the most popular category in the Central and South American higher education. Brazil, Chile and Argentina offer most of the relevant programmes (altogether 16 countries are listed).

There are no characteristic differences between Central and South America concerning the relevant programmes. This is the continent where the number of the unclassifiable level of programmes is highest (higher than the BSc and MSc programmes together). Probably, due to the globalization (for example the European Erasmus Mundus programmes), the structure of the various levels of programmes will approximate the European and North American ones (Reyes, 2011).

## 3. A historical overview of cartography programmes

Cartographic education in the last ninety years grew out of either mapmaking (drawing and editing), map production, geography or land surveying/geodesy depending on which part of the world the program was initiated. Cartographers were seen as providing a service to these primary disciplines, especially geography.

Cartography degrees were established in many universities and some scholars went on to Master of Philosophy, Master of Science and Doctor of Philosophy studies. Cartography graduates were in demand as they were at the forefront in knowledge of new techniques.

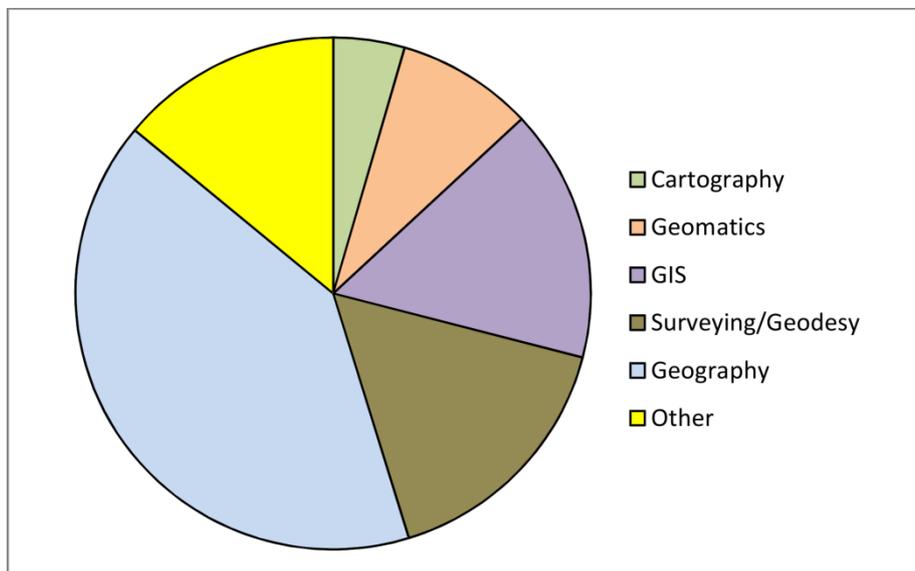
The first independent cartographic programmes were established in MII-GAiK, Moscow in 1923, but the most important institutes concerning cartography at that time were in the German speaking countries (Switzerland, Austria, Germany). The first scientific organization of cartography, the Swedish Cartographic Society was formed in 1908, followed by the Institut für Kartografie, ETH Zürich (1925) and the German Cartographic Association (1937). As the discipline of cartography matured after World War II, and then again with the introduction of computer technology, it developed

into a standalone offering in many countries (Fraser-Zentai-Brandalize, 2011).

Cartography and GIScience is not an isolated area. Europe has always kept its eyes on the most developed countries, like USA and Japan. People in higher education also know that some countries have very efficient higher education system in general (Finland, Ireland, Singapore etc.) (Zentai-Fraser 2006).

An academic revolution has taken place in higher education in the past forty-fifty years characterized by transformations unprecedented in scope and diversity. In the early 21st century, higher education has become a competitive enterprise. In many countries, students must compete for the limited number of places in universities and admission to the best institutions has become more difficult in all countries. Universities compete for status and ranking, and generally for funding from governmental or private sources, which is much more difficult nowadays, when the economic crisis affects our every day's life. The impact of globalization on higher education offers exciting new opportunities for study and research no longer limited by national boundaries (UNESCO 2011).

Cartography has always been affected by global processes; good geographical maps were not possible to produce without collecting information globally even before the digital era (cadastral and topographic maps were less affected by globalization at that time). The computer era increased the role of globalization, especially because the speed of information exchange improved. It is also important to mention that the first civil users of computer network were research institutes and higher education institutions, which proved that international cooperation is very important in this discipline. The foundation of the International Cartographic Association in 1959 was preceded by similar processes including the cooperation of cartographic enterprises, national mapping agencies and academia. With the help of this collaboration, nowadays the role of cartography and GIScience is still stable, because higher education is continuously improving their programmes in order to produce valuable students for the labour market (*Figure 2*).



**Figure 2.** The world-wide distribution of different groups of cartography and GIScience programmes in 2012.

#### 4. Conclusion

The systematic and regular overview of cartographic and GIScience programmes is a good reflection of the development of our domain. The appearance of information technology in cartography changed most of the characteristics of our profession. However, the several hundred years of traditions are integrated in the modern technologies. These new technologies became part of the higher education programmes, but due to the financial and cultural differences of various countries, the development on each continent is characteristic, although the effect of globalization continuously brings the content of programmes closer to each other.

One of the main tasks of the ICA Commission on Education and Training is to monitor this process and highlight the potential problems in order to improve the cooperation between the professionals.

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