New Challenges and Responses in the Education of Geodesy

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1. New Challenges and Responses in Higher Education

The higher education in geodesy must face to the same challenges than the higher education of any other discipline has to do. They are a natural part of the following worldwide trends of our age:

- general use of information technology;
- mass production;
- globalization.

Let's investigate the manifestation of them in the higher education and the possible responses for them.

1.1 General use of information technology

In the last 20 years the use of computers have turned to be so well spread in the society like radio or TV set from the mystified use of academic application. The higher education has had a double face challenge due to this process: 1/ teaching this new technology and its consequences in the different scientific fields; 2/ using this new technology in the teaching method.

The **first challenge** is more critical in the engineering education than in other fields. This education – since its birth – has been struggling to find the proper **depth** and **actuality** of certain technical knowledge that the student had to be acquired. Concerning to the depht of the teaching material, the University wanted to supply the students with the most detailed information of their field, on the other hand the continually increasing number of specializations made impossible the deep penetration into each branches of a technical science. The solution was a general education and after that a specialization in one or two directions. Of course the consequence of this method was a permanent debate on the ratio of the general and the specialized lessons and on the number of specializations. The objective facts were often mixed with traditional and prestigious arguments in this kind of debates. The actuality of the educational material is even more sensitive point of educational discussion in technical Universities. The main questions are: 1/ a new technology is a long term science that must be included in the education or just a short term fashion; 2/ a new technology is new field of the technical science or a new specialization of a traditional field; 2 / what part of the new technology has lasting value that should be included in the educational material; 3/ the lifetime of the "lasting value materials" in the rapid development. The last factor can be composed more generally as follows: what is the cycle of time of the renewal of the engineering knowledge in a certain field? This period is less and less (especially in informatics) that strongly supports the idea of life-long learning.

All enumerated problems of the introduction of a new technology into higher education appeared in case of information technology. Because this technology had a radical effect on ALL scientific field the introduction was unquestionable. The discussion was vehement in the distribution and the control of the topic. Different type of informatics appeared like mushrooms (like medical information, economical information, geoinformation etc.) and

strong fight went for the independent treatment of the education in informatics. Beside the administrative and terminological problems, the real professional question has been the **content** of the teaching material. The development is so fast, that the traditional educational system is not able to follow. The consequence is numberless specialized course with questionable quality and usefulness, misinterpretation of the importance of some results (e.g. INTERNET), discontent between students and teachers and discontent between Universities and the labor market. All we can hope, that they are the growing pains of the new technology of our age. However, there are opinions (the author has a preference for this) that we should be prepared for "chaotic conditions" for long (for ever?), because the technical development is so fast that the "classic" way of incorporating a new technology in the higher education (filtering lasting values, composing, printing books, preparing teachers) can not be followed any more.

The last, rather dark prediction lead us to the **second challenge** - the use of new technology in education. The necessary change in the process of the classic incorporation of new technologies in the education has been appointed as main professional task to overpass the chaotic conditions of the introduction. The main problem is the time factor i.e. the time of preparing teaching materials and preparing teachers is longer than the time of growing obsolete the knowledge included in the materials. Let's make a virtue of necessity! The information technology helps to make shorter the time of its incorporation in the education. The materials can be included in very short time in eBooks, and large number of appropriate teachers (who can assure the quality of the education) can be replaced (more or less) with effective remote education using INTERNET. Obviously the information technology can not help so much with the selection of long lasting values for teaching. Here only the idea of life-long lerning can be applied, which is supported by the information technology: much less time and expenses to create new courses and to make them available for much larger audience. The real great challenge and RESPONSIBILITY of Universities is the proper use of these means i.e. for short term benefits not to sacrifice the quality of education.

1.2 Mass production

The term has a strong negative flavor, recalls a nostalgic wish for the old time and old products, but in fact it is only a method producing cheap goods in large numbers. In the modern, welfare society this method is an imperative necessity. Bad quality as disdainful adjective is associated to this term, although it is not an imperative necessity. Simply the misprints (that can appear in the production of small series, too) can appear also in large numbers, influencing the opinion of several people. It warn us that the quality control has a central importance in the success of a mass product.

The equivalent of the mass production is the **mass education** in the higher education. The increased need for higher education is striking in the last decades. There are reasons of many aspects and the paper is not going to be devoted to investigate them. We are restricted here for pure statistical numbers. While 12-14 % of the relevant (between 18-25 year old) Hungarian population participated in the higher education in 1970s, recently this number is 35-37%, i.e. the number of students has been **three folded** besides the unchanged number of population.

Obviously the increased need is an other great challenge for the Universities. The basic problem is the assurance of quality in the education. This problem is also multi folded: 1/ the 35-37% of the population can not pass the exams with requirements elaborated for the 12-14% of the population 2/ in several European country the higher education does not have the appropriate educational conditions (teachers, rooms, labs, teaching materials, dormitories) for three times more students.

Without the underestimation of the second problem, we believe the first problem is more important. The educational conditions are depending on the economical level in a country. In

the wealthy European countries these factors – teacher/student, educational area/student, etc. - are much better than in the poorer ones. We can expect that the improving economy will eliminate the recently very strangling difficulties in the poorer countries, and they will not influence the teaching quality. However, the solution of the first problem can not be expected from the improvement of the economy or any other factor. The improvement of teaching quality in elementary and high schools can help but can not solve this problem. It seems to be that the next solutions are possible: 1/ to decrease the level of teaching materials; 2/ to decrease the level of exams; 3/ to throw out 2/3 of the students from the University. The adaptation of the first two "solutions" are serious danger for the quality of University education. The last solution is inhumane and not in accordance with he goal of mass education.

The distribution of the higher education for 3 levels (undergraduate BSc, graduate MSc, doctorial PhD) can dissolve the contradiction between the mass education and the quality of the education. The frame for the distribution is provided by the so called Bologna Agreement (after the city where the EU countries accepted its introduction). In this system the University materials are distributed into two parts. The "easier part" is included in a bachelor course (3 or 4 years) where we can expect that the majority of the students passes the exams and can receive a BSc diploma. A part of them (≈1/3) can continue the studies on the graduate master course where they will get the "harder part" of the material. Passing the exams they will get MSc diploma what gives them the right to continue their studies in the third level i.e. in doctorial schools. This system is operating in UK since long therefore there is "living example" to be followed. The problem is the acceptance of this system by the society especially the labor market. Probably it will be longer process than to change the system in the higher education.

The real challenge here for the Universities is the proper distribution of the University teaching material. The success of the system – and the dissolving of the contradiction between the mass education and the quality of education - will depend on the appropriate distribution of the teaching materials in each scientific field.

1.3 Globalization

The globalization is the expansion of the national markets to regions and to the world. The expansion goes hand in hand with a kind of standardization, it provides the same type and quality of products all over the world. Obviously, the driving force of globalization is the mass production.

The globalization in the higher education manifested as a need for standardization. The students claims an internationally accepted credit system and diploma. It is a very hard challenge for the Universities. One of the academic high thoughts is the academic freedom what is believed to be in complete contradiction with any kind of standardization. According to several academics, the fame of a University resides its own special educational topics and methods presented by special individuals that is by their professors. There is a general truth in this argumentation. The Platon's Academy, the predecessor of all University, could not exist without Platon. Then what is the solution? How can we dissolve this new contradiction between the rightful demand of students and labor market for a standardized and transparent education and the rightful and useful need of academics to save their academic freedom and individuality in the education.

The solution is again the multilevel higher education. The basic undergraduate education must be standardized among the European countries as much as possible and as soon as possible. The first step in this direction – beside the introduction of the multilevel higher education system – is the transparency of the existing education. The transparency can be provided by the effective operation of the National Institution(s) of Quality Assurance and Accreditation further the effective operation of ENQA at European Level. The standardization

must be covered the graduate, master education as well. However, as the practice shows in UK, certain deviations do not make problems in the student mobility and labor market. Obviously, the doctorial schools are the real territory of the academic freedom and individuality. Here the academics can present their individual knowledge attracting the best students from all over Europe. It will create a real field for competition among Universities and among academics of a given scientific topics.

The real challenge in the globalization for the Universities is to accept and to perform the standardization in the undergraduate and graduate education at the highest level as possible and to place the academic freedom, individuality in education to the doctorial level.

2. New Challenges and Responses in the Education of Geodesy

After the general overview we turn our interest to the special problems of the education of geodesy. We follow the guideline of the earlier chapter in the investigation, that is the effect of: 1/rapid development of information technology, 2/mass education, 3/standardization.

2.1 The information technology in the Education of Geodesy

The rapid development of information technology brought dramatic changes in geodesy, consequently in the education of this field. Large quantity of data is measured and processed in geodesy. The final product, the map, is also a dataset presented usually by graphical methods. The development of satellite and remote sensing technology – that partly preceded partly overlapped the development of the information technology – made remarkably faster and easier the data collection. The consequence was shifting of the professional interest almost completely to the data processing and the graphical presentation. Obviously, the rapid development of computing technology strengthened and accelerated this process.

The education followed the trend surprisingly quickly - at least in terms. The names of classic geodetic departments (Higher Geodesy, Physical Geodesy, Mathematical Geodesy, Photogrammetry, Surveying) disappeared and Satellite Geodesy, Geomatics (from Geodesy and Informatics), Geoinformation, Spatial Information and Remote Sensing appeared instead. The new terms demonstrate the revolutionary change that went on in geodesy due to the satellite and remote sensing technology and due to the information technology.

The real challenge in education is to be adapted to this revolutionary change, not only in names but in content. New curricula, new methods and new teachers are necessary to accomplish this task. Several ways can be noticed: 1/ unification of old geodetic department with an information department, 2/ application of young information engineers, 3/ special education for elder teachers. The depth and actuality of the teaching material will come to the focus after this transition. Recently the administrative and personal difficulties of this change are in the focus of interest. The depth and the actuality of teaching material are discussed but it invokes less interest yet.

The application of information technology in the teaching process, especially the remote courses via INTERNET, seems to be unimaginable in the old schools. The central part of education was the data acquisition on the field that could not be taught remote. Since the emphasize has been shifted to data processing, there is room for new methods. What is more, there is a need from practicing professionals for REMOTE retraining courses on geoinformation, GIS, spatial informatics. Similar needs can be identified from the secondary educational sector where the teachers want to apply the GIS in their work. This is a new challenge for the Universities. The concept of eLearning consist of eMaterial (eBooks, interactive exercise books, multimedia materials etc.) and eTransfer when the teaching space is remote and the teaching material is transferred via electronic way (INTERNET, Intranet, TV etc.). It seems to be that eMaterials started to appear in the education of geodesy, but

there is a lack in the methods and realization of eTransfer. To give an appropriate answer to the challenge of the application of information technology in the education of geodesy, the Universities must concentrate to elaborate new remote teaching methods using the facilities of eTransfer.

2.2 Mass Education in Geodesy

While number of students in Hungary has had three folded in the last 3o years, it did not appear yet in the education of geodesy. We can expect the growth in the next years when the need for GIS experts will come to the notice of public.

However, the education of geodesy, like other fields, must be prepared for mass education. It means that the recent materials must be distributed in two parts (undergraduate BSc course and graduate MSc courses). The special problems in the education of geodesy are as follows:

- Not only the distribution but the content of a complete material (undergraduate + graduate) is still discussed due to the above described drastic change in the profession. Reasonable solution is to close the discussion of the complete material, accepting the risk of later correction, and to concentrate on the distribution. The emphasize must be given to the selection of direction of Master Courses;

- The treatment of Bachelor Diploma by the Professional Chamber is unknown. The University must insist to arrive an agreement in this issue as soon as possible. The curricula of undergraduate courses must be modified accordingly;

- Other University branches (like Geography, Agriculture, Informatics, Economy) also establish Bachelor and Master education in Spatial Information, Geoinformation, GIS, therefore a compatible curriculum must be developed to provide the mobility for students.

- The geodetic education must be prepared for eLearning. At first it should be introduced for retraining and using the experiences to elaborate the facilities for undergraduate and graduate courses. A very probably guess: it is better to do in the frame of international cooperation (see next point).

2.3 Globalization in the Education of Geodesy

We defined the globalization in education as the introduction of an internationally unified credit and accreditation system that provides the ground for the free mobility of students and labor force.

This system is a basic component of the Lissabon Decision of EU in which the relevant leaders of EU declare their intention to create a Higher Educational Zone of the World from the European Universities. This program provides the possibility of the education of technical sciences like geodesy, to step into the mass education at worldwide level. Close international cooperation is necessary to establish the appropriate undergraduate and graduate programs, and methods. Naturally the eLearning methods will have a basic importance in this type of education. The real challenge for the geodetic education is to prepare the international courses using the existing cooperation forms (Socrates, Leonardo exchanges, Thematical Networks, etc.). This will be the real test for the reality of a unified European Education.

Beside the grandiose vision of the Higher Educational Zone of the World, there are small, traditional niches of the international cooperation of European Universities in education. There are special educational programs, that can attract only few persons from a country. An economically efficient and high quality solution is to elaborate the teaching material in international cooperation and to run the course via eTransfer. This way the students can enjoy the best experts as teachers at low cost. A good example in geodesy a retraining course on GMES. The EU programs (e.g V6th.Frame Program) provides a possible financial background of this kind of activity.

3. Closing Words

We discussed the 'geodetic aspects' of the new challenges of the recent higher educational system. Because geodesy relays on IT heavily it is more subjected to this challenge than other fields. Because the engineers in geodesy are more subjected to the competitive tenders than other sectors, and the success is strongly depending on the qualification of the participants, they are more sensitive to the 'value' of the Bachelor – Master diplomas comparing to the earlier issued qualification. And at last but not least, the field exercises are an indispensable part of the education in geodesy. This really need the personal contact between teachers and students. Still we have a lot to do to make a harmony between the modern remote learning methods and the field work training. The international cooperation – e.g. thematical networks like EEGECS – offer a chance to unify the particular, national efforts into stronger international programs to give a response for the challenges of our time.