Structure and Significance of Fieldwork Courses in Transformed Surveying Education

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SUMMARY

Czech Republic joined the Bologna Process which started the most radical reform of european higher education in recent time. It caused transformation of many university study programmes. Brno University of Technology (BUT) together with other Czech technical universities offering the higher surveying education has recently modified the curricula. Part of the curricula are the fieldwork courses which play an irreplaceable role also in contemporary conception of transformed studies.

The important aim of a fieldwork course is to train the students in the use of classical and current surveying equipment. Intensive weekly teaching blocks are quite different from hourly term practices. Students have to adopt the basic phases of a practical project – feasibility study, planning, implementation and completion – together with consideration of resources involved. Practical surveying works develop the ability of students to analyse, interpret and apply survey data.

In the paper besides short historical overview of the development of higher technical education in the Czech countries also the aspects concerning the fieldwork courses, e.g. team work, basics of project management, solution complexity, technological aspects, employment of modern educational trends (web, e-learning), relationship with research projects, cooperation with commerce, international cooperation possibilities, are discussed. The principles mentioned were applied by transformation of the fieldwork courses curricula in bachelor and master study programmes of Geodesy and Cartography at BUT, Faculty of Civil Engineering.

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1. PREFACE

The Bologna Process started reform of European higher education. Czech Republic joined the process which is the most comprehensive in recent time. The structuralized study system initialization in CR was started by approving the Act which anticipated introduction of bachelor study programmes and follow-up master programmes. Similar transformation is going on in other EU countries (signing the Bologna Declaration). Estimated period of the process is about 10 years. Brno University of Technology (BUT) together with other Czech technical universities offering the higher surveying education has recently modified the curricula. Part of the curricula are the fieldwork courses which play an irreplaceable role also in contemporary conception of transformed study.

The important purpose of a fieldwork course is to train the students in the practical use of classical and current surveying equipment while employing the theoretical knowledge acquired. Intensive weekly teaching blocks are quite different from hourly term practices. Student have to adopt the basic phases of a practical project – feasibility study, planning, implementation and completion – together with consideration of resources involved. Practical surveying works also develop the ability of students to analyse, interpret and apply survey data.

In the paper besides short historical overview of the development of higher technical education in the Czech countries also the aspects concerning the fieldwork courses, e.g. team work, basics of project management, solution complexity, technological aspects, employment of modern educational trends (web, e-learning), relationship with research projects, cooperation with commerce, international cooperation possibilities, are discussed. The principles mentioned were applied by transformation of the fieldwork courses curricula in bachelor and master study programmes of Geodesy and Cartography at BUT, Faculty of Civil Engineering.

2. HISTORICAL REVIEW

Educational process in Czech countries has a long tradition, which dates back to the middle ages when the Charles University in Prague was founded in 1348 by czech and roman emperor Charles IV as first university in central European region. Next milestones were Komensky´s contribution to universal pedagogic, and democratic approaches of T.G. Masaryk to a ”general scholarship”.

Generally considered as beginning of technical education in Czech countries is the year 1707 when Emperor Josef I in response to the request of J.Ch.Willenberg recommended to the Czech General Estates to found an engineering school in Prague and in 1717 the Institut of

Engineering Education was established. Christian Doppler lectured here in years 1838-1847 on subjects mathematics and practical geometry. All the lectures were in German language up to 1864 when the school was divided to Czech and German parts. Contemporary name Czech Technical University dates from 1920 shortly after establishment of Czechoslovakia. History of Brno Technical University dates back to 1849, when a technical college known as the German-Czech Utraquistic Institute was established in Brno. Education of Czech mining engineers has also a long tradition. VŠB – Technical University Ostrava is successor of the first mining school in the world founded 1716 in Jáchymov. Surveying education had been included in all the study branches at above mentioned technical schools and universities. Stand-alone surveying study branch started 1896 in Prague, and 1900 in Brno.

After the disintegration of the Austro-Hungarian Empire and the constitution of the independent state Czechoslovakia (1918) both Polytechnics in Prague and Brno were transformed into Czech Technical Universities (1920). After the World War II the restored republic became part of the Soviet sphere of power. Private property was expropriated and political and human rights were suppressed. Collapse of communist regime and following social, economic and political changes in eastern Europe in late eighties and beginning of nineties of the last century lead to thorough changes to free democratic society and to market oriented economics in most of the countries mentioned.

The transformation of Czech education system begun shortly after 1989. One of the most important changes was establishment of the government Accreditation Commission, which approves the realization of the single study programmes. Another radical changes were the transfer of most of the universities from state to public form of financing (with exception of military and police schools), and the chance for foundation of private higher schools. Distinctly increased also the possibilities for lecturers and students mobility.

In Czech and Slovak Federal Republic (ČSFR) the changes in higher education system started by passing the new Higher Education Act Nr. 170/1990 Sb. in May 1990. The Act confirmed renewing of the academic privileges at universities and introduced thorough changes to the control system. Universities became again the independent self-governing institutions with elective academic bodies. In 1993 the ČSFR was partitioned and two new countries came into existence – the Czech Republic and the Slovak Republic. From this moment the higher education in both countries is developing separately, with some particular differences. Further legal changes in Czech Republic (CR) brought the Higher Education Act Nr. 111/1998 Sb. with its later complements which reflects efforts for integration into the european education structures at more wide scale. The trend was emphasized when the Czech Republic together with several other countries joined the E.U. in 2004.

In present time it is possible in CR to study the Geodesy and Cartography branch, or a branch similar, at 5 universities – Czech Technical University in Prague, Brno University of Technology, Technical University in Ostrava, West Bohemian University in Pilsen, and University of Defence in Brno. All the universities have accredited the respective bachelor, master, and doctoral study programmes. Details of the curricula can be found on www pages of the single schools.

Comparison of European education systems for surveyors was firstly outlined in the well-known Allan´s Report (Allan, 1989). Some of the universities (e.g. Brno University of

Technology) are involved in international project EEGECS (European Education in Geodetic Engineering, Cartography and Surveying) coordined by Polytechnic University of Valencia, focused on comparison of European studies of the branch. Similar project exists also for civil engineering faculties (EUCEET – European Civil Engineering Education and Training), which expresses efforts also for coordination of the geodesy courses in civil engineering studies. The project is coordined by the École Nationale des Ponts et Chaussees in Paris.

3. BOLOGNA PROCESS IN CZECH REPUBLIC

Ministers of Education from European countries started new process to harmonise the European system of higher education in 1999 in Bologna. Meetings and conferences on the topic in Prague, Berlin and Bergen followed.

Main goals of the Bologna Process are:

- Adoption of a system of easily readable and comparable degrees
- Adoption of a system essentially based on two main cycles
- Establishment of a system of credits
- Promotion of mobility
- Promotion of European cooperation in quality assurance
- Promotion of the European dimension in higher education

The Bologna Process aims to establish a European Higher Education Area by 2010. Its most important part, however, is the national implementation as well as the implementation at each higher education institution. Results of the meetings mentioned above were projected into the Czech educational system in many ways. All the Czech universities have implemented three-level system of university studies. Higher Education Act Nr. 111/1998 Sb. was complemented by novel Nr. 552/2005 Sb. Ministry of Education, Youth and Sports issued special publications as the White Book – National Programme for Educational Development in Czech Republic. According to the Act every university provides accredited study programmes, and programmes of life-long learning. Levels of study programmes are: Bachelor, Master, Doctoral.

Table 1 Numbers of university graduates 1990 – 2003 in CR

Year of grad.	total					public HS					private HS			
	total	Bc	Mgr	Mgr Foll.	Ph.D.	total	Bc	Mgr	Mgr Foll.	Ph.D.	Bc	Mgr	Mgr Foll.	Ph.D.
1990	15318					15318								
1991	18043					18043								
1992	17726					17726								
1993	17587	1491	16022		74	17587	1491	16022		74				
1994	19238	2095	17034		109	19238	2095	17034		109				
1995	19017	3764	15037		216	19017	3764	15037		216				
1996	20517	5023	15156		338	20517	5023	15156		338				
1997	23389	7152	15782		455	23389	7152	15782		455				
1998	26656	8076	15263	2621	696	26656	8076	15263	2621	696				
1999	27446	7653	15981	3053	759	27446	7653	15981	3053	759				
2000	28235	7659	16467	3317	792	28223	7647	16467	3317	792	12	0	0	0
2001	29156	7398	17014	3764	980	29156	7398	17014	3764	980	0	0	0	0
2002	30646	7916	17674	3838	1218	30224	7494	17674	3838	1218	422	0	0	0
2003	32194	8335	18419	4029	1411	31503	7644	18419	4029	1411	691	0	0	0

Progress of the Bologna Process in Czech Republic illustrates Table 1 which shows growing numbers of university graduates of all three types of study programmes in period 1990 – 2003. In the table two types of master graduates – Mgr. and Mgr. Follow-Up are stated (www.msmt.cz).

4. FIELD TRAINING – SIGNIFICANCY AND STRUCTURE

Meaning of practice from pedagogical point of view firstly outlined Komenský in his Didactica Magna (1657) - „from simple to complex“, „from known to unknown“, and proven „to hear, to see, to try and to do“.

Work toward a “knowledge society” requires changes in learning process and new didactic methods (e.g. internet, e-learning). But for the practice it is valid only partly, or not valid at all. Internet may solve some problems of distant training e.g. in computer graphics, but it cannot substitute practical measurement with geodetic instruments or experience from field surveying.

Geodesy and Cartography (Surveying) covers many special disciplines from science, technical and economical subject fields. Besides theoretical knowledge it necessarily includes also wide practical aspects and experiences. Students beginning the bachelor studies in CR are graduates from two principally different secondary school types – gymnasiums, or engineering schools. A gymnasium prepares students universally and rather theoretically, while an engineering school is more specialized with greater part of practical knowledge. In CR there exist several engineering schools with stand-alone study branch Geodesy and Cartography lasting 4 years. The fact had to be considered especially when preparing the university bachelor courses.

There are several ways to acquire practical experience and skills in course of studies. Basic way represent the hourly term practices, laboratories, seminars and colloquia on single subjects or themes. However, from several reasons only parts of them are devoted to practical surveys in field. Another way represent the weekly field trainings. Still another ways are the complex projects and other project-oriented tuition. Inconsiderable role plays also free-time and vacation practice at private enterprises.

Basic form of practical teaching – the hourly term practices – is more nad more insufficient because of growing demands for instrumental, hardware and software equipment. Often it is devoted to solution of standard tasks, or to demonstrate some measuring or processing procedure. Main setbacks are often the great number of student falling on one tutor, insufficient number of instruments required, and lack of time. Generally only overview or short introduction to the task solved is possible.

Quite different quality have the intensive field training courses lasting from several days to several weeks, which are much more important for students. Such courses are oriented either on one subject (e.g. photogrammetry), either on a group of interrelated subjects. Favourable is the possibility to use an external locality distant from university so as to ensure minimization of possible disturbances. Characteristic here is the project- or task-oriented work in small groups of students. Conditional is an area where reliable horizontal and vertical geodetic control had been built in advance, enabling the evaluation of students work. Contacts of tutors and students is more tight, students are intensively cared for by the teaching staff. It is even possible the connection of research, teaching and practice in some cases.

Special complex projects and project-oriented courses enable the solution of problems requiring more complex knowledge of many subjects, and eventually the addition of elective ones according to the project type (economical, legal etc.)

Practice in private enterprises represents the way of increasing the professional surveying skills. It is to say that in CR is the cooperation of universities and private enterprises on low level, compared with advanced industrial countries. It concerns the insufficient promotion of schools by private companies, but also the problems of use of research results in industrial practice. Evaluation of positives and negatives in the problems had been in long term discussed in Commission 2 of the FIG (Enemark and Pernergast 2000), (Willgalis, 2002), and there are substantial differences in different education systems and/or different countries. WG4 of EEGECS is engaged in detailed analysis of the problems (Steinkellner and Heine, 2005).

5. FIELD PRACTICE IN BUT CURRICULA

Brno University of Technology has 7 faculties. Branch Geodesy and Cartography is studied under Faculty of Civil Engineering (FCE). Following Table 2 and Table 3 illustrate the growing number of students due to newly opened bachelor study programmes in last 5 years.

Table 2 Number of Students at BUT 2001-2005

	2001	**2002**	**2003**	**2004**	**2005**
BUT	15090	15740	17561	18623	20563
FCE	4312	4260	4489	4742	5435
Geodesy and Cartography	277	268	277	301	347

Table 3 Number of Graduates at BUT 2001-2005

	2001	**2002**	**2003**	**2004**	**2005**
BUT	2099	2314	2464	2629	2870
FCE	433	542	470	516	481
Geodesy and Cartography	46	38	38	40	41

In following overview the practically oriented courses in contemporary bachelor and follow-up master study programmes Geodesy and Cartography at FCE BUT are stated.

Field training and project-oriented education in Bachelor study programme Geodesy and Cartography (3 years = 6 terms)

Field training I :	after first year of studies – 3 weeks
Field training II :	after the second year – 3 weeks
Field training III:	after the third year – 2 weeks
Bachelor seminar I	2 hours per week during the fifth term
Bachelor seminar II :	3 hours per week during the sixth term
Bachelor work :	1 week for bachelor work and for completion of bachelor thesis

Field training and project oriented education in Master study programme Geodesy and Cartography (2 years = 4 terms)

Field training IV:	after first year of studies – 3 weeks
Complex project :	4 hours per week during the third term
Diploma seminar :	4 hours per week during the fourth term
Diploma work :	3 weeks for diploma work and for completion of diploma thesis

Decisive components of the practical teaching are the obligatory courses Field Training I, II, III and IV with following contents:

Field Training I: Fundamental methods of point positioning (polar point, intersection, traversing). Control establishment. Levelling. Detail horizontal and vertical surveys. Checking and adjustment of instruments. Creation of a simple map.

Field Training II: GPS Positioning (control densification), Mapping (large scale horizontal and vertical surveying including the computer elaboration), Profiling, Cadastre (simple geometric plan, setting out of property boundary)

Field Training III: Engineering Geodesy (simple control network, setting out of a construction, setting out of a road axis), Photogrammetry (determination of naturally marked control points), Cartography, GIS

Field Training IV: Theoretical Geodesy (precise angle measurement, precise levelling), Satellite Geodesy (observation in a GPS network), Gravimetry (gravimetric profile surveying), Special Geodetic Networks (special control network according to accuracy demands, setting out by intersection, precise setting out of a distance including the accuracy analysis), 3D Networks.

Students are choosing the themes of the bachelor and diploma thesis 1,5 year before finishing of the respective study programme. The themes are individual and are set by single teachers of the department. Students may come up with their own themes of bachelor or diploma thesis, which naturally must be approved by head of the department. Most of the themes need particular practical knowledge acquired before. Usually the bachelor thesis is oriented more practically, while the diploma thesis are more theoretical and research oriented.

6. CONCLUSIONS

Aim of the paper was to point out the still important role of practical teaching in modern system of geodesy and cartography education. An example is a system of intensive field training included as integral part of professional education of geodesists in Poland. The ”minimal curricula” proposed representing the step towards standardisation of studies in the five faculties of surveying in the country recommend minimally 10 weeks of field training (Czarnecki, 2002). Curricula of geodesy and cartography studies at Brno UT similarly include 11 weeks of field training courses – 8 weeks in bachelor studies and 3 weeks in follow-up master studies.

Field training is a suitable form for exchanges of students in scopes of mutually coordined projects, observation campaigns etc. It makes possible the realization of common practical or even research projects of the students from several countries concentrated on themes suited to particular universities. It might also be appropriate for preparing graduate students to actively take on leadership and responsibility in future occupation and in society.

Conception of development educational system in CR envisages the growing access to higher education from contemporary less than 35 % of young population to about 42 – 45 % in 2010, which together with high schools and other types of tertiary education will include over 55 % of young people in CR. Completion of higher education transformation in compliance with European progress should contribute to increasing the study success rate from contemporary 66 % to about 80 – 85 %. There is expected increased number of higher education students from contemporary 280 thousand to some 330 thousand in 2010, and will stay on that level up to 2015 (www.msmt.cz).

It is to say that the growing number of students in last years is in contradiction with demands on individualization of practical teaching.

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EEGECS - European Education in Geodetic Engineering, Cartography and Surveying, Working Group 4 - http://gfl.boku.ac.at/eegecs_wg4/

BIOGRAPHICAL NOTES

Josef Weigel 1975 degree in geodesy at Brno University of Technology; 1981 first scientific degree (PhD.); 1987 associate professor; since 1979 member, and since 1992 national delegate for FIG Commission 2 Professional Education, since 1994 chairman of the Czech National Committee for FIG, 1986-1994 Vice-Dean of the Faculty of Civil Engineering Brno UT; since 2004 Head of the Department of Geodesy, research activities in problems of geodetic networks. Specialisation: theoretic geodesy, theory of errors and adjustment, geodetic networks, GPS measurements, cave measuring (speleology).

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