ANALYSIS OF PHOTOGRAMMETRY AND REMOTE SENSING EDUCATION IN SLOVENIA AND PROSPECTS FOR THE FUTURE

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ABSTRACT:

Fast technological development, globalization and society change highly affect education contents and styles. An efficient education system is of vital importance for every state politics as well. The most current topic of education reorganization in Europe is the so called Bologna reform. Slovenia has been a member of European Union since 2004 and has also signed the Bologna declaration. This paper focuses on analysis of the existing education of photogrammetry and remote sensing in the Slovenian national framework and discusses problems and dilemmas referring to education reform. The existing curriculum is thoroughly presented and discussed in the paper, focused on photogrammetry and remote sensing. The author's suggestions for improvement of the curriculum that considers Bologna guidelines are given. New technologies are continually emerging, e.g. 3D laser scanning, that influence much the existing techniques of data acquisition. Thus novelties must be adequately integrated in the curriculum. More emphasis should be given to interdisciplinary approach, connection of different curriculum subjects and cooperation with firms and institutions from the field of work in the country. Although conventional methods of education are mainly used for teaching photogrammetry and remote sensing, e-learning is also an option of consideration when preparing new program.

1. INTRODUCTION

Photogrammetry and Remote Sensing (hereafter P&RS) is taught in Slovenia mainly at the University of Ljubljana, Faculty of Civil and Geodetic Engineering (hereafter FCGE). Reorganization of university education according to the Bologna reform is taking place recently at the Faculty. According to plans, new program should start in academic year 2008/2009. In this paper, only regular graduate program is considered (in addition, there is also post-graduate program including master and doctor study, and special study organized at weekends for people that are usually employed).

Only a few years ago, as a result of Phare-Tempus Structural Joint European Project (No11001-96) the Department of Geodesy of FCGE started with new study program. The general aim of Phare-Tempus S-JEP program was to reform university education systems in some central and East European countries in order to assure the comparable study programs that are needed for unified labour force market in economically united Europe. The aim of the particular project at the Department was to remodel some general courses of study. The outcomes of the project were two integral study programs: University Degree Study Program (four study years plus diploma thesis) and High Technical Study Program (three study years plus diploma thesis), which started in academic year 1999/2000. New subject areas were introduced: principles of law, business economy, elements of public administration, property law and real estate valuation. There were also essential changes of existing subjects, some being merged or cancelled. New curriculum for each study program was prepared. In order to better support the introduced changes and new subjects an extensive procurement program was implemented. A new computer classroom was formed together with all the necessary equipment and software. In addition, the Faculty library was renewed with the literature that is primary related to the topics of new subjects. However, this relatively new study program has to change now according to Bologna reform.

Currently, in the geodetic University degree study program there are all together approximately 180 regular students per year and in the geodetic High technical study program all together approximately 145 regular students per year. Students finish their University degree study in average in 7.1 years and High technical study program in average in 6.9 years. Duration of the study is much too long, what is one of the biggest present problems. We can find various reasons, however the faculty must improve this situation when entering the Bologna reform.

The results of the investigation that was accomplished within the sample population of students that graduated between 1999 and 2004 are presented in the paper. The topic of the investigation was about all subjects lectured in particular study programs, but in this paper, mainly the results for photogrammetry and remote sensing subjects are presented and discussed.

Further on, the author's suggestions for improvement of the curriculum that considers Bologna guidelines are given. Although conventional methods of education are mainly used for teaching P&RS, e-learning is also an option of consideration when preparing new program.

2. ANALYSIS OF THE EXISTING EDUCATION OF P&RS

2.1 Existing Curriculum

To be able to prepare new program, we must first analyse the existing one. Here, a short description of the existing curriculum is given.

Photogrammetry and remote sensing is taught in both existing study programs: University degree study program and High technical study program. However, the scope and objectives within the programs are different. The subjects are covered with the staff of Chair for Cartography, Photogrammetry and Remote Sensing, with two full time lecturer, one full time assistant, and four colleagues from other institutions partly covering some specific topics.

Generally, the aims of the photogrammetry and remote sensing subjects are the following:

- to acquaint students with different methods and complementary technologies,
- to equip students with basic theory and advanced methods, according to the level of study,
- to stimulate student for self-dependent study and work, as well as permanent update of knowledge,
- to use interdisciplinary approach,
- to stimulate students for research work (at university level).

In High technical study program, photogrammetry and remote sensing is taught yet and only in the 3. study year. Photogrammetry includes 30 hours of lectures and 45 hours of practical exercises, all together valid 5 ECTS. The emphasis is given to data production, as this study program is more practically oriented. The theory of analytical and digital technology is explained in short and most focus is given to current national projects as cyclical aerial survey, digital orthophoto production, topographic data acquisition etc. The implementation of modern photogrammetric technologies in national projects is a necessity today. Thus, a high-quality photogrammetric profession in a country is a key element for the efficiency of the projects. In the last ten years, photogrammetry played an important role in bulk national projects aimed at collecting new spatial data for different products, e.g. DTM, topographic database, record of buildings, etc. Remote sensing at High technical study program includes 30 hours of lectures and 30 hours of practical exercise, all together valid 4.5 ETCS.

In University degree study program, photogrammetry is taught in 2. study year (subject Photogrammetry I, one semester), 3. study year (subject Photogrammetry II, two semesters) and optionally in 4. study year (subject Photogrammetry III, one semester) for students that have chosen the geodetic stream (in addition there is also spatial information stream). Remote sensing is taught in 4. study year (one semester) for students of both program streams.

In academic year 2005/2006 University degree study program attend 36 students in the 2. study year, 46 students in the 3. study year, and 18 students in the 4. study year - geodetic stream. High technical study program attend 43 students in the 3. study year. These students all together attend different lectures and practical exercises in photogrammetry and remote sensing subjects in this year.

Photogrammetry I includes all together 45 hours of lectures and 45 hours of practical exercises arranged in two semesters, all together valid 6 ECTS. The general topics taught are:

- history of development, basic technological periods,
- physical basics of photography/image,
- mathematical basics of photography/image,
- introduction to digital photogrammetry (image enhancement, resampling, filters, image pyramid, compressing data, etc.),
- aerial and terrestrial surveying,
- orientation methods (single image, stereo images)
- photogrammetric equipment.

Photogrammetry II includes 30 hours of lectures and 15 hours of practical exercises in one semester, all together valid 3.5 ETCS. The general topics taught are:

- topographic information systems and bulk data acquisition,
- aerial triangulation (bundle block adjustment, GPS supported AT),
- orthophoto production,
- automation in production process (e.g. image matching),
- quality assurance and quality control in photogrammetric projects.

Photogrammetry III includes 30 hours of lectures and 30 hours of practical exercises in one semester, all together valid 4 ETCS. The general topics taught are:

- camera calibration methods,
- close range applications,
- DTM (acquisition methods, modelling),
- introduction to lidar,
- dynamic methods of data acquisition,
- 3D modelling and visualisation.

Remote sensing includes 30 hours of lectures and 30 hours of practical exercises in one semester, valid 4 ETCS. The general topics taught are:

- physical basics of remote sensing,
- different sensors and processing techniques,
- the production workflow,
- interpretation and classification,
- current satellite systems.

The way of lectures is still traditional in the classroom, mainly with slide projection but sometimes also using blackboard and chalk. In the Photogrammetry II subject, students prepare a seminar research work in small groups and than present them in the classroom. They get knowledge on how to organize their work and how to prepare presentation. The results so far are amazingly very good and their interest for the topic increases significantly.

In addition to lectures in classroom students make their practical exercises in computer rooms and on photogrammetric equipment. Students are divided into smaller groups of maximum 3 students for individual practical exercises, however some introduction lectures into practical work are done together in the classroom.

2.2 Equipment

For practical exercises, our faculty possesses the following specific equipment:

- digital camera Nikon D-70,
- digital photogrammetric workstation DVP (DVP Geomatics Systems Inc., Canada) using polarisation monitor and passive spectacles,
- digital photogrammetric workstation StereoExplorer (DFG Consulting Ltd., Slovenia) using Crystal Eyes for 3D observing,
- DOG (Digital Orthophoto Generation; DFG Consulting Ltd., Slovenia) including project managing, automated fiducial points measurements, semi-automated homologues points measurements,
- AeroSys for aerial triangulation,
- MoDiFoto (in-house developed software for digital camera calibration, projective transformation, production of orthophotos of facades, mosaicking).

In addition, students have on disposal different common software in computer rooms (Matlab, Adobe Photoshop, AutoCad, ArcView, etc.).

Faculty cooperates also with enterprises and other institutions in projects as well as graduate students often make their diploma thesis in such cooperation. To our opinion this is a good practice as students get insight into the real working environment and they can use other technical infrastructure that is not available at the faculty.

Although the available equipment covers all the necessary topics for the didactic needs, there are not enough working places for the amount of students. Thus, students must make their practical exercises according to plan which extends over the whole day.

2.3 Investigation results

In order to get some objective parameters about what is good and what bad in the past and existing study programs, an investigation was accomplished within the sample population of students that graduated between 1999 and 2004. Questionnaire was sent to 251 former students of both University and High technical program, 89 (39 %) of them replied. Here, only a general summary of the results is presented, focusing on photogrammetry and remote sensing subjects.

Around three quarters of questioned people arranged the study of geodesy at FCGE as demanding or very demanding study. However, in this study enter average students with respect to their results in secondary school. All of the questioned persons, except one, who study further in post-graduate program, are employed. More than 80 % of them find the first employment in six months or less, 88 % work in geodesy related fields. Almost all are satisfied with their employment placing. However, only 2-5 % (according to the study program) of them is working in particular photogrammetry and remote sensing area. On the other hand, the top working fields are: real estate recording, geodesy survey, engineering survey and spatial informatics.

Most of the questioned people estimates that the general contents of the study is comprehensive and demanding enough for the needs in practice. For University program 88 % and for High technical program 71 % of the population estimate that the knowledge they have received during their study in photogrammetry and remote sensing is useful in the practice. Further on, more than 90 % of the population estimate that photogrammetry and remote sensing will play important role in the future.

The questioned population would introduce more communication and organization skills in the program, as well as foreign profession language (not included in the program at present). They would also advice to implement more practical exercises and practice with more modern equipment. They would like to have more optional subjects, better study literature (in Slovene language) and more interdisciplinary approach.

An additional investigation is being prepared, focused on the Slovenian professional society, public and private enterprises and national administration offices. The aim of this investigation is to find out what are the needs and expectations for new profiles at the existing market. Unfortunately, the results are not available yet, but will be considered in further reform process.

3. COURSE OF THE BOLOGNA REFORM AT FCGE

The Bologna declaration is the document that has been signed in 1999 by the Ministers of education from 29 European states and later adopted by some additional states. Although this states are mostly members of the European Union (hereafter EU), and the declaration considers legal acts of EU for education, this is not a project of EU. The Bologna declaration is only one and the most known document among some others (e.g. Sorbonne, Prague, Berlin). The Bologna process aims at harmonizing high education programs and academic titles in Europe. However, national particularities and university autonomy are considered as well.

The main goals of the Bologna reform are the following:

- acceptance of a system of recognised and comparable university diploma,
- two or three levels study, composed of different numbers of study years,
- mobility of students and high education teachers,
- implementation of European Credit Transfer System (ECTS),
- quality assurance of high educational study programs,
- life-long learning.

In Slovenia, the high educational system is regulated by the Law on higher education and its supplements from 2004. The three level education is introduced:

- first level: high technical study programs and university study programs,
- second level: master study programs,
- third level: doctoral study programs.

In the beginning of 2006, the Faculty of Civil and Geodetic Engineering accepted the model 3+2 (i.e. three study years for the first level, two study years for the second level). In the first level, high technical (called geodetic engineering) and university study (called geodesy and geoinformatics) programs will be organized. In the second level, four different modules are planned in order to specialize in particular fields (geodesy, geoinformatics, spatial management, environmental and

urbanism planning). Currently, first versions of particular programs are prepared which will be discussed, improved and harmonized. The formal procedures should be accomplished in the next step (e.g. acceptance by the faculty senate, accreditation by the national authority and European accreditation network). According to plan, the new study program will start in academic year 2007/2008.

4. PROBLEMS AND SUGGESTIONS FOR IMPROVEMENT OF THE CURRICULUM

We are facing many problems in preparing the new program according to the Bologna declaration, regarding human, spatial and financial resources. First of all, the finances available will remain expectedly the same as in the present program for the first level and possibly for the first year of the second level. This means that although there are ideas and needs for some new programs, we should stay realistic and not split too much the present scope of the study in the second level. The nearby faculties that have already implemented the new studies are warning of modest number of students in the second level as the result that students rather go to work after finishing the first level than to continue the study at the second level. Due to this fact, there are intentions to fill the first level consisting of three study years with almost the same contents that were in the old four year programs. There is also a lack of adequate teaching staff for some profession areas and study premises remain the same. However, these are more or less only organizational problems.

According to Schiewe (2005), the transition from the traditional University Diploma towards two level educational model (i.e. Bachelor and Master degree) in several European countries, leads to rethinking of all issues related to education. This means not only organizational but also thematic, didactical and economical aspects.

More important are the real changes in the profession we are currently facing. New technologies are continually emerging, e.g. 3D laser scanning, high resolution satellite imagery, that significantly influence the existing methodologies. Thus novelties must be adequately integrated in the curriculum. Traditional methods are no more enough, we have to combine different sensor systems (e.g. implementation of GPS and IMU in aerial triangulation, combination of lasers scanning and digital images). Subjects, which were taught independently must now be presented more complex and co-dependent. Thus, more emphasis should be given to interdisciplinary approach and connection of different curriculum subjects that this was now the practice. Further on, we should implement more project-oriented work in the new program.

The problem also exists how deeply a particular topics should be taught. For those students who will work in photogrammetry and remote sensing areas, the scope and depth of the current subjects is definitely too small, on the other hand, students who will not work in photogrammetry and remote sensing areas have enough or even too much knowledge. However, we estimate that not much specialised photogrammetrists and remote sensing experts are needed in Slovenia. Some students choose their diploma work from photogrammetry or remote sensing, and can in this way deepen their knowledge of the field.

Another problem that is in practice usually difficult to overcome is how to assure modern P&RS equipment, hardware as well as software for practical exercises of students. This equipment is usually quite expensive. The only possibility we see at present is to cooperate more with private sector and to have common research projects that enables to purchase modern equipment. In addition, the initiative of ISPRS TC VI to support the professional society with web tutorials, free of charge software and other materials is also one of the very positive options.

5. CONCLUSIONS

The need to renew our study program according to Bologna reform could be observed from different perspectives. One can see it as unnecessary work but one can see it as a challenge for introducing new contents and educational tools in the lectures.

We think that new programs should be prepared for the future and not only for next few years. We must consider existing needs and trends of the profession as well as technological and social development of the society.

Most European countries report on decreasing of interest for technical study in general. This is also the case in Slovenia. Our faculty is satisfied with the number of entry students so far and to our information all graduated students get jobs in reasonable time, although not necessarily in the profession. But we are not sure if this remains in the next years.

According to Bähr (2005) information technologies will definitely lead to many structural changes in our education system. When preparing new program we should be aware of this and try to introduce new ways of learning, at least as some case studies. Here, I have in mind especially e-learning program for particular topics. E-learning is without any doubt a good option for the future, although it could not replace completely a teacher. It is an efficient and flexible form of teaching. We think that particularly in photogrammetry and remote sensing subjects some topics could be better presented through interactive examples and tutorials than only with traditional lecture.

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