

Education in Geodesy and Geoinformatics at the University of Zagreb and the Bologna Process

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SUMMARY

The introduction of the paper features a brief presentation of the Faculty of Geodesy of the University of Zagreb, the only higher education institution in Croatia where one can study geodesy and geoinformatics at Bachelor, Master and postgraduate levels.

The undergraduate or Bachelor study of geodesy and geoinformatics according to the new curriculum started in academic year 2005/06. The paper describes experiences of applying the Bologna process on the first generations of students. Some characteristics of this study are: a large number of students, introduction of higher institutions information system, beginning of e-education, beginning of continuous assessment of students' knowledge and skills, partial or complete exam removal, financial problems, etc.

Furthermore, an introduction to the Master study is given. This study started according to the new curricula at the University of Zagreb, Faculty of Geodesy in academic year 2008/09. It is interesting that the number of students who enrolled the Master study next academic year 2009/10 was 100, which was more than double in relation to the previous year.

The first generation of students are going to finish the Master study this year, and most of them are going to find a job immediately, while some of them will continue with postgraduate studies.

By signing the Bologna Declaration, the Republic of Croatia became responsible for implementing standards and following guidelines for higher education quality assurance. Therefore, some documents were produced and activities done to stimulate and develop higher education quality. The higher education quality assurance policy in Croatia is based on the Law about Scientific Activities and Higher Education, as well as statutes of universities and individual higher education institutions and rules and recommendations made by the Ministry of Science Education and Sport, the National Higher Education Council, universities and faculties themselves. In addition, some activities were also done at the Faculty of Geodesy to improve study organization and education quality.

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1. INTRODUCTION

Croatia has a longstanding tradition of higher education in surveying and geodesy. The oldest textbook on surveying *Exercitationes Gaeodeticae* was written in Latin by Martin Sabolović and printed in 1775. Furthermore, the first diplomas presented and certifying that one could act as surveyor date back in 1811. The students who have graduated from the today's Faculty of Geodesy, University of Zagreb are highly acknowledged experts in Croatia and abroad.

Graduate engineers of geodesy have never had any difficulties in getting employed, and the present situation in the work market in Croatia indicates that each of about 40 annually graduating engineers finds adequate job immediately. Private firms and the public sector grant scholarships and stimulate students in other ways in order to provide high-quality experts for themselves.

Scientific work and its connection with the teaching process have influenced the introduction of new cognitions into the teaching activity. In the periods shorter than 10 years, the Faculty of Geodesy has made more significant changes of the curricula. The previous curricula changes have mostly been influenced by the university curricula from Central and Western Europe where the role of surveyors in the society was similar.

2. STUDY PROGRAMS OF GEODESY AND GEOINFORMATICS

2.1 Bachelor Study

The Bachelor or undergraduate study at the Faculty of Geodesy, University of Zagreb, last three years, i.e. six semesters, and a student obtains 60 ECTS credits for each academic year in which he or she meets all regulated conditions. By finishing Bachelor study, one acquires 180 credits and the title "sveučilišni prvostupnik (baccalaureus) inženjer geodezije i geoinformatike", which means *university bachelor or baccalaureus and engineer of geodesy and geoinformatics*, and also competences for performing all works of today's surveyor and geodesists, but with a lower level of responsibility than masters. The Bachelor study ends with a final exam (Lapaine et al. 2006, Lapaine 2007a).

Reform of education at the Bachelor study of geodesy has been a continuous process since the old curriculum was adopted in 1994. In accordance with new legal regulations, it was still necessary to make a radical change, one with more than just a formal character. Therefore, at the beginning of 2005 the professors of the Faculty of Geodesy decided to produce the *Body of knowledge*, that is a list of knowledge and skills every student needs to acquire after each year of study. After that – rather than use the earlier usual approach in which the professors

would choose what to teach their students – contents of particular subjects were determined according to the Body of knowledge. The subjects were named in the second phase, and the professors were determined at the end. The proposed Bachelor (and Master) program was reviewed nationally and internationally and the Faculty of Geodesy got a positive opinion from the National Council for Higher Education and a concession from the Ministry of Science, Education and Sport of the Republic of Croatia.

The basic elements of the 2005 reform were: considerable reduction of the number of classes of some traditional subjects, introducing numerous new professional subjects related to the informatics, a field with increasing importance and introducing law and management into the profession. In order to successfully execute the new curriculum, of importance are decisions by the Faculty Council, according to which the professors are required to prepare their lectures for the new subjects in digital form and make them available to students via web-pages.

The main characteristics of this study in Zagreb are: a large number of students, simultaneous introduction of Higher Education Information System, beginning of e-education, absence of Study Regulations, execution of continuous assessment of students' knowledge and skills, partial or complete exam removal for some students, financial problems, etc.

2.2 Master Study

The Master study at the Faculty of Geodesy lasts two years, i.e. four semesters, and a student obtains 60 ECTS points for each academic year in which he or she meets all regulated conditions. The Master study ends by producing a diploma thesis and a diploma exam. By finishing the Master study, one acquires 120 credits and the title "magistar inženjer geodezije i geoinformatike", i.e. *master engineer of geodesy and geoinformatics*.

The Master study at the Faculty of Geodesy is carried out in two subject-oriented fields: *Geodesy* and *Geoinformatics*. New contents have been introduced to that new Master study, according to the Body of knowledge.

Masters of geodesy and geoinformatics take relevant legal, economic, ecological and social viewpoints affecting each single geodetic project. A master of geodesy and geoinformatics will be an expert with university qualification and technical experience to:

- Measure, determine and present the position of land, 3D objects, fields and trajectories on a scientific basis
- Collect and evaluate land information and geoinformation, and to apply this information for the purpose of planning and managing the land, sea and structures, as well as the objects on them
- Encourage the improvement and development of the above stated activities.

3. EXPERIENCES

According to the Bachelor and Master Study curricula, the optimal number of new students able to enrol each year with respect to space, equipment and staff number at the Faculty of Geodesy of the University of Zagreb is 150.

The total number of students studying at the Faculty of Geodesy of the University of Zagreb in the academic year 2008/09 was around 930 (taking into account all studies and all years of studying).

2005/06

Already in 2005 in applying the new curricula in the Bachelor study of geodesy and geoinformatics it was possible to perceive certain positive and negative phenomena related to the Bologna Process and other circumstances the Faculty of Geodesy, University of Zagreb, had no effect on. For instance, the effect of regulations, especially the new higher education financing system in the form of *lump-sum* is going to become evident in months and years to come.

The first semester of the academic year 2005/06 featured the first education according to the new Bachelor study program of *Geodesy and Geoinformatics*, adapted to the Bologna Process. However, one should take into consideration that results of that semester are not representative, since the number of students enrolled in 2005/06 was almost double (224) the number for 2004/05 (115 students). But this was an exception, since the enrolment quota was increased from 115 to 135 students. Also, 26 students were enrolled by special dispensation, while 63 students did so because they had failed the first year of the former program and it was impossible to do the first year of the old and new programs simultaneously. The large number of students hindered continuous evaluation, and mentor work with smaller groups was impossible because of lack of professors and assistants (Lapaine, 2007b, Lapaine et al. 2007).

Only 115 students entered the 3rd semester with the possibility to take all courses from the 3rd semester. There were only 23 with maximum 60 ECTS points.

2006/07

There were 263 candidates at the classification procedure in the academic year 2006/07. A total of 147 new students enrolled, 118 out of which had their study financed by the Ministry of Science, Education and Sport, 29 enrolled for personal needs.

2007/08

It was planned to enrol 115 students; 123 new students were enrolled; 145 students passed the classification procedure threshold.

2008/09

At the beginning of the academic year 2008/09, we faced a large problem – many students were not able to continue with their studies due to Study Regulations. Therefore, we had to change some rules in order to give the majority of such students another chance.

Moreover, a total of 282 people applied for the Bachelor study in 2008/09. 188 of them passed the threshold. Tests contained mathematics, physics and, for the first time, informatics exercises. 115 students were enrolled.

Furthermore, the first generation finished their Bachelor study according to the Bologna system in 2008. We promoted the first 39 university Bachelor engineers of geodesy and geoinformatics. Only 39 students finished their study within scheduled time, out of 224 enrolled in 2005/06. 36 of those 39 immediately continued studying the Master study, which started for the first time in 2008/09. We also accepted 6 students who finished Bachelor studies in other fields, raising the total number of the first generation Master students to 42. 12 of them study Geoinformatics, and 30 study Geodesy.

2009/10

There were 341 applicants for the Bachelor study. Seven of them did not have to take the classification exam because they had been awarded national awards (five from the field of geodesy and 2 from mathematics). 330 applicants took the classification exam on July 8, 2009. The results were available the same day. There were 4 applicants with the maximum 1000 points, but also some with a negative total! 247 participants passed the threshold, and 115 enrolled.

There were 101 applicants for the Master study in academic year 2009/10. One of them withdrew, which means we enrolled exactly 100 students, which was the quota.

Table 1.

Number of students enrolled in the first year of the geodesy and geoinformatics studies at the Faculty of Geodesy of the University of Zagreb

Academic year	Number of Bachelor students enrolled in the first year	Number of Master students enrolled in the first year
2004/05 and years before	115	–
2005/06	224	–
2006/07	147	–
2007/08	123	–
2008/09	115	42
2009/10	115	100

3.1 Survey of Students Who Completed the Bachelor Study in 2007/08

At the end of 2008, a survey was carried out of students who completed the three-year Bachelor study in academic year 2007/08. Based on analysis, we can conclude the survey's aim was achieved, i.e. valuable information was collected about students' experiences concerning the Bachelor study. The survey referred to various aspects of the entire study (Lapaine, Frangeš 2009).

Nevertheless, we can not be satisfied with the evaluation. Survey question responses point out deficiencies and difficulties in education and should help in improving its quality. Following recommendations were made based on the survey.

All aspects of the Bachelor study have to be adjusted/improved as soon as possible, especially:

- Organization of external student practice and collaboration with professionals working in practice
- Participation in field education (including summer schools)
- Inclusion of students in scientific-research projects of the educational staff
- International collaboration (student exchange, travelling abroad, etc.)
- Working in an international environment
- Participation in activities which develop a sense of belonging to the Faculty (excursions, celebrations, competitions, etc.)
- Balance of knowledge evaluation criteria in various courses
- Study support – general.

The Faculty of Geodesy of the University of Zagreb has started a process of self-analysis which is going to consider the results of this and all other surveys.

3.2 Final Exam

The Bachelor study at the Faculty of Geodesy of the University of Zagreb ends with the final exam. Such an exam was held for the first time on July 18, 2008. There were 16 students and all of them passed it. The second exam was held on September 12, 2008 with 23 students, all of who passed it. In academic year 2007/08, the first generation according to the Bologna Process resulted in a total of 39 university bachelors (baccalaureus/baccalauera) engineers of geodesy and geoinformatics. An additional 98 students passed the final exam in academic year 2008/09, thus there was a total of 137 university bachelors engineers of geodesy and geoinformatics (univ. bacc. ing. geod. et geoinf.) in Croatia at the end of 2008/09.

4. QUALITY ASSURANCE AT THE FACULTY OF GEODESY

"Quality assurance" in higher education is a comprehensive expression which usually includes all policies, processes, activities and mechanisms acknowledging, maintaining and developing higher education quality. Higher education institutions are responsible to all participants in higher education: students, who invest a part of their life in their education, parents, who

make sacrifices on their part, and potential employers. Institutions financed from the national budget are also responsible to tax payers so that the funds are used in the best way possible.

In the European Academic Education Space, a quality assurance system is considered to be founded on the autonomy of each higher education institution and its responsibility for the quality of education it offers to its students. Quality assurance begins with the quality of an individual study program and the responsibility individual higher education institution has for that quality. By signing the Bologna Declaration, the Republic of Croatia became responsible for implementing standards and following guidelines for higher education quality assurance. Therefore, some documents were produced and activities done to stimulate and develop higher education quality. The higher education quality assurance policy is based on the Law about Scientific Activities and Higher Education, as well as statutes of universities and individual higher education institutions and rules and recommendations made by the Ministry of Science Education and Sport, the National Higher Education Council, universities and faculties themselves. In addition, some activities were also done at the Faculty of Geodesy to improve study organization and education quality.

4.1 Quality Assurance Standards and Guidelines

Standards and Guidelines for Quality Assurance in the European Academic Education Space were produced in order to improve academic education quality. They are divided into:

- European standards and guidelines for internal quality assurance in higher education institutions
- European standards and guidelines for external quality assurance of higher education quality
- European standards and guidelines for agencies for external quality assurance.

The standards and guidelines were prepared by the European Association for Quality Assurance in Academic Education, as requested by the Bologna Conference from Berlin (2003) in order to develop and improve study program quality for students and other academic education users.

A study program is a frame within which students have the opportunity to achieve a certain educational level. The optimal study program can be achieved if its production is entrusted to all individuals included in its realization. The entire staff participating in realizing the study program has to be considered a team and has to work on improving the study program quality by agreement. It is important to receive feedback from students concerning their educational experience. They are the only ones with direct experience with the program. They experience it for several years on a daily basis.

Realization of the European Academic Education Space depends on the institution's determination at all levels to assure its programs have anticipated outcomes, its staff is ready and capable to assure education and help students reach the outcomes, and to acknowledge those who demonstrated excellence, competence and dedication. Institutions are heavily

responsible for service quality and its assurance, so they should produce and implement a strategy for permanent academic education quality stimulation and improvement. One of basic indicators of higher education quality is a high-quality study program, which should be systematically improved at all times.

4.2 Quality Assurance in Higher Education in the Republic of Croatia

Quality assurance in academic education in the Republic of Croatia is based on

- Law about Scientific Activities and Higher Education and
- Regulations about Norms and Criteria of Higher Education Institutions and Study Program Quality and Efficiency Evaluation,

which were the basis for following documents for external institution evaluation produced in 2007:

- Criteria for Evaluation of Higher Education Institutions Belonging to University,
- Guidelines for Making Self-Analysis Tables and
- Guidelines for Making Self-Analysis of a Higher Education Institution.

In addition, certain facilitating organization structures were formed.

Academic education institutions are subject to quality and efficiency control of educational, scientific and professional work. The evaluation is executed by the National Higher Education Council, and the Agency for Science and Higher Education is specialized for administrative support of the National Council.

In evaluation of academic education institutions, general documents/programs required for arrangement of scientific and educational work at the institution are taken into consideration, as well as quantitative and qualitative elements characterizing the institution's work. Their content and quality are evaluated by a professional committee for external evaluation of institutions, nominated by the National Council.

The National Higher Education Council produced a three-year schedule of evaluating higher education institutions, according to which the Faculty of Geodesy is to be evaluated in 2010.

4.3 Quality Assurance at the Faculty of Geodesy

In order to improve educational quality, some measures are being taken at the Faculty of Geodesy, while others are being prepared. Certain documents were made at the Faculty which can help improve educational quality and efficiency, for example Regulations about Studying, Regulations about Awarding Students, Regulations about the Diploma Exam, Regulations about the Final Exam of the Bachelor Study, Regulations about Postgraduate Studies (Ivković, 2009).

In addition, the Committee for Quality Control was formed, which being systematically educated about all activities and measures is taken to assure quality at academic education institutions. Its basic has been to organize and execute student surveys to obtain student feedback about professors, study conditions, attitude toward students, study programs, etc.

Doing student surveys has been significantly facilitated by online surveys. Nevertheless, considerably fewer students participate in such surveys, which mean data from such surveys might not be relevant. Perhaps students would be more motivated to participate in surveys if student representatives were included into the Committee, so that students would have "first hand" information about all activities and aims.

The international "Workshop on Educational Process Quality Assurance" was organized within the TEMPUS CARDS project "Geographic Information Science and Technology in Croatian Higher Education (GIST-CroHE)" and held at the Faculty of Geodesy. The Workshop was also meant to inform and teach professors and students about educational process quality assurance and what is being done in the European Academic Education Space.

The Faculty is soon going to have to do an internal evaluation, i.e. self-analysis, which precedes external evaluation, which is scheduled for 2010. In order to do the self-analysis, Tables were made for representing certain objective parameters which can indicate the Faculty's quality. These are empirical information which can show how an institution realizes its aims and assures educational process quality.

Based on objective indicators in the Tables, one is going to be able to compare various Faculties and determine their deficiencies and real needs, which includes the Faculty of Geodesy.

5. CONCLUSION

Education according to the Bologna Process represents a fundamental reform of high education process in the Republic of Croatia. The goal of the reform is to make studying more successful, and that would mean to make the number of highly educated people in Croatia greater.

This new way of education requires different approach from all participants. Professors are to be engaged more and are more responsible, but also a more thorough, more responsible and more serious approach of students to new instruction requirements is expected. It is also necessary to secure work with smaller groups of students, a larger number of professors and collaborators, enough lecture rooms, computer rooms and laboratories, and adequate equipment and instruments.

Furthermore, all lectures, exercises, tasks and other have to be available to students, and e-learning is to be applied as much as possible in instruction. When all of that is done, the Bologna Process will show all its values.

This reform is going to completely succeed only by fulfilment of tasks of all participants. During the past year, the Faculty of Geodesy of the University of Zagreb had done a fundamental reform of all its educational programs: from the Bachelor, Master and postgraduate doctoral studies.

By introducing the Bologna Process, the Faculty of Geodesy has become responsible to implement standards and guidelines for quality assurance in academic education. Standards and guidelines specify that academic education institutions have to assure quality internally. This is why those institutions, such as the Faculty of Geodesy, have to create and implement a strategy for constant improvement of the educational process. The entire staff participating in the study program has to work on improving its quality.

Students also play an important part in quality assurance. Their feedback can be obtained from student surveys, which have been carried out for several years after each semester. Aims of student evaluation of education and professors are determination of professors' strengths and weaker sides, which have to be changed. It is therefore extremely important for students to take student surveys seriously and participate in them, which unfortunately has not been the case lately.

REFERENCES

- Ivković, M. (2009): Osiguranje kvalitete na Geodetskom fakultetu, Godišnjak 2008-2009, Sveučilište u Zagrebu, Geodetski fakultet, 41-44.
- Lapaine, M., Kapović, Z., Frangeš, S. (2006). New University Curricula of Geodesy and Geoinformatics in Croatia, on CD Proc. XXIII International FIG Congress, October 8-13, 2006, Munich, www.fig.net/pub/fig2006/papers/ts34/ts34_04_lapaine_etal%20_0599.pdf.
- Lapaine, M. (2007a): Geomatics Education in Croatia, GIM International, Vol. 21, No. 3, 15-19.
- Lapaine, M. (2007b): Preddiplomski studij geodezije i geoinformatike u Hrvatskoj – prva iskustva / Geodesy and Geoinformatics Undergraduate Study in Croatia – First Experiences, in: Ed. Z. Kniewald, Zbornik sažetaka, Proceedings, Obrazovanje inženjera Bolonjski proces "3 godine kasnije" / Engineering Education The Bologna Process "3 Years Later", 8-10 November 2007, 80-81.
- Lapaine, M., Kapović, Z., Frangeš, S. (2007): Some Experiences of the Bologna Process in Geodesy and Geoinformatics Undergraduate Study in Croatia, in: Scientia Est Potentia – FIG Commission 2 Symposium, Proceedings, Ed. Aleš Čepek, Prague, 7-9 June 2007, 85-93.
- Lapaine, M., Frangeš, S. (2009): Education in Geodesy and Geoinformatics at the University of Zagreb – 3 Years of the Bologna Process, ICA Symposium on Cartography for Central and Eastern Europe, Proceedings on CD, Eds. Georg Gartner and Felix Ortog, Vienna, 16-17 February 2009, 455-466.

BIOGRAPHICAL NOTES

Miljenko Lapaine studied mathematics and graduated from the Faculty of Science, University of Zagreb, in the field of theoretical mathematics in 1976. He finished the postgraduate studies of geodesy, the field of cartography in 1991 at the Faculty of Geodesy in Zagreb by defending his Master thesis *A Modern Approach to Map Projections*. He obtained his PhD at the same Faculty in 1996 with a dissertation *Mapping in the Theory of Map Projections*. He has been a full professor since 2003. He published more than 700 papers, several textbooks and monographs. He is a vice-president of the Croatian Academy of Engineering, a founder and a vice-president of the Croatian Cartographic Society and the chief editor of the *Cartography and Geoinformation* journal.

Stanislav Frangeš graduated from the Faculty of Geodesy, University of Zagreb in 1984, obtained his Master's degree in 1993 by defending his Master's thesis *Differentiation of Objects on Maps with Area Symbols*, and his PhD by defending his doctoral thesis *Map Graphics in Digital Cartography*. His subjects are Geodetic Drawing, General Cartography, Topographic Mapping, Thematic Mapping, Map Reproduction and Map Visualisation. He published several course materials and about 20 cartographic representations. He was awarded for excellence in cartography at the International Cartographic Exhibition in Ottawa in 1999. He is the dean of the Faculty of Geodesy, University of Zagreb and the president of the Croatian Cartographic Society.

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