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MSC CURRICULUM IN GISCIENCE – AN EXAMPLE FROM CROATIA

PROGRAM STUDIÓW MAGISTERSKICH W DZIEDZINIE GEOINFORMATYKI – PRZYKŁAD Z CHORWACJI

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Introduction

The Tempus program funds cooperation projects in the areas of curriculum development and innovation, teacher training, university management, and structural reforms in higher education (European Commission, 2009). Therefore, the Centre of Geoinformatics at the University of Salzburg together with Jagiellonian University in Cracow (JU) and Faculty of Geodesy at the University of Zagreb (FG) as a beneficiary prepared a proposal "Geographic Information Science and Technology in Croatian Higher Education" (GIST-CroHE) for curriculum development under TEMPUS III Joint European Project (JEP) 2006. The 2-year project began on 1 September 2007 (Faculty of Geodesy, 2009). The main objective of GIST-CroHE was to revise the existing but not yet implemented MSc programme in Geographic Information Science & Technology (GIS&T) at the Faculty of Geodesy in accordance with the Bologna Declaration. The revision of the MSc curriculum in GIS&T focused on the contents, teaching methods and the form of content delivery, as well as on establishing foundations of quality assurance in such a higher education institution. These activities were expected to lay foundation for life long learning in the respective field as well. This paper, based in part on the recently published overview (Car, Medak, 2009) describes the curriculum and discusses important issues related to its implementation. As Croatia shows many similarities in the field of education to a number of Central European countries, this paper may help to understand various problems related to the GIS&T curriculum implementation in Poland.

MSc Curriculum in GISc&T

The Faculty of Geodesy at the University of Zagreb is the only Croatian public higher education institution which organizes university studies, scientific and professional work in the field of geodesy and geoinformatics. The latest major revision of the respective curricula at the Faculty of Geodesy was conducted in 2005, after a new legal framework promoting Bologna process was adopted in Croatia (Faculty of Geodesy, 2005). Traditional profile of a *graduated engineer of surveying* (Dipl. Ing.), which took 9 semesters to complete, changed to BSc in Geodesy and Geoinformatics (6 semesters, 180 ECTS) followed by an MSc in either (1) Geodesy or (2) Geoinformatics, each lasting 4 semesters and awarding 120 ECTS.

At the time of the 2005 revision, the MSc Curriculum was conceptualized as an extension of the BSc Curriculum. The contents of the courses on surveying were checked for redundancy, and updated regarding the recent technological advances. New modules related to GISc&T were introduced in the BSc curriculum, based on the 2004 version of the UCGIS Body of Knowledge (BoK) as a model curriculum (UCGIS, 2003). The professional profile of an MSc in Geodesy and Geoinformation graduate was based on the surveyor's profile defined by the International Federation of Geodesy (FIG, 2004), where a surveyor is expected to demonstrate the following competences related to GIS&T:

- design, establish and administer a GISystem, as well as collect, store, analyze, manage, display and disseminate data;
- analyze, interpret and integrate spatial objects and phenomena in GIS, including the visualization and communication of such data in maps, models and mobile digital devices.

As a result of the 2004 revision, the Geoinformatics part of the MSc curriculum had the following structure:

- three compulsory modules per semester (total 18 ECTS);
- elective/optional subjects amounting to total 12 ECTS per semester;
- Master Thesis to be completed during the final (4^{th}) semester (30 ECTS).

The set of obligatory modules included Spatial Databases, Spatial Management Support, Computer Cartography in the 1^{st} semester; Advanced Methods in Remote Sensing, Geoinformation Systems, Spatial Data Analysis in the 2^{nd} semester; and Integrated Systems in Geomatics, Image Survey, and Geovisualization in the 3^{rd} semester.

The content of MSc modules partially overlaps with certain BSc modules, but this redundancy may have positive consequences if Bloom's taxonomy of educational goals is properly implemented: the content is delivered at different levels of detail and complexity (DeMers, 2004).

Revising and cross-referencing the MSc Curriculum in Geoinformatics

The goal of the GIST-CroHE project – substantial revision and improvement of the initial MSc curriculum resulted mostly from the lack of comprehensive cross-referencing of the MSc curriculum to the existing content-based standards in this field. Already during the GIST-CroHE proposal phase in 2006 the Consortium partners recognized that important

topics such as e.g., interoperability, SDI or mobile GIS were not covered in the MSc Curriculum. Additional topics that could also be included in the revised Curriculum emerged from interests of project partners and represented overlapping areas of expertise between natural (geography) and technical sciences (geodesy).

In the GIST-CroHE project, the revision MSc curriculum was based on cross-checking against the model curricula in GIS&T to assure the compatibility with other programs both in European Higher Education Area (EHEA) and at the global level. Compliance of content of the respective curriculum to models and standards is essential for academic mobility. The revision included also adjusting of the ECTS points and introducing modular structure, which together with academic mobility are some of the major components of the Bologna process.

UCGIS GIS&T Body of Knowledge (BoK) (DiBiase et al., 2006) was used as a reference as it is the most current and comprehensive model curriculum to date and reflects state-of-the-art research and industry achievements in GIS&T. BoK includes content for graduate, post-baccalaureate and professional curricula. It is divided into 10 Knowledge Areas (KA) that cover concepts, methodologies, techniques and specific applications. KAs are further subdivided into units, and those into topics with accompanying objectives.

Cross-referencing with BoK shows that FG curriculum – having a strong tradition in surveying and geodesy education – covers exceptionally well KAs like 'Geospatial Data' and 'Cartography and Visualization'. Similarly, 'Analytical Methods' are well covered in modules dealing with mathematics and data processing; and these are distributed at both BSc and MSc level.

We identified the need to update the content to include new methods of data collection (e.g. remote sensing, close-range photogrammetry and mobile GIS) and issues related to interoperability and Spatial Data Infrastructures (SDI); creating new modules related to these subjects was one of the major activities in this project.

Common sense activities are required in the future, such as improving, updating and adding new content to the curriculum. For example, one of identified gaps is the KA 'Geocomputation', expected to be included in the next curriculum revision.

Problems and perspectives

The work on the curriculum development and Tempus project itself has had many benefits beyond the in-depth revision of the MSc curriculum. These are e.g.:

- meetings and workshops related to the Curriculum update and revision homogenized the teaching staff at FG, allowed frequent exchange of information about the teaching process and evaluation, and thus improved communication culture;
- students accepted the restructured and new modules well; the same holds for the content, the form of delivery and evaluation process;
- relatively small number of students (measured by the FG standards) can now work on common projects in small groups and more practical task-oriented work enabling individual approach by teaching staff, thus increasing the efficiency of the learning process;
- awareness that the current curriculum – after its revision – complies to international standards, has significantly raised the number of MSc students applying for academic mobility (e.g. 4 in 2008/2009 and 10 in 2009/2010).

One of the issues related to further development and refinement of the MSc Curriculum in GISc&T at FG is the need to improve possibilities for students from other disciplines to enroll in the MSc programme. In 2004, when the Bologna compatible programme was first designed, there was no experience at FG in admitting students with different backgrounds at the MSc level. Interestingly enough, in discussion with many academic teachers in several countries the 3+2 year scheme compared to the former linear 5-year MSc programmes was seen as a major drawback, and not as an advantage. To some extent, experiences of FG confirmed not only the existence of this problem but also its significance. In September 2008, the first generation of BSc graduates enrolled on the new MSc in Geodesy and Geoinformatics. The Geoinformatics part of the curriculum attracted 12 students; half of them with the surveying background (BSc at FG), five students with a BSc in IT and one student who graduated from the 4-year diploma programme in GIS&T at the School of Geoinformation in Villach (Austria). We observed that students without the BSc background of the 3-year programme at FG experienced difficulties in gaining the knowledge and basic skills related to measurements, cartography, georeferencing, but they excelled in tasks related to programming and database technology (due to their IT background). Thus introducing additional optional modules appears necessary to bridge such gaps in students' knowledge and skills. An MSc programme needs to be structured in such a way that it can fully use the potential of students with various backgrounds.

One of the results of the project and the MSc revision is that the number of students choosing MSc in Geoinformatics increased from 12 to 53, compared to the slight increase of those choosing MSc in Geodesy (35 to 47). The revised curriculum in MSc in Geoinformatics has significantly improved the former study programme of geodesy/surveying and opened new perspectives for graduates entering the professional job market. The improvement is manifested in both the content, and in teaching methodology and the mode of content delivery. Focus of the revision was on redefining learning outcomes, intensifying and/or introducing problem-solving approaches, project work and continuous assessment. E-learning has been introduced in teaching thus allowing for blended learning.

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Streszczenie

Artykuł przedstawia efekty projektu "Geographic Information Science and Technology in Croatian Higher Education" (GIST-CroHE), realizowanego w ramach programu TEMPUS. Partnerami projektu były Uniwersytety w Zagrzebiu i Salzburgu oraz Uniwersytet Jagielloński, przy czym głównym beneficjentem projektu był Wydział Geodezji Uniwersytetu w Zagrzebiu. Projekt rozpoczął się we wrześniu 2007 roku, a jego głównym celem była wszechstronna i zgodna z założeniami Procesu Bolońskiego aktualizacja programu studiów magisterskich z geoinformatyki na Wydziale Geodezji Uniwersytetu w Zagrzebiu, zatwierdzonego w 2004 roku. Efektem aktualizacji były propozycje nowych kursów oraz zmiany zawartości i metodyki nauczania kursów istniejących, a także wypracowanie metod oceny jakości nauczania.

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