Towards Competencies for the Msc Curriculum Geo-Information Science

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SUMMARY

Wageningen University, the Netherlands, is formulating competencies for the various BSc and MSc curricula. For the MSc Geo-Information Science, five Core Competencies, each with a number of sub-competencies have been developed. This article shows some operational difficulties, describes how they were tackled, presents the results that were achieved and suggests further course of action. These results have been used to adapt the description and content of the courses in the MGI-curriculum. The process leads to a clear position of our curriculum, showing the academic competencies and the Wageningen focus of our programme to students and to the job market. The roles for competencies, the creation of competencies and the curriculum development will be discussed in more detail.

KEYWORDS: *GI-education, curriculum, competence, Bologna Declaration, ECTS*

INTRODUCTION

An objective stated in the Bologna Declaration about Higher Education (European Ministers of Education, 1999) was to create more convergence among the education systems in the participating countries. This would require better comparable degrees, which, in turn, would increase the possibilities for student mobility.

Wageningen University is presently in the process to operationalize those objectives. Part of the process is to formulate the competencies brought about when a student follows a curriculum. Here the followed course of that action and its results are presented for the MSc Geo-information Science (MGI) Curriculum at Wageningen University (WU). The MSc curricula in Wageningen are 2 years and prepare the students for academic jobs both in research and in other professions. This is done by offering courses and a thesis research project directed to academic knowledge and skills in the domains, along with an internship and an academic master cluster to train for academic jobs outside the university and research institutes

Competencies are among the key concepts for achieving this objective, a joint credit point system (ECTS) being another. A competence is the ability of a person to perform tasks in a specific situation based on a combination of skills, knowledge and attitude (Douma, 2003). The focus on abilities rather than knowledge and skills means an important change of viewpoint from the approach at WU, which was based on "learning objectives". Chancging the focus to abilities is also a move towards the point of view of employers. The difference between their needs and what regular education offers is reported as significant (Meyles, 2003).

As no generally accepted standard procedure to formulate competencies exists so far, WU decided to use a combined bottom-up and top-down approach, and only loosely channel the general scientific creativity. The WU central section for educational support provided a 5-step framework (Douma, 2003), to be followed for every curriculum:

1. Formulate Areas of Competence: describe the area of interest of a curriculum, and where the alumni find jobs. The description of the course as provided by the WU study guide was supposed to be sufficient for this. It had to be complemented with an overview of the types of first jobs young alumni get into;

2. Formulate Complex Questions: describe typical tasks that fresh alumni must be able to tackle;

3. Construct Core Competencies (CC's): formulate 5-8 CC's to characterize the curriculum. They should convey the message: this is what students are able to after completing this curriculum. A set of CC's describes the most important results, brought about by a curriculum;

4. Formulate the competencies that each CC consists of: the Sub-competencies (SC). SC's are an elaboration of a CC with more details about the knowledge, skills and attitudes to be obtained;

5. Analyse the curriculum: determine how curriculum elements (the courses) contribute to building up competence in students.

This procedure was carried out, accompanied by feedback sessions with scientific staff and student representation, connected with the MGI-curriculum.

The greater part of the work, except the final curriculum analysis, was completed by the end of 2003, and reported about (Rip, 2004). Five MGI Core Competencies (CC) came into existence, with Sub-Competencies for each CC.

The objective of this article is, to show some operational difficulties in following the framework, describe how they were tackled, present the results that were achieved and suggest further course of action.

METHODOLOGY

The following steps have been performed:
- Determine the type of jobs of MGI-students get after their study
To get an overview over a longer period of where MGI-students get their first jobs was hampered by the fact that MGI has not been a curriculum for postgraduate students ever since the start of the first GIS courses in 1982. The MGI programme in more or less its present form started in 1999. Before that time a MSc programme directed to international students existed, and Dutch students followed a number of courses or even did a large thesis in Geo-information Science as part of another curriculum. This means that alumni who followed GIS courses, can only be found under the name of the study in which they started their studies at WU, unless they specifically entered the university for only this MSc course. The result is, that a large part of the MGI alumni is invisible in the WU alumni list. In order to know who they were and what job they got, some backtracking was done through the thesis list at the department. On this list are about 300 students that wrote a thesis for MGI after 1982. The majority of them could be found in the university's alumni list, together with the discipline in which they received their master degree, and sometimes an indication of the job they have. In this way a list could be made of the type of jobs of about 60% of the Geo-information Science alumni. Together with a knowledge of present GI-jobs, this gives an indication which type of first jobs will be suitable for MGI students.

- Constructing a format for MGI competence description

Since no standard format was available, an existing format (Van Mil, 2002) was adapted, in which clear levels of competence were described. It was a foundation for the decisions about contents and composition of the elements in the competence descriptions. This turned out to be useful in determining and formulating competencies.

There are 5 components in the format:

- the type of task performed by the alumnus in an organizational context
- the level of task complexity (3 values: elementary, advanced, complex)
- task approach (3 values: operational, tactical, strategic)
- indication of knowledge domain in which GI is applied
- general academic competencies

In this project, the choice of parameter values was based on gut feeling. It seems advisable to develop a better foundation for this activity. This applies to the CC's as well as to the SC's.

- Constructing CC's without complex tasks

In the original set-up it was expected by WU that definition of complex tasks to be performed by alumni in a job situation could be a useful step in the approach. This was not the case for MGI. Possibly the concept of arriving at CC's on a basis of complex tasks is based on experience in disciplines that have a full five year or a straightforward Bachelor - Master curriculum, leading to easily recognizable professional activities. GI however is a discipline that can be additional to every other discipline in which spatial objects play a role. At WU, the MGI curriculum always follows a bachelor study in one of the environmental or life sciences. So pointing out a characteristic complex GI-task quickly leads to either an incomplete multitude or to a rather abstract generic result. Therefore it was necessary to follow another road to arrive at MGI-competencies. A short analysis was made of the types of roles that MGI's can fulfill in the context of organizations that deal with geographical space. This resulted in 5 Core Competencies for WU MGI alumni. In short, not following the above mentioned format, the alumni are able to:

- Carry out GI-research for an external client or for a PhD-thesis
- Leading applied GI-research projects for external clients
- Develop new geodata processing concepts and implement prototypes
- Bring about GI knowledge transfer in educational settings
- Provide GI-consultancy to management of organisations

- Constructing SC's for CC's

Core Competencies do have a container character. They need to be split in more detailed Sub-Competencies. That is the stage in which recognizable knowledge elements, provable skills and manifest attitudes come at the surface. It is at this level that links can be established between competencies and individual courses in the curriculum. Therefore it is also where a link will have to be made with the learning objectives for a course.

- Describing curriculum elements in input-output terms

Staff members contributing to the MGI curriculum were asked to describe their own course in terms that relate to the input and output level of knowledge, skills and attitude. The experimental results enable us to chart the official curriculum structure against the educational process as staffmembers experience it. These descriptions, together with the sub-competencies, will show were adaptations of the present courses are needed. The relationship between those descriptions and the formulated competencies still needs further development.

RESULTS

In short, results from the work are as follows:
- The job range for WU MGI-alumni (N=151, period 1982-1998): 37% gets into policy-related jobs, 25% does research, 15% becomes a technical specialist, either in GI or their own discipline. These numbers are no more than an indication, because for 130 persons no data were found.
- The Core Competencies for MGI: fresh alumni are supposed to be able to: 1) Lead applied GI research projects, 2) Do GI research, 3) Do GI-technical development and tool-prototyping, 4) Transfer GI knowledge, and 5) Provide GI consultancy.

Sub-Competencies for each of these Core Competencies can be found in the report (Rip 2004).
- Descriptions of the individual courses in terms of input and output levels of subject knowledge, skills and attitude. An early attempt to insert these descriptions in the curriculum schedule showed that the descriptions need more elaboration in order to improve the visibility of their cohesion. In cartographic terms: they do not yet allow nice mapping.

DISCUSSION OF THE RESULTS

Three subjects will be discussed in detail:
- Roles for competencies
- Formulating competencies
- Curriculum development

Roles for competencies

Competencies will be important in a number of ways for international convergence of education systems. Three of those are obvious:

a) Competencies are like the constitution of a curriculum. That status means that both schools and employers can expect a long lasting continuity. It helps stabilising and structuring the educational field, which is necessary for intra-national and inter-national co-operation and exchange between universities.

b) Competencies have a shopping window function: they are on display to attract students. At the same time they help alumni and employers in matchmaking.

c) Competencies also have a gatekeeper function: they are essential for assessing admissibility of students from other educational institutes in the same country, or from abroad.

Playing those roles sets conditions for the competencies.

- the constitutional role demands continuity and flexibility at the same time. When formulating competencies, it is very important to find the balance between detailed and controllable description versus a sufficiently abstract description that still holds after several minor readjustments in the course elements configuration. As this was the first time to formulate competencies for the MGI-curriculum, it must be expected that as awareness and experience grows, they will be adapted to a certain extent.

- the shopping window role demands recognizability and attractiveness of the promised abilities. Because geo-information is applied in an ever increasing number of disciplines, the competencies tend to get abstract and general. This will make it difficult for employers to recognise the abilities they look for, and at the same time graduate students may fail to see that MGI at Wageningen University is the perfect Master curriculum for them.

- the gatekeeper role demands an operational tool to measure admissibility: do applicants have the right entry level competencies, so they can reach the end competencies of the MSc with an appropriate choice of courses? Are academic and other qualities sufficiently present in the candidate? Until now the focus in explicitly testing students is on their knowledge and understanding of subjects taught. Assessing the ability to carry out tasks will require another approach, which will have to be developed. Apart from that the required levels will have to be made explicit. This introduces another item. Although Europe aims to unify, cultural differences between the countries may be an obstacle when trying to set attitude requirements. Foreign students with a different cultural background may be deterred by some attitude requirements. Differences, even within Europe, are large and having students from other continents even gives more variation. Finding a balance is necessary.

Time will tell if the CC's and SC's formulated for MGI meet the requirements mentioned here. It is very likely that regular maintenance will be necessary in the course of development of the European Union.

Formulating competencies

Increasing the comparability of European university degrees cannot be done by introducing only ECTS as a unit of measurement[62], because size isn't all that matters. Ideally, a EU description method for the content of curricula should be developed. One might wonder if it is useful to formulate competencies

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[62] In ECTS, 60 credits represent 1 year of study in the terms of workload. Apart from that ECTS provides a 6 step grading scale: from A (excellent) to F (fail). (European Commission, 2003)

without a commonly agreed method, and still have comparability and convergence in mind. Nevertheless, at Wageningen University the challenge was taken up.

The approach used (bottom-up and top-down combined) has produced an interesting array of curricular competence descriptions, each one structured by the rough guidelines provided (the 5 step-framework mentioned) and otherwise coloured by the nature of the content of the curriculum[63]. The management of this Competence project can be looked at as seeking for a balance between "guidelines from central" and "local freedom". This resulted in a learning experience for all parties.

A recommendation to other universities is, to start a process like this by spending time and effort to set up more detailed guidelines, to be used for their organisation. The reason for this is, that providing central guidelines is good for the coherence of the results, however a too strict format might obscure specific fundamental difference between the curricula.

Another recommendation is, to base such guidelines on a reconnaissance of existing literature on the subject, combined with decisions on the position the organisation wishes to take regarding procedures, methods and formats.

Curriculum development

The description of individual courses as interrelated building blocks that are part of a structure (the curriculum layout) helps staff members realise in more detail that, and how, their particular course relates to other courses. A first try showed positive and interesting results. Possibly further analysis along lines comparable to for instance traffic network analysis may be a useful approach.

CLOSING REMARKS

For the description of competencies, standard descriptors, syntax rules and value sets are required. Our explorative attempt to create them for MGI resulted in some products, presented to the department for tasting.

The process has been a stimulus (at least at WU-MGI) for scientific staff of MSc Geo-information science courses to take an interest in competencies as a potential tool to improve the fabric of the curriculum. It made them more aware of resulting abilities in alumni they help shaping. They also realised that their personal attitude and ideas, if made explicit, are helping to do so.

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[63] WU houses 4 'schools': Environmental Sciences, Life Sciences, Technology & Nutrition, and Social Sciences. The Environmental Sciences school presently has 11 MSc programmes. See http://www.wau.nl/msc/