

How to translate Geo-Information competencies to GI education?

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Abstract

Preliminary results of a ongoing study dealing with the necessary Geo-information competencies are presented. The demand of employers for Geo-information specialists and the supply of educational institutes are related in order to make decisions about possible changes in the curriculum.

Introduction

The last few years the word competencies is also appeared in the Geo-information (GI) world. Both in the job market (e.g. job advertisements) and in the educational field (e.g. see amongst others UCGIS, 1997). In this paper the method of defining the needed competencies is shown, as a first approach to translate the competencies to a Geo-Information curriculum. Competencies are here defined as "the integration of knowledge, skills and attitudes relating to a certain role/job". Knowledge is defined as what the person working in a GI job has to know, skills is seen as the specifics to do a job (relates to training). Attitude is defined as the mental state (involving beliefs, feelings, values and dispositions) to act in certain ways. Looking at a sustainability scale, knowledge will be more permanent (especially if has in itself methods of updating), skills can change more rapidly (e.g. proficient in ArcView 3.x will not mean automatically proficiency in ArcGIS 9.0) and especially the attitudes can differ rapidly (e.g. a new manager can take away the fun in your work).

Earlier work (Bakker and Bakker, 2000) indicated some of the major changes as seen and needed in the GI curricula. Also the answer of the questionnaire in Meyles et al (2002) indicate that the job market see the need of a constant update of the curricula.

The two major driving forces for this approach are a restructuring of all the curricula of the Van Hall Instituut according competence oriented learning and the need to define the Bachelor-Master connections between the Van Hall Instituut and Larenstein (both universities of professional education, mostly with curricula on a Bachelor level) and Wageningen University Research center (Bachelor and Master of Science).

Aim

The main objective in this study is to present the method and results of the translations of needed specific GI competencies into a GIS curriculum. We will show preliminary results, because the process is still ongoing. Final results are expected at the end of the year 2004.

Method

An overview of the method of the research is presented in figure 1.

As first step job advertisements are collected. Most paper advertisements are from the Netherlands collected in a period of circa 4 years. They were published mostly in daily newspapers or specific journals dedicated to geo-information or one of the domains/subjects. Also web advertisements were collected over a period of three years. Almost all are published at <http://careers.geocomm.com/>. Some other information was collected from Huxhold and Grams, 2000. Also a process to collect a more extensive description of the tasks (function specific performance descriptions) of GI professionals is undertaken, but that is still in a first phase. Not all agencies are willing to give this information, because it also relates to business information. All this data is summarized in a database. See for an example Appendix 1.

The second step incorporates the analysis of the data from step 1. Using the analysis, literature (e.g. the materials of the Geospatial Workforce Development Center), discussions with people and companies involved in geo-information and own experiences formulate a list of competencies, also subdivided into knowledge, skills and attitudes. The competencies are separated according a more general set and the more specific geo-information competencies.

The results of this step is also not yet finalised, because the number of competencies and level of needed detail are still under discussion.

The third step incorporates the different levels of the competencies, by combining the major products of the GI community in relationship with the possible different roles. Products are typical examples of what people have to deliver. Roles are the different actions and activities that are assigned or expected from the person or group on the workplace. We foresee now three different levels of competencies like basic/orientation, intermediate/intensification and excellent/outstanding. The result will be a competency profile, a kind of table of one page that summarises the relevant information. Especially at this level cultural differences may arise because definition of tasks, content and title of a job differs according types or organisation (e.g. public or private) country and domain (e.g. civil engineering or human geography).

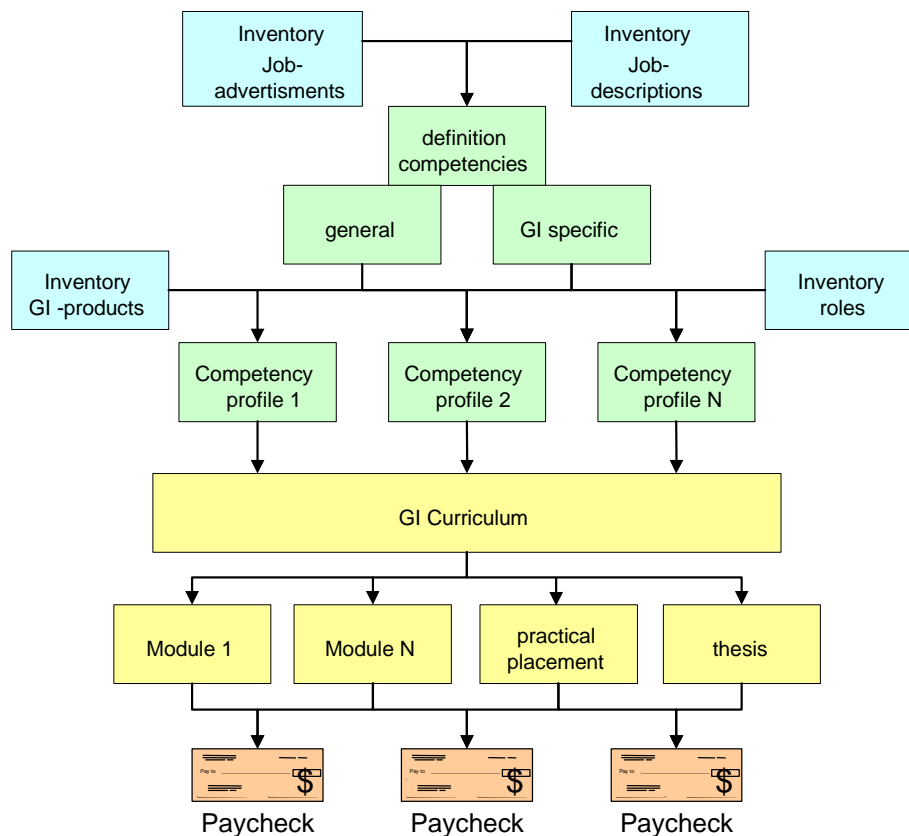


Figure 1 An overview of the used method

From these competency-profiles the curriculum is defined and developed, taken into account the chosen objectives (perhaps not catering for all the different needs in GI-country worldwide), didactic methods (e.g. project based learning) and type of students (with working experience or not). Different modes of delivery (e.g. e-learning, learning on the job) and possible length (e.g. 1 year full-time, or 2 years part-time) are also important to consider. Certainly the possible competencies of the involved lecturers will influence the development and content.

The definition of the curriculum is aided by a general model (figure 2). This model has three major points, as seen in the collected and analysed data. GIS can be seen and used from a certain domain (e.g. agriculture or environmental sciences); from the Geo-ICT: geo-information communication technology side or from an management perspective. The spatial data is the basis of all work. A possible workflow is a question from the management, that can be answered by a specialist in a domain, using the relevant spatial data with the spatial tools (GIS). In such a way the management will receive the relevant information. This model can help to locate the needed knowledge, skills and attitude depending on the location of certain roles and jobs.

From these competency-maps the curriculum is defined and developed, taken into account the chosen objectives (perhaps not catering for all the different needs in GI-country), didactic methods (e.g. project based learning) and type of students (with working experience or not). Different modes of delivery (e.g. e-learning, learning on the job) and possible length (e.g. 1 year full-time, or 2 years part-time) are also important to consider

If the results are good, students will receive their pay-checks and can live long and prosper in geo-information country.

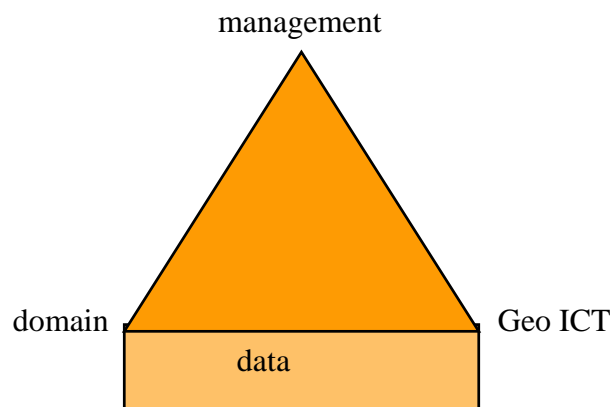


Figure 2 The model that is used for the analysis

Results

The preliminary results are given according the different steps as indicated in figure 1.

In analysing the job advertisements and the descriptions it became clear that the used language was not easy to standardise. Using lookup-tables makes this somewhat easier, but still some subjectivity is present. Especially the used terminology is extremely different. 100 job descriptions from the United States gave already 68 different job titles, with only a few scoring higher then 5 (GIS Analyst, GIS Technician and GIS Specialist). An example of the differences in the job market in the Netherlands is given in figure 3. Especially the increase in the year 2000 is remarkable (millennium bug meant more work for IT), but at this moment some decline is visible, although posted jobs are not always a good indicator of the real demand for people.

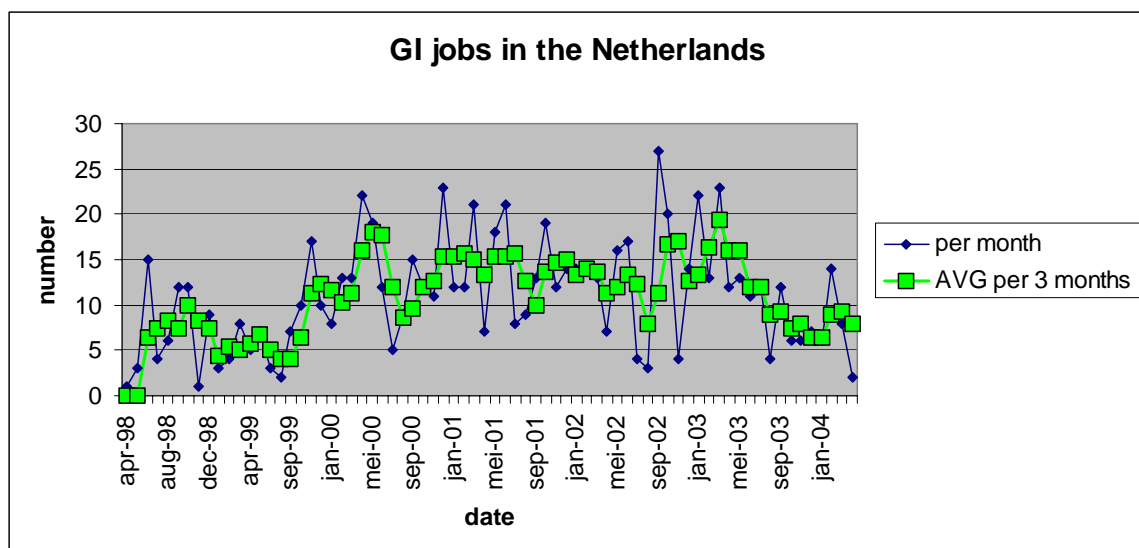


Figure 3 The number of GI Jobs per month as advertised in newspapers and magazines between April 1998 and April 2004 (total number 791) Also the average per three months is given.

In the following tables 1 till 4 some first results and examples are given. In figure 4 the coverage of the needed competencies for an Analyst are given. In such a way a curriculum can be defined by the different topics related to the sides of the triangle of figure 3.

Table 1 Some examples of competencies

General competencies	Specific Geo-information competencies
Reporting (written and oral)	Spatial literacy
Creativity	Map making
	Spatial analysis
	Relation between business needs and spatial data (workflowmanagement)
	The translation of a spatial problem into a solution

Table 2 Some terms used for geo-information knowledge, skills and attitudes (not complete)

knowledge	skills	attitudes
Spatial analysis	Master GI software of different(?) vendors	Flexible in choice of different solution
Spatial representation (cartography)	Make an efficient and effective map	Creativity in choice of spatial analysis tools
GI algorithms	Program GI - tools	Communicate with the aid of maps
		Accuracy in data collection and description

Table 3 A few examples of products and a short description

Geo-information products	description
Map	To process a question towards an answer using a good spatial presentation
Spatial database	To develop a spatial database, so that standardized queries are possible
GI software	To develop an application that is reliable and robust in use
Implementation plan	Plan to implement an enterprise wide GIS
Web mapping service	To build and/or maintain web mapping service

Table 4 Some roles or jobs, with their specific Geo-information competencies

Roles / jobs	Specific Geo-information competencies
(Project) manager	Communicate about the value of geo-information
Programmer	Adjust GI software according clients needs
Analyst	Use GI software in order to answer a (complex) question
Data-collector	Collect and maintain spatial data in such a way that standardised use is possible

In table 5 an example of a competency profile is given. Such a profile can be used to see if in a certain module this aspects are coming back. If a students lacks certain competencies, he could choose specific the modules with the needed competencies. A good support of the student and relevant assessment is also necessary to have success. Success is defined as that the student can find a job where also the employee is satisfied with the result.

Table 5 An example of a competency profile

<i>definition</i>	The translation of a spatial problem into a solution			
<i>Context</i>	<i>control indicators</i>	<i>Level 1 (basic)</i>	<i>Level 2 (intermediate)</i>	<i>Level 3 (excellent)</i>
The application of GIS for siting a new nature reserve	Use of different datasets, overlay, reclassification Quality of final product (map)	To sketch the needed result, and with help of the lecturer can use certain commands to reach the result	Develop an model on paper to communicate with the client and lecturer	Discuss and evaluate used data, model and presentation
<i>products</i>	<i>roles</i>	<i>knowledge</i>	Theoretical concepts of siting	
Report and maps	Client and consultant	<i>skills</i>	Use of GI software	
		<i>attitudes</i>	Creativity, communication	

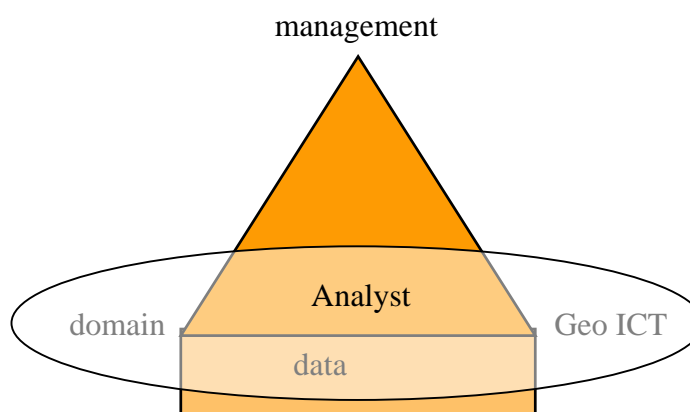


Figure 4 An example of an Analyst in relation with the educational needs.

Discussion

A better approach would be to let the people already active on the job market to describe their activities by themselves. But if this gives a more reliable result is not certain.

The translation of the competencies in a curriculum is also influenced by the availability of the lecturers involved. The possibility to bring in new competencies with help of new lecturers is at the moment due to the economic situation not feasible. Also it is important to sustain the already available knowledge, skills and attitudes inside the actual curriculum and be critical to different fashions in educational theory

The fast development of geo-information software, data and the overall information technology development (Petch, 2000) makes that these competencies are placed in time. So especially the general competencies like flexibility and creativity are needed, but both are not easy to teach and to assess.

The whole process as described gives a better relationship between job market and education, but it is not sure of using e.g. a model curriculum like developed earlier will give a similar result (E.g. Goodchild and Kemp, 1992).

Conclusions

It can be concluded that it is possible to define competencies for jobs in the geo-information market, but that the reliability (in time and content) should be improved. The translation of competencies into a geo-information curriculum is possible but needs a dedicated team of lecturers which are proficient in the same competencies.

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