



Potholes and Obstacles on the Learning Path. An experimental analysis of a GI curriculum using GI-activities as teaching subjects

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Abstract

In 2007, a small survey was held among teaching staff of the Master of Geo-information curriculum at Wageningen University. The objective was to find out if an overview of entry and exit mastery levels per teaching subject would provide a basis for judging the quality of the curriculum.

Findings were, that this approach gave insight into some quality aspects.

A conclusion was that specifically the connectivity between curriculum components can be strongly influenced by subjective concepts held by members of staff about on the contents of components. This may result in cliffs, gaps and overlaps with regard to knowledge and contents between consecutive curriculum components. Where that happens, the chain of components that constitute a Learning Path can be improved.

Keywords: curriculum, competencies, GI-activities

1 Introduction

This paper is about an experiment with a new approach to describe some aspects of a curriculum on geo information science, with a focus on the relationship between competencies and internal structure.

The trigger for this was the intention of Laboratory for Geo-Information and Remote Sensing at Wageningen University to evaluate the current Master curriculum MGI in early 2007. This author contributed to that evaluation by reporting about an experimental application of some ideas, developed in the GI-Link project (Rip 2006).

The GI-Link project was focused on trying to bring about greater clarity and transparency in the relations between the world and the GI community. It was partly based on the descriptions of competencies that the educational programmes at our university were asked to prepare in 2004 (Rip and Epema 2004). It is also partly based on a later GI-education-harmonisation project in the Netherlands ((Meijles, Rip et al. 2005).

In GI-Link, the concept was introduced to designate professional GI activities (fig.1) as teaching subjects¹ for GI education. The ability of a student to perform these activities can be viewed as the competency that a course or curriculum educates for. This concept, used for analysis of a curriculum, seemed useful to support a discussion on curriculum quality.

¹ Teaching subject: a topic about which lessons are given.

So, a survey was held among members of staff involved with teaching the Master of Geo-information curriculum at Wageningen University. The objective was to find out if the concept of GI-activities would provide a basis for judging the quality of the curriculum.

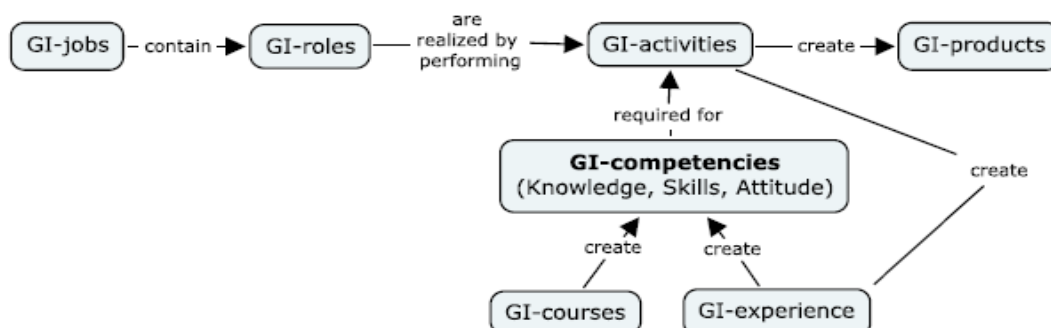


Figure 1 The position of GI-activities is at the intersection of professional GI application and GI learning

2 Objectives and research questions

In this experiment, the focus was on the relationship between teaching content and curriculum organization.

A curriculum is designed to develop capabilities in its students. These capabilities may vary within a certain bandwidth, depending on the specific Learning Path² students follow within the curriculum. These capabilities can be formulated as competencies³.

The concept of a Learning Path as a coherent succession of courses would be stronger if the subjects, dealt with in these courses, are not accidentally occurring. A thematic clustering, recognizable by occurrence in one Learning Path and by repetition of subjects in the courses, would underpin that concept. Therefore the distribution of subjects across courses is an important aspect of a curriculum.

Another aspect is the nature of the learning curve: learning as a gradual growth of capabilities, or: increasing mastery of a domain. Using the "path" metaphor suggests, that a set of well connected segments constitutes the best way to reach the objective.

Therefore, research questions of this experiment were:

- Which subjects (GI-activities) are taught in the curriculum?
- In which courses are they taught?
- What is the intended capability growth for a subject in a course?

3 Methodology

In preparation for the survey, a tentative list of subjects (formulated as GI activities) was created by the author. Subjects on the list were inspired by various sources,

² Here, the phrase "Learning Path" means: a sequence of learning activities, designed to teach a specific theme. A curriculum might contain several Learning Paths.

³ Used here as: the ability to perform a certain role in a certain context on a certain level of complexity.

including(Gaudet, Annulis et al. 2001) and (Property Services Training Australia 1998).

The items on the initial list regarding Attitude were taken from (Meijers, Overveld et al. 2005).

The initial list was included in a table with 3 groups of 2 columns. The 3 groups represented the components of competence: Knowledge, Skills and Attitude (K, S, A). For each of these components, two columns (entry and exit levels) were available to record the member of staff's assessment of intended growth in mastery of a subject during his particular course.

Four possible levels of subject mastery were offered to the teacher to indicate mastery levels for Knowledge and Skills: 0, 1, 2 and 3. They represent the development stages of 'nothing', 'beginner', 'advanced' and 'expert', respectively.

The same 4 values were used for the Attitude assessment with a different meaning: unmoulded - basic - satisfactory - very good.

A student is supposed to enter a course with certain values for K, S and A for each subject (say 0, 1 or 2) and finish the course with KSA-values for each subject on a higher level (say 2, 2, and 3). The difference between K, S, or A values at entry and exit level reflects the intended teaching result⁴.

The student's actual learning result, as might show at examination, may differ from the intended result. Here, the focus is on the intended growth of capabilities.

It was left to the individual members of staff to assess both the required entry level and the intended exit level for subjects in the courses they teach.

The table with the initial list of subjects was presented to 6 members of the teaching staff consecutively (involved in 10 courses). They were asked, for each course they teach, to rate the entry and exit levels of K, S and A for each of the subjects they deal with in that course. As the initial list of subjects was tentative, new subjects were mentioned in almost every interview.

The names of the subjects, as indicated by staff, were then reformatted by this author to the GI-activity format: ideally, this would be a verb referring to an action, followed by words indicating the result (for instance: "think out data acquisition procedure").

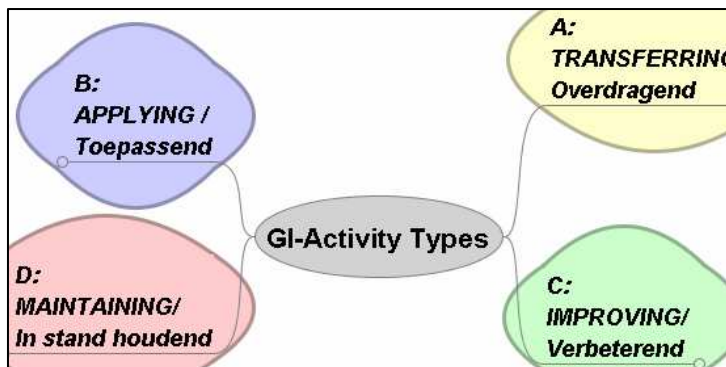


Figure 2 The 4 GI-Activity groups (Rip, 2006)

The resulting GI-activities collection was organized into a taxonomy with 4 main activity groups (Fig.2). Within these main groups, the activities are organized hierarchically in (sometimes) 5 levels of detail⁵.

In the end, the 6 members of staff had identified 108 subjects related to

⁴ This approach is similar to the method used for the ADISA curriculum design tool (Paquette, 2007)

⁵ In its present state, the collection contains 31 Transferring GI-activities, 72 Applying GI-activities, 16 Improving GI-activities and 43 Maintaining GI-activities.

Knowledge and Skills for the MGI curriculum. For Attitude, 20 subjects had been collected.

These data -except the Attitude subjects - were used to create the curriculum matrix, containing all of the teaching subjects (or GI-activities) in its rows. In the columns, 3 groups of 2 bundles of columns represent the 3 Learning Paths in the curriculum: GIS, Remote Sensing and Geo-IT.

The Attitude aspect was left out of the curriculum matrix, because the results did not seem to contribute much to answering the research questions: the response from staff had been low and the Attitude items were not specific for the GI-field.

3.1 Curriculum matrix

Each Learning Path section contains one bundle of columns to reflect Knowledge growth, and a second bundle of columns to reflect growth of Skills. Each bundle counts as many columns as the number of courses that make up the Learning Path. In a bundle of columns, the intended growth of mastery of a subject during the sequence of courses was represented by a sequence of domino pieces (fig.3).

The curriculum matrix itself is an answer to the first 2 research questions: which subjects are taught, and in which courses.

Its contents were then used to answer the remaining question about capability growth.

3.2 Capability growth

Within a Learning Path, the same teaching subjects can occur in the sequence of courses. The entry-exit Knowledge and Skill values for a subject in each of those courses reflect the capability growth, or the increasing level of mastery of that subject in the course of the Learning Path.

A gradual increase of mastery requires the exit level of a course to be the same as the entry level of the next course. This is a condition that can be checked for each subject, at every transfer to a next course.

In terms of the road surface metaphor:

- a connection between courses, where the exit value for a subject is lower than the entry value for the next course, constitutes an obstacle;
- a transfer where the exit value is higher than the entry value constitutes a pothole.



Figure 3 An idealized sequence of domino pieces to represent growth to mastery of a subject while on a Learning Path consisting of 3 courses. The left half represents entry level, the right half represents the exit level.

4 Results

Working along the lines as described in the previous section, the results were obtained and processed.

4.1 List of subjects

A list of the collected teaching subjects, organized as a hierarchical taxonomy was a first result.

This list reflects the choices made at Wageningen University's MGI curriculum for teaching GI application in Environmental Sciences. The curriculum is of a generalist nature: a wide range of subjects, most of them with low first entry levels.

Curricula offered by other organizations that focus on for instance Cartography, Geo-ICT, SDI or Land Surveying will have a different list. For specialized curricula, one would expect a higher number of detailed subjects, and a larger proportion of subjects with higher entry levels of mastery.

The taxonomy is available from http://skgr0103.wur.nl/~geodesk/GI_activ/GI_activities_taxonomy_5oct07_EN.htm

4.2 Curriculum matrix

A matrix with the subjects taught in this curriculum by means of Learning Paths. The matrix part for one of the Learning Paths (Remote Sensing) is shown (Fig. 4). The matrix parts for the other 2 Learning Paths are similar, but different.

The RS Learning Path matrix shows the distribution of the subjects, the entry and exit levels per subject in a course, and, by that, the contents per course.

It also shows the intended growth of mastery for each subject per course by means of the domino pieces.

This enables us to get an impression of the smoothness and the steepness of the learning curve for both the Knowledge and the Skills aspects of subject mastery.

The matrix also shows that in this Learning Path of the MGI curriculum there is more or

	KNOWLEDGE					SKILLS				
A Transferring										
A4 Taking Care of PE										
A401										
A5 Communicating										
A502										
A6 Reporting										
A601										
A602										
A604										
A605										
B Applying										
B202 Working Basics										
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less a balance between the Knowledge and the Skills aspects.
Other curricula, for instance in vocational training in some GI subject would probably have more emphasis on the Skills columns.

4.3 Unexpected

In the Learning Path matrix, that records subjective assessments of course teaching staff, some cases of differing opinions between members of staff were found, concerning intended entry and exit mastery levels.

This occurred where more than 1 member of staff was involved in teaching a course.

Another unexpected find was, that in some cases the entry mastery level for a subject was lower than the exit level for that subject in the preceding course.

Finally, the response from staff with regard to Attitude was less than expected.

5 Conclusions and discussion

In this paper, the results of a fairly simple and small experiment were presented. It shows a way to map a curriculum, a learning path or just a single course.

This method might be applied for academic education, vocational teaching or training. In principle, it is not tied to any specific discipline within the GI-field.

The approach provides insight to curriculum structure, which is good for manageability. It also shows course content in a way that makes it comparable to other courses (if they are shown in the same way). This is relevant for awareness within the discipline. And it would be helpful in case of international co-operation for the same reasons.

Finally, the clear view on the contents of courses, phrased as activities, might help students to select a course or learning Path, or avoid it...

This approach, however, is only simple because of some important preconditions:

- a list of teaching subjects that can be used
- a willingness to take a simple approach to mastery levels

Apart from those points, the tiny scale of this experiment is of importance. A survey about 1 curriculum among just a few people in the same organization is likely to present less problems than surveying multiple curricula in different countries.

5.1 Teaching subjects

The list of subjects used here was sufficient to characterize the MGI curriculum, because the initial list was supplemented during this experiment. Therefore it clearly does not cover all possible teaching subjects in the GI-field.

It would be nice to have an international standard for GI teaching subjects.

An important step in that direction has been made by the American University Consortium for GIS (UCGIS) by composing the GI Science and Technology Body of Knowledge ("BoK") (DiBiase, deMers et al. 2006). The 2006 edition lists hundreds of topics to teach, but it doesn't seem very easy to link the contents of an existing local curriculum to the BoK methodology. Nevertheless, in case that set (or a next version) becomes a standard in the United States, GI-teaching organizations elsewhere might find it interesting to see if BoK can be related to their ideas about teaching GI.

5.2 Mastery levels

In the approach used for this experiment, there is no need to define class boundaries of mastery levels beforehand. It is left to the gut feeling of staff to assess the growth

of mastery they bring about in their students. A basis for this are the following 2 assumptions:

- a) Teaching staff is relied upon to have a notion of where the content they teach stands in the subject field. This notion enables them to indicate entry and exit levels for subjects in the courses they teach.
- b) As staff, involved in teaching in a curriculum, are supposed to be part of a coordinated teaching effort by a group of people, the teaching content will have been discussed among staff involved in the teaching. Ideally, that would be the place where agreements are reached on the intended entry and exit levels for subjects that are dealt with in the courses.

These assumptions appeared to be not entirely correct for this experiment. In case of repeating a survey like this, a researcher should be better prepared to handle differences of opinion within organizations or teaching teams.

In spite of the above, experiments like this could be easily repeated with little cost involved. This approach might be considered as a way to make a quick scan of content and connectivity of a curriculum.

6 Recommendations

Based on the results of this experiment, some recommendations can be made:

- Every GI-teaching institute should carry out the survey as described here, and discuss results internally and externally. This should increase awareness of what goes on in GI-teaching.
- Every GI-teaching institute should make an attempt to relate the Body of Knowledge topics to their own curricula and courses. This important initiative deserves to be taken seriously.
- UCGIS might try to further develop Body of Knowledge to enable it to make curricula matrices as presented here.

These recommendations are made to better enable GI teaching organizations to cooperate nationally and internationally, with each other as well as with professional GI-users and their employers.

With regard to Europe, it is relevant to mention here, that an international structure for recognition of acquired capabilities is about to become reality: the European Qualification Framework for lifelong learning (EU 2008). The GI trainers and educators in Europe might embrace this development by attempting to work out an internationally accepted collection of GI teaching subjects.

7 References

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