

Training Offers in Geographic Information Methodological References as a Preliminary Requisite in a Quality-Control Approach

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SUMMARY:

This article’s objective is to propose some methodological references for putting together offers for Geographical Information training, offers that have to be adaptive and effective to be able to maintain the quality of training. The suggested approach is based on five key elements: the diversity of situations and requirements as well as the changing nature of the content matter of the training to be dispensed; the interaction between the latest scientific knowledge and the competencies mobilised in action; the definition of the skills aimed for, of the content matter of the training, of training tools and aids, of instructional sequences; the granularisation of the training content matter which allows the putting together of best adapted solutions; the use of educational technologies that lead to the setting up of new pedagogical situations to answer trainees’ needs and constraints for the best. This frame of reference is then structured into a pedagogical-engineering approach and is demonstrated by implementation perspectives.

KEYWORDS: *educational engineering, vocational skills, granularisation, training quality, Elementary Content Units*

INTRODUCTION

The debate on training quality forms an important part of the overall discussion on trainers’ practices and the effectiveness of what they teach. This evaluation often involves the economic angle: training-costs analysis and financing.

This approach is most often based on the setting up of a mechanism to evaluate the training, as it progresses as well as at its completion, to evaluate its results (number of trainees, evaluation of acquired knowledge and know-how, feedback on the training by the trainees at the completion of the training).

This approach cannot be used to its fullest unless it is prepared by an appropriate process in the putting together of the training offer that is focused on the definition of objectives and resources necessary to attain them.

This article’s aim, therefore, is to build a base of methodological references for putting together Geographical Information training offers that are adaptive and effective.

ELEMENTS OF THE METHOD

Five key elements, involving the general context and specific dynamics of the Geographical Information training market, will form the framework of the proposed approach:

The changing nature of contexts and requirements

As a field of scientific knowledge and professional skills, Geographical Information is always ‘on the move’:

- The contents and framework of knowledge are in rapid change: once beyond the basic concepts, the concerned technological fields are in rapid expansion as are the opportunities for operational applications in other scientific domains and professional fields.

The state of the art is highly fluid; the definition of the training contents should be capable of being changed quickly and often.

- Competencies and know-how requirements also vary widely, as much due to the large number of application fields involved as by the inherent variability of incorporating Geographical Information skills in different trainee job descriptions. (Depending on the organisations and their sizes, the requirement for Geographical Information skills will take the form of either the profiles of specialised employees or those of employees with dual skills, the profiles sought for being that of professionals who have incorporated geomatic skills in their knowledge base.)
- The prospective trainees all have different levels of pre-acquired knowledge, not only, of course, in continuing-education programmes, but also in initial education where the diversity of different educational streams leads to very heterogeneous target audiences. Though the training objectives may be homogenous, expectations and requirements of the trainees vary widely.

This ‘uniqueness of each student’ is a factor that will weigh more and more heavily on the trainers and on the creation of any reasoned training offer.

Conditions for developing a training offer

Two major aspects dictate the mechanics of putting together a training offer:

- Ongoing changes in the knowledge base, resulting from the production of scientific knowledge. This aspect relates naturally to the system of initial education (universities, engineering institutes).
- Need expressed by employers (business enterprises and public organisations) to satisfy short- (or longer-) term requirements for skills and practical competencies in using tools and methods. This aspect is often handled by the system of continuing education consisting of specialised training centres, software publishers and solution providers.

There is a risk of an imperfect response in fulfilling the required results if these two aspects are taken into account independently, or even concurrently, the first because it tends to generate an ‘identical reproduction’ of know-how rather than responding to the requirements of the target population, the second because it is often limited to fulfilling short or very short term requirements without factoring in the need for the evolution and adaptation of competencies necessary (for professionals and their organisations) over the longer term.

In fact, we observe a situation that is dialectic between knowledge and action: rapid appropriation of new concepts by the users leads, beyond the new skills acquired, to the production of new knowledge, professional in nature and complementary to the scientific concepts involved; the matter to be taught to the students should combine these two sources of knowledge.

It then follows that the creation of an offer for Geographical Information training should be an ‘interactive’ exercise involving the new knowledge produced and the expression of the real requirements of professionals.

Four classes of items to be distinguished

Conceptually, the approach to putting together a training offer can be summarised as the interaction between four 'items' analysed or conceived by the instructor:

- **Skills** to be imparted to the trainees forming the pedagogical aim of the training offer: their analysis and accurate definition should be linked to the context, limitations and pre-acquired knowledge of the prospective trainees.
- The **content** matter of the training that the instructor should transfer towards this end: it consists of key elements of knowledge and know-how that constitute the target skills. It should take into account the pre-acquired knowledge of the prospective trainees.
- Training **tools and aids** developed or mobilised by the instructor to ensure the best possible delivery of the training contents, all the while taking into account the trainees' specific limitations and constraints.
- The design and 'assembly' of a **training course** structured in instructional sequences (themselves composed of elementary educational activities).

The approach towards putting together an offer for training will thus consist of a process involving these different item types and the training objectives for their implementation. The focus of this process will be on the training content that the trainee has to assimilate to acquire the target skills.

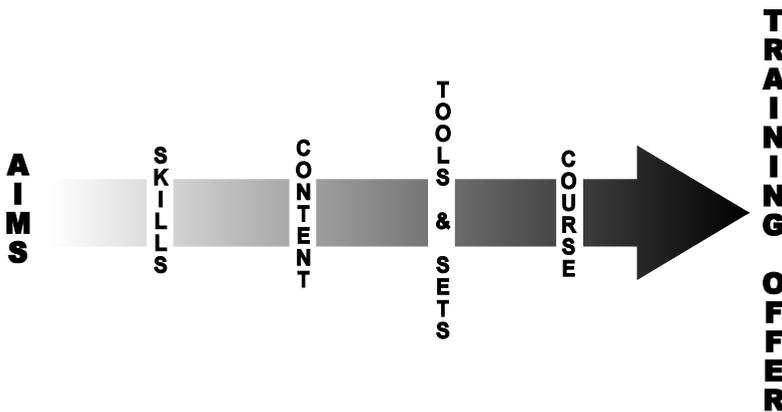


Fig. 1: The four levels in the construction of a training offer

A necessary 'granularisation' of the content matter

To account for rapid change and variability of requirements and their contexts, it is necessary to develop diversified and adaptable methods and solutions. We have thus to 'granularise' the training offer, i.e., break it up into several small components that can be later combined into different learning paths depending on the level, expectations and constraints of each student.

This granularity will be centred around the training content matter (both on the conceptual and key-skills level) that is focus of the offer's structure but shall also apply to other elements that make up the approach:

- The target skills will have to be analysed to elaborate their architecture and conceptual structure.
- The granularisation of the training content matter into Elementary Content Units will allow their later combination into diversified sequences or individualised learning paths. It is the sequencing of the training offer and the development of pedagogical tools and aids from these granules that will ensure their assembly into training offers best adapted to students' requirements and limitations.

We can define these content granules as ‘operational units that constitute **reference knowledge**’ (Samurcay, Pastre, 1995).

- These granules are constructed by bringing together content matter clustered around **pragmatic concepts** (Pastre, 1997) that bind them; a granule therefore remains a ‘relative’ entity which can itself be further divided into finer granules or assembled with other granules into a bigger one depending on the level of fineness being sought (and the degree of detail envisaged).

Finally, one point is of particular importance in Geographical Information: the assimilation of concepts and methods cannot be limited to tutorials and simple exercises (easily mobilised). They should be presented in an ‘operational’ situation through practical work and case studies using ‘real’ data sets. These tools (case studies, more complex data sets) can be used as key-elements in inter-granular assembly and consistency.

Why educational technologies?

How educational technologies are used in any teaching programme depends on the position of those involved. If we refer to the ‘educational triangle’ with the three vertices representing knowledge, teacher and student respectively (Houssaye, 1980), we see that the relationships between any two vertices is based on the actors’ pedagogical conduct which itself depends on their existing ideological positions: teaching (relationship of the teacher with knowledge), learning (relationship of the student with knowledge), training (relationship between teacher and student).

We can distinguish educational technologies depending on what positions (and how) they have an impact on educational processes, as shown in the following diagram:

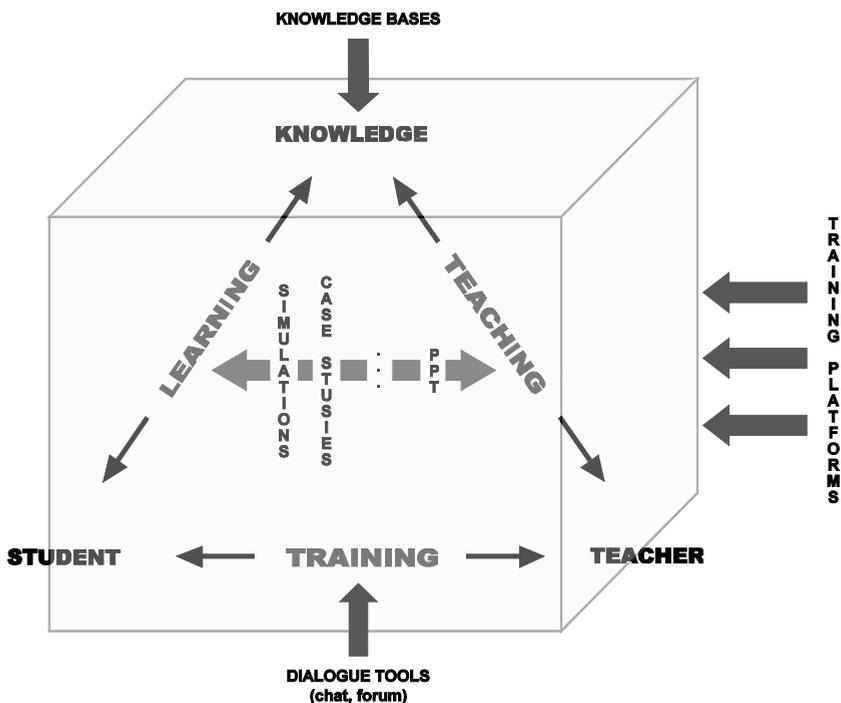


Fig 2: Impact of educational technologies on pedagogical conduct (according to Houssaye, 1980 and Haeuw & al., 2001).

So it seems necessary to propose a ‘training-needs driven’ process, far removed from some E-learning approaches, so called ‘technology driven’. Depending on the types of tools involved, the use of educational technologies should allow the introduction of new pedagogical situations.

The **desynchronisation** of the learning process allows, by affecting either time or space, the overcoming of limitations and constraints of the target population (distance, time available for learning) and/or the requirements of interaction to improve overall acceptability, while putting into perspective or individualising knowledge acquisition.

The use of sets of varied training methods and aids (classical presentation method, desynchronised in time, distant learning, etc.) can itself be combined from one sequence to the other with respect to different granules: offers for training need not be ‘presentation type’ or ‘distance type’; a continuum of solutions based on circumstances can lie between these two ‘extreme’ solutions. Varied education sets can be assembled sequence by sequence, even activity by activity, best adapted to both educational aims and students’ limitations (Haeuw & al., 2001).

The mobilisation of specific resources and skills to conceive and develop these technological situations cannot be justified from the economic point of view except within a costs-benefits framework where the investments in pedagogical engineering are justified not mainly on the basis of certain cost reductions (travel costs, for example) but rather by a better (measured) performance of the training (declination, adaptability, access to populations who would otherwise not be able to participate).

Finally, in the context of allocation of expensive resources (software, hardware and human investments, major engineering projects), efforts must be directed towards the pooling and sharing of these resources which will require the **interoperability** of pedagogical tools and aids. This interoperability cannot be seen as a fixed concept (exchange of support tools, of sequences) but as a sharing of resources and methods between trainers. The more the pedagogical circumstances will be desynchronised, the more the mechanisms implemented and pedagogical tools used will be contextualised in their form and the more they will require usage support beyond simple resource meta-data: detailed user guides that permit the end user to customise these resources and adapt them to his or her own needs and contexts may become necessary (Mc Kell & al., 2001, Purves & al., 2003).

STRUCTURING THE APPROACH

The proposed approach will be logically divided into three clearly defined methodological stages, preceding the carrying out of a training course:

Analysis of target-population requirements and limitations

The expressed demand or the needs of the target population have to be analysed to ascertain their scope, consistency and ‘generic’ determinants, after which can be defined a detailed frame of **skills references**.

As far as possible, these references should be constructed in association with other training stakeholders (client organisation, target population) or, if it concerns more general goals, with other representatives (experts, employers, GIS managers,... and instructors).

An evaluation of the diversity of the target population’s circumstances is also required, both in terms of the individuals themselves (levels and pre-acquired knowledge) and of extraneous difficulties (travel possibilities, time availability, Internet access, etc.).

An ongoing iteration between the recipient population, instructors and experts is necessary to avoid two pitfalls: limiting the perspective to that of the offer or taking into consideration only the requirements or limitations, expressed in advance, of the target population. Going beyond short term operating skills, one has to aim for the ‘intelligence’ in professional situations, the ‘ability to conceptualise which renders the skill adaptable and transferable’ (Pastre, 1997).

Defining the granularised content matter

This phase consists of delimiting modular and declinable training content matter on the basis of the detailed skills references mentioned above. Its granularity will serve as a basis for the implementation of different instructional sequences in the following stages.

This stage leads to the creation, for each granule, of:

- A more or less formalised reference content matter.
- A prototype instructional sequence (assembled from learning activities: course, exercises, tests, etc.).

Developing adapted educational sets and creating pedagogical tools

The design process of educational sets is developed for each granule. This process takes into account the target population's limitations (see Stage 1) to define the requirements of desynchronisation and individualisation of learning paths. It also incorporates cost and time constraints (mobilised resources, time to implement) within the framework of the training project.

The development and production of pedagogical tools should be adapted to the pedagogical aims, to the context and to the selected training sets. This should be done while taking into account (and adapting to) technical and material limitations of the students.

Particular importance should be accorded to using case studies and they should be considered at this stage as a way for trainees to learn in 'operational' circumstances. Case studies will also lend consistency and continuity between granules and sequences that relate to them.

This stage will provide all the operational elements necessary for creating the session at a material level (practical organisation, mobilisation of participants, resources and pedagogical material).

Links with a quality-control process

In this structured framework, a quality-control approach could be supported by the evaluation of the training results using 'standard' procedures concerning:

- The evaluation, formative (monitoring the trainee, inside the learning process) or certificatory (assessing and attesting results) of the knowledge and skills acquired by the trainees during the course or at the end of the training.
- The evaluation by the clients (trainees, employers, human resources managers) of the session or the entire curriculum.
- A longer-term evaluation of the impact of the training: use of acquired knowledge in trainees' professional activities, impact on the functioning and results of client organisations.

In fact, for the first two items in particular, the common designing of the references of targeted skills, and therefore of the training objectives themselves, will lead to an improved idea of the results to expect, and will therefore legitimise the evaluation criteria used.

IMPLEMENTING THE METHOD

This approach is currently being implemented in two educational-engineering projects in Geographic Information. Their frameworks differ but they have a common objective to produce, for the use of trainers, operating tools for creating training offers adapted to the target population and/or adaptable to varied offers and situations: set of resources and educational tools, methodological guides to help trainers use these tools and adapt them to their own needs and to those of their public.

GIS Training in European Agricultural Education (GISA2E)

This project, currently in progress (it will conclude in end-2004), is conducted within the framework of the Leonardo da Vinci II programme with seven European partners. Its objective is to create an open training offer in GIS that allows agricultural teachers and trainers to grasp the new training content matter. They should be able to produce new training offers adapted to their target population, including the ability to 're-engineer' existing thematic training offers, i.e., to introduce the 'Geographic Information' dimension to existing content matter and courses.

The approach adopted for this project is the general one described above, with the added particularity of an action at two levels:

- development and 'open' analysis leading to the design, within the perspective of final production, of tools and 'generic' and adaptable aids.
- implementation and test offers with tools and aids that are highly contextualised, adapted to more narrow target populations (for example, professionals of precision farming in Sweden).

This should allow both:

- the validation in a real-world situation of references and tools developed,
- the production of references and 'generic' tools that are reusable by trainers and teachers in different and varied situations.

This production of a structured set of pedagogical resources (professional and pedagogical references, content granules, pedagogical tools and sets) will be (and should be) accompanied by a 'trainer's guide' designed to help understand these resources and this approach.

Open Training in GIS for the personnel of the French Ministry for Agriculture and Fisheries (FO-SIGMAP)

This project, currently in the initial phase (January 2004 to September 2005) aims to develop open training sets in GIS to diversify, customise and contextualise the training offer destined for the decentralised service personnel of the Ministry (about 15,000 individuals of which 3,000 are concerned with Geographic Information and 1,000 users of GIS tools).

The current offer, which has been developed considerably over the last few years to fulfil the growing skill requirements, has led to substantial growth in the number of agents trained at the classroom training courses conducted at agricultural institutes of higher education (training of decision makers, GIS project heads, advanced users, etc.).

However, this mechanism has to be improved to take better into account the individual and his service history (individual educational paths, service projects, specific local contexts) and has to be made more interactive both upstream and downstream of the actual training.

We have thus to move towards an 'individualisation' of the training path by making the offer both readable and flexible and, at the same time, present to the Ministry's personnel a culture of technical sharing in matters relating to Geographic Information, all to allow for better coherence between skills and activities driven in common.

The project therefore aims to produce an open training offer, partially desynchronised, based on an integrated architecture of continuing education (online service, database of pedagogical resources, network of trainers and tutors).

The results that are expected from this experimentation (development, prototyping, tests, implementation) consist of:

- a set of open-learning scenarios and pedagogical products,
- a set of operational pedagogical sets,
- a methodological guide for trainers and tutors.

These products will be complemented by a structured proposal for training systems to be deployed by the Human Resources Service of the Ministry: local resource personnel (trainers, tutors), system for validating acquired knowledge, etc.

CONCLUSION

The value of this approach for the instructor, educational organisation or network of trainers extends beyond the immediate results expected. For them, this real investment in the medium term in pedagogical engineering is of great interest because all processes that lead to the development of an offer for training can be upgraded (reused, changed, improved) for developing new offers in the future that are similar. This is due not only to the reuse of developed products (skills references, pedagogical references, Elementary Content Units, pedagogical tools, pedagogical solutions and sets, etc.) but also to methodological aspects : a fine-tuning of methods developed will be allowed by both ‘accumulation’ of experiences and profitable exchange and sharing of pedagogical experiences, references and resources with other trainers.

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