Geographic Didactical Approach in Remote Sensing and Sampling Techniques. From the Satellite Imagery to the Territorial Model

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Abstract

Didactic approaches have fundamentally for ambition to set the student in situation of research. The didactics approaches have two pedagogical finalities :
The first finality is to train to the observation of the geographic phenomena that can be noticed or recognised in the geographical space. They are signs, cultural significant, land cover, concentration's places activities, which in order this first objective privileged methods of classifications using for example satellite data, sampling techniques, image processing. The most often results are the typologies of geographical objects or geographical phenomena. The geographical reality analysis from the experience of terrain (sampling technique) and "mediators" (satellite data, image processing) has for objective to make pass the student from a confused representation of the geographical space to intelligible data.
The second finality is to induce the student to elaborate abstracted general ideas from the suitable observation with the help of remote sensing data and image processing by the constitution of models with Geographical Information System (GIS). This wording and model can be a fundamental dimension of the instrumental didactic approach in geography. It participates in the training of the geographical intelligence. That is to say the capacity to understand and to explain geographical realities. This "active pedagogy" approach has as interest to allow a appropriation of knowledge by the using of quantitative methods : data analysis, image processing, GIS. It gives the student in the framework of the learning and the appropriation of both conceptual and methodological tools. We support its purposes on the example of production of geographical information and modelling the urban region of Casablanca in Morocco.

Keywords: geographical didactic, remote sensing techniques, geographical knowledge, active pedagogy.

Introduction

The didactic approaches that are developed within the framework of the training of the use of the *remote sensing* tool and data in human sciences at the Ecole des hautes études en sciences sociales has for fundamental ambition to set the students in situation of research. They want, besides, determinedly multi-field. Training ask to students of Diplôme d'étude approfondie (DEA) or beginning their doctorate of various disciplines: geography, history, archaeology, architecture, computer sciences and mathematical applied to social sciences.

Education have a triple objective. First objective is to train the students in methods of production's systems of spatio-temporal information by remote sensing: spatial information characteristics, image analysis, data analysis, sampling techniques, databases, geographic information system. Second objective is to set the young researcher in operational conditions of its future researches. Third objective is to take the student to elaborate computational rules of interpretation and semiological and semantic transfer. That is to give a thematic meaning to computed and produced spatial information.

Two educational axes are developed to achieve the educational objectives. First finality, in educational term, is to train the young researchers in the observation of geographic phenomena by satellite images. Second finality consists to set the student to elaborate general abstracted ideas by the computing of spatio-temporal information model from the satellite observation. This didactic method of education implies two aspects. First, it emphasises the meaning of the measure of remote sensing. Secondly, it makes links between the information carried to the screen, its meaning and algorithms used. The didactic approach used applies to three scenarios: the students and the lecturers according the education seminar of the EHESS, the continues training on one week and training period of several months.

Education of the remote sensing makes from two basic ideas: meaning of the measure and educational strategy developed to set the student to elaborate it model from satellite images.

1. Signal and meaning, object of spatial knowledge

The meaning of the measure, that is the radiometric contents of the remote sensing image information put three questions: what is measures, what is represented on the remote sensing images, which are the knowledge which can remove?

Remote sensing numeric image is a radiometric matrix measure of the surface of the Earth. Every elementary unity of measure, the pixel, is the expression of biophysics property of the ground. It acquires a sense in geography in the consideration group of pixels. They define and characterise a geographic object.

The awareness and understanding of the information contained in satellite or airborne data is fundamental for the training of the spatial observation methods of the geographic space. The

set of measures stemming from remote sensing sensors conditions the representations that can make of the space, and more particularly of their visible perceptive forms (landscapes) due to the extracted and analysed information.

The produced knowledge on the geographic space and the spatial objects it composing articulates around the concepts of objects and information. It has to approach in semiological terms transfer (from the image computed towards a symbolic representation of the space), then semantics (from the symbolic representation of the space to the thematic meaning). For example, the study of structures and spatial dynamics can make through concept of landscape. It is an interface and an indicator at the same moment between the image of remote sensing and the geographic space. Preliminary in the semiological representation phase is the data processing: the image analysis. Methodological method consists to stall in best algorithms with the human interpreter reasoning. It requires a constant interactive progress between processing, obtained representations and thematic. It is definite the interactive method or more the active pedagogy. This approach wants at the same moment global and analytical. It uses the informative concepts of textures and structures. They give form, structure and area object values.
Form intervenes as descriptive variable of the space and structure as an explicative element. The knowledge which removes from the spatial imagery can be didactically approach according to the interactive reasoning processing / representation / thematic:

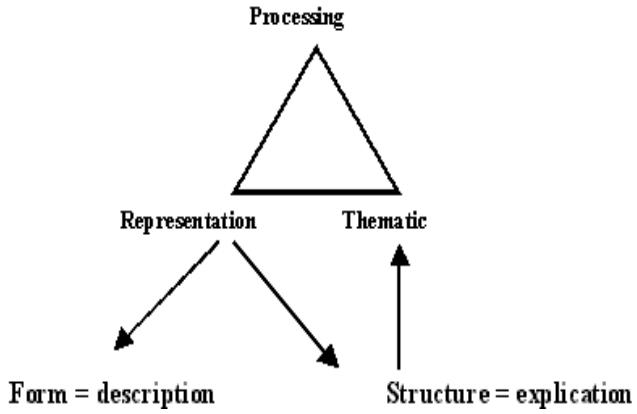

Figure 1

The image analysis, the description and the explanation are followed with the implementation of analysis and interpretation rules. They allow to take into account the multiplicity of image information and their contextual constituents. They have as didactic interest to oblige the human interpreter to analyse his reasoning, to formalise it and it make understandable. The contents of the spatial information are formalised by computational rules and knowledge base methods It implies the use of artificial intelligence systems as the multi-cellular systems or expert systems. We will note that the integration of the temporal contents (historic inheritance, dynamic analysis) with the shape of interpretation computational rules is problematic at the moment.

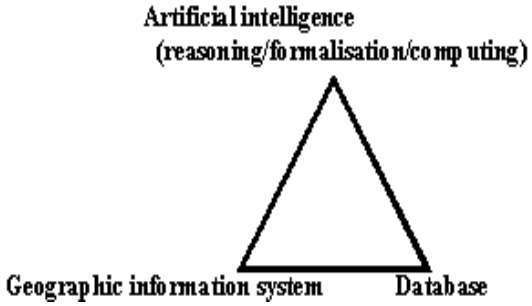

Figure 2

2. Pedagogical ways of image analysis

The didactic strategy organised gets four aspects: the information production, the choice of the perceptive constants, the choice of data and the method of research.

Chosen educational approach urge the students to join three logic's of information production: a descriptive logic, a measure quantification logic and an abstract (conceptual) logic. Within the framework of an abstract (conceptual) approach, landscape, in example, is considerate as an interface to reach the information and the knowledge. It constitutes a stratified sampling base. The interest of this approach is to make autonomous the researcher in the production of information. It constitutes a scientific independence security in comparison with the statistical information agencies and a landing tool in lacks of data, or in the inadequacy of its.

Variable as perceptive constants is a fundamental choice. They have to make link among the variable, mathematical and thematic object, its semantic meaning and its visual representation on the image in the same time.

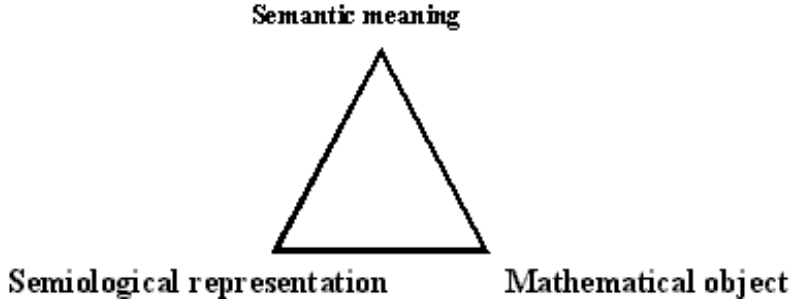

Figure 3

Arises the problem of nomenclature choice with the question of the object taken as perceptive constant choice. It has to be functional to a certain extend that it produces perfectly of the reality studied.

Data choice is original. It determines methodological strategies, representations of the space and influences results and interpretations which are made (Gadal, 2000). "Multi-sensors" or "multi-data" methods, that is use of various characteristics data give a more close vision of reality by the stake in correspondence of different sources. It give also other visions of reality. Didactic approach insists on the choice of data. The multiple vision of reality allows to estimate the aptness of models. It also allows to elaborate new concepts.

The training in the analysis and in the description of remote sensing images makes it two time: the first education phase is of inductive disposition. It obliges the student researcher to analyse his reasoning and to connect every stages of this one in algorithms. Objective is to end a descriptive model of the studied reality. It completes in the following more pushed phases of education by the implementation of analyses and descriptive rules, then, by the implementation and by the formalisation of reproducible methodologies. Training makes on territories which are known of young researcher. Knowledge of the territory facilitates learning and integration of analytical methods. The second education phase applied is of deductive order. It consists to work on unknown spaces with exogenous data using methodological knowledge acquired in the first phase of learning and in the individual lived. The research is concerned by the identification of thematic perceptive constants and on semiological and semantic transfer questions. It allows to introduce additional techniques in the remote sensing that are necessary for the analysis, for the description and for the image interpretation: computational vision and sampling technique theory. Objective is to go to spatial statistics from “map and quantification” monocenical results. Spatial information produced is combined in the knowledge base models. They can be cognitive or formal. Fusion of “spatial information knowledge” ends in distribution and spatial analysis models.

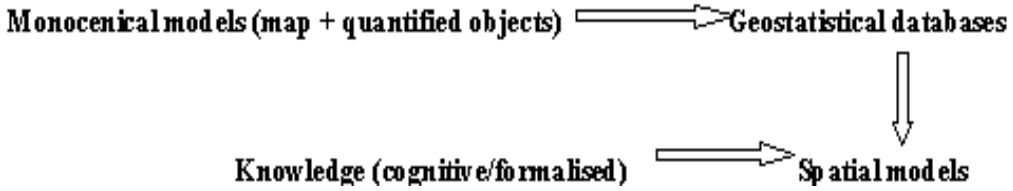

Figure 4

The training is completed by additional courses in computational vision, on the theoretical nature of the human perception system and in sampling techniques.

3. Didactical aspects

Every didactic method answers one of three training courses. The first cycle of training courses is of academic nature. It is asked the doctorate school students during nine month. The second training courses, more practical, is intended during one week for the researchers,

lecturers and professors. The third training courses asks the trainees students and the researchers on applications directly concerning their topic of research.

The academic training takes place at three times. The first educational phase is of theoretical order. It concerns the remote sensing methods and image processing. Education is organised around the "data choice", the "methodological strategy", the extracted information, the meaning and thematic aptness reports. The meaning of the measure and the semantic questions of transfer hold a wide part in the educational teaching. When the students are acquired the bases of the meanings of the measure and of each of algorithms, courses take place on SUN workstations with the TRIAS software. This software is a program library. It has as didactic interest to decompose everybody phases of processing of every algorithm. The choice of such algorithm rather than the other one obliges the students to control the report "choice of the algorithm" / represented information and extracted, thematic meaning. The third part of the course is more specialised. It concerns the integration in image analysis of sampling techniques and knowledge and computational rules base methods. It is coupled with particular training in geoarchaeology, in geology and in geomorphology, in environment and in town planning. They are did within the framework of specialised research seminars whose lecturers, professors and researchers present applications.

The training periods intended for the DEA, for the doctorate students and for the young researchers resume academic educational structure. It is more steered and condensed. Courses are coupled at the end of day with practical works on the TRIAS software. Various methods of image processing are presented. During all the training period is approached the link between the remote sensing, the GIS and the databases. The last day of training period is dedicated to the presentation of applications.

Research training periods are made according to a didactic plan in three stages. The trainee, in a first stage, establishes link between the informative properties of the image, the concepts which stretch out its researches and discriminate indicators. These last ones make link between concepts and data images used.

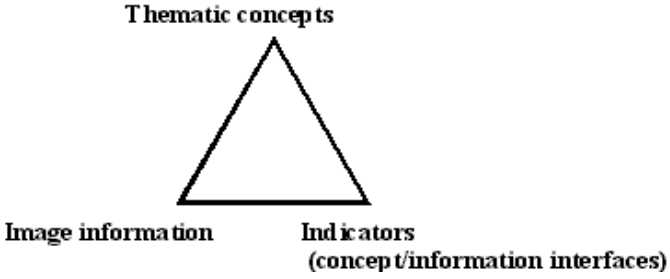

Figure 5

A framework methodology is then proposed by the supervisor to the trainee whom each stages of processing, analysis and interpretations are described and followed. The last stage consists that the trainee develops his own methods and analyses in autonomous way from the framework methodology.

Conclusion

The teaching of spatial analysis methods from the remote sensing data in a research training finality stumble over two didactic aspects. The current didactic methods don't insist of one part on integrated approaches including the remotes sensing data, the GIS, the databases, the hypertextual information system and the artificial intelligence. On the other hand, the rarity of the integration of computational vision in the remote sensing educational programme limits considerably the students researcher in them elaborating capacity of analysis and interpretation computational rules quite as reproducible methods**.**

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