

# TEACHING FOR UNDERSTANDING: FOLLOW-UP OF AN OWN MONOGRAPHIC WORK

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**Abstract.** *The evaluation mode of the course on Elements of Environmental Engineering from the 1997 Curriculum (Faculty of Engineering) includes writing a monograph, and its oral defence is the final exam of the course. The difficulties detected in the first three years of lectures were the heterogeneity in the rhythm of work of the different groups during the term, the students' lack of criticism towards their own work regarding degree of advance, the information sources consulted, the own production. In 2002, an experience with the Educational Unit (EU) began to try to promote a metacognitive approach in the learning process, so that students develop their own tools and analysis criteria regarding methodology and results of their work. In this sense the EU gives firm and direct support to professors of this subject. A way to do a follow-up which includes the already present monthly meetings with professors has been implemented, featuring the filling in of forms which help visualize aspects of the rhythm of progress of the work. The EU has also carried out observations of non-participants' class and interviews to students and lecturers. The general aim has been to encourage a greater systematisation in the students' methodology of work, strengthening this personal-group like organization with the back-up of the proactively critical spirit. Our hypothesis is that this methodology will allow students to reflect upon their own learning processes, encouraging and stimulating an entirely mindful learning process. It is the intention to work with students on the self-regulation of their learning processes, the knowledge they have of their own cognitive processes and products, their cognitive and metacognitive strategies, emphasising the training in group work.*

**Key words:** *metacognition, learning, monograph*

## **1. Background**

The 1997 Curriculum has incorporated the realization of a minimum of 7 credits in the Subject on Environmental Sciences for all students in Civil Engineering. Consequently, the course Elements of Environmental Engineering was designed with the objective of being the first of the succession in that Subject and therefore to be the course that the totality of the students of Civil Engineering would take, eventually the only one taken throughout the whole career by many of the students.

Since the number of students in this subject oscillates between 80 and 100, in order to gain a result in formation rather than in information about the topic, the exam consists of a defence of a monograph carried out in groups in which professors give real support and involvement. This is materialized through monthly meetings with each of the groups (generally more than 12) not during class time -apart from permanent enquiries after class or at any casual meeting with students- so to achieve an interaction that would not happen in a more expository-like lecture, even if students' participation were promoted.

The monograph task implies a relation and personalised attention which allow professors to adequate more precisely to students' difficulties, interests and concerns. Professors also try to collaborate with them in the improvement of their working habits, detection of spelling and expression complications, criteria difficulties, etc.

Generally, in previous years the groups that maintained a constant rhythm of work throughout the term, that enabled a good development and maturation of the chosen topic and its associated topic, have always accounted for less than half of the total. In many other cases they reached the beginning of the final month of the course without having managed to produce a written draft of any part of the work. Then in that last push it became very difficult to substitute the under profited time not only for the production of the written work but also to be able to go from the mere gathering of data into own analysis and reflection, and with this into own elaboration and production. It is sadly frequent for students to believe their work would be valued upon its "weight" and as a result they "stick" on their text a lot of information which they have not read or have not made the effort to understand and critically analyse. What is even worst is their difficulty to generate their own vision or production –a critical analysis, a calculation, a creative approach, the processing of "raw" data into previously unknown results- from the information they collect about a case.

Summarising, the main problems detected could be typified as instability or discontinuity in the rhythm of group work, and difficulties to critically analyse the product they are obtaining –the monograph- regarding degree of progress, consulted information sources, coherence –consistency in the exposition, and personal production (any mention to writing style, syntax and spelling is omitted).

## 2. Conceptual Framework

The complexity in the teaching of scientific concepts obliges the university professor to put into practise methodological strategies to stimulate the learning processes of the students. There is not a simple didactic strategy to guarantee success; apart from developing the contents it is necessary to teach thinking, practice and communication processes. According to a traditional didactic conception it is valid to think that the professor is the transmitter of the learning process, but from a newer conception, the educator is conceived as the one who organizes the learning situation. The teacher ought to be a guide and mediator of knowledge, when planning a class the teacher needs to organize the context of the student's learning process combining content, rigour and creativity, to promote the construction of knowledge in the one learning.

Apart from the conceptual change, to achieve these changes (concept, procedure and attitude) deep in the mind, it is necessary to place them into a specific context of activity, under the direction of the teacher, since each specific domain of knowledge has its own cognitive map. When the discipline contents and the way to teach them does not connect with the interests and worries of students who, besides going to the institution, live in a broader atmosphere, academic tasks turn artificial, costly, and meaningless in themselves. In such proposal of learning, concepts like social building of knowledge, metacognition, and distributed intelligence are central. These styles of teaching centred on the group, stress on the activity of the students, their participation, initiative and responsibility.

These activities of learning are conceived as evaluation activities in themselves, since this teaching model assumes a constructive conception of evaluation, being an extra tool in the service of learning. The activities of evaluation give feedback and information to the pupil, not only about success and failures, but also about the causes. To get a good mark in an exam because it has been given back to the lecturer exactly what has been memorized the night before may be gratifying if it works, but it is surely less gratifying than finding the solution to a problem in the present (Langer, 1999).

The role of professors in the metacognitive development of students has been investigated, the observation of the practices of professors in the classroom and interviews produce similar results; students are hardly trained in metacognitive skills. It has been concluded that those who receive explicit training on this aspect regulate their learning process better than those who receive less training of this kind (Mateos, 2001). Flexible thinking is the essence of plentiful consciousness; flexibility is nowadays considered an essential quality of intelligent thinking (Langer, Perkins, Resnick, Gardner, Mateos, Casacuberta, Damasio and other authors). Metacognitive knowledge constitutes the declarative component of metacognition and comprises the knowledge of own cognitive resources, the demands of the task and strategies that can be used. Metacognitive control constitutes the procedural component and includes the process of planning appropriate strategies for solving a task, supervision and regulation of their use and effectiveness as well as progress towards the established aim and evaluation of results (Mateos, 2001).

Experts in solving problems typical of a specific knowledge domain not only have at their disposal specific knowledge on their domain which is better organized and integrated than tyros, but also tend to act in a more self-regulated way when facing new kinds of problems or complex problems within their domain of expertise, for which they do not have a standard procedure directly or automatically applicable.

In view of the close link that exists between what is cognitive, metacognitive and motivational, the effective instruction of learning strategies should be led metacognitively. It should seek students' consciousness and autonomy in their learning process, but without leaving out the fact that such metacognitive instruction needs to have appropriate motivational and contextual support.

On the basis of what was said before, it is endeavoured to work with students on the self-regulation of their learning processes, the awareness they have of their own cognitive processes and products, their cognitive and metacognitive strategies.

## 3. Experience 2002

In order to improve the learning of students and their profit of the course, there has been carried out an experience between the teaching team and the Educational Unit (EU). This was to try to promote a metacognitive approach in learning, so that students could generate their own analysis tools and criteria regarding their work in terms of methodology and results. This has been materialized through a project in which the EU provides strong and direct support to professors to tackle aspects that would otherwise be banned from their pedagogical instruction despite their authentic interest in cooperating with students in the improvement of working habits.

The general objective of this proposal has been to foment a greater systematisation in the methodology of work of the students, fostering this personal-group-like organization with the promotion of a proactively critical spirit. Our hypothesis is that this methodology will allow students to reflect on their own learning process, encouraging and stimulating a profuse conscious learning. If something is learnt fully consciously, it will not be necessary to worry about recalling it; the information and knowledge will be there when needed.

Specific aims are:

- ♣ To improve the development phase in the monographs of the subject Element of Environmental Engineering in the course of each group's own control.
- ♣ To achieve a constant rhythm of work throughout the semester in each group.
- ♣ To make each group reflect on:

- the quality of their piece of work in general and of their written product in particular, with clear guidelines adaptable to other future tasks.
- their elaboration process of the piece of work.
- their processes and products of learning.

In order to achieve this, apart from the monthly meetings, the submission of record cards has been interspersed -this is also monthly but every two weeks after the meetings, so to have fortnightly control- for each group. In these record cards each group is asked about their degree of advance in their task from simple considerations anticipated for request, regarding real advance in the task as well as the way of work the group is using, or the level of commitment and personal satisfaction with the work. The UE observes classes and takes part in the aforementioned monthly meetings.

The course of 2002 had 113 people in the list; 94 actually took part in the course –that is, carried out their monograph-, having formed 20 groups of work for the monographs.

Throughout the first half of the year the first two meetings took place and the first two record cards were filled in with questions for the groups and for the individuals.

When assessing the advances up till the second meeting (event which indicates approximately the middle of the course), it can be affirmed that:

- only one out of the 20 groups had an almost null degree of advance –this group had neither turned in its second record card.
- eight groups had a low degree of advance, but manifested not being satisfied with the results so far – so, the self-critical vision had been installed regarding the rhythm of advance of the work-.
- three of the groups had an acceptable level of advance, which did not seem to compromise the concretion of a good work.
- seven of the groups had a good degree of advance, both in the matter of acquisition of theoretical tools as well as in the analysis of the chosen case –but still many of them consider they could have progressed much more.
- one of the groups reached a level of advance and own production frankly superior to the expected for that time of the course.

On the second half of the course another record card was filled in as well as another meeting and a closing card which was personal, all these to be handed in with the pre-hand-in of the work in the last week of class.

To finish the course, students had a final meeting and a due date was set. In these two, 90 % of the students qualified the topic of the course as very interesting, although they agreed that it should have been implemented in such a way that it showed a greater connection with practical professional life. Probably as a consequence of what is said before, for most of the students, the course did not match the profile to be chosen in their professional practice. Nevertheless, they found relevant the inclusion of this course in the curriculum. Regarding the monograph, they considered this instance of work and evaluation very useful as well as the meetings they held with professors as tutorials, emphasizing the availability and good will they showed towards the students, despite the time seemed scarce to them. What concerns to the course in general, most of them considered that it enabled them to have a scientific-technical approach to a specific problem as well as to foresee and discuss about conclusions from the obtained results. Finally, all of them expressed feeling comfortable attending to class.

Throughout the whole course, support to the follow-up of complementary actions was given, these actions being selective interviews with members of some of the groups according to the progress of their work and specially to the answers in the personal files, to enable the deepening of the reflections for a better and more complete valuation of this experience, detecting its strengths, weaknesses and opportunities for improvement in the proposal for the course in 2003.

#### **4. Conclusions**

The groups which had an earlier discussion of the objective of the record files in the meetings and a more frank dialogue of their responses are the ones that reached a clearer aspect of the organization of their work in relation to the objective of the files, and evaluated this as a relevant input of the course. A student pointed out: ‘I learnt to write a monograph in THIS course, and I had already turned in several works throughout my career’; another student: ‘The worst of the course: not having started to work from the beginning. The best: having started’.

The groups which considered that the files were for their self-control obtained better products (quality of monograph) and accomplished the task in due time, turning in the monograph at the end of the course and generally without being asked to do extra work. The groups that did not understand the objectives of the files, believing that it was an occasion of professor’s control, were the ones with more feeble quality of work, and in general it was needed to ask for supplementary work in order for the monograph to be accepted.

The few groups that did not have their product ready in time, and that finally did not achieve a good product, were the ones that apart from believing that it was an instance for professor’s control did not submit the files at all.

A very positive aspect to highlight is that in this edition of the course, unlike previous years before the 2003 given course, the totality of the monographs were handed in and over 90% of the students from the class of 2002 have already sat for the exam. Both the grades and the quality of the defences have been in compliance with what was said before,

with a very interesting fact: the ones who understood the objective of the files defended their works in an almost “amongst equals” talk with the examining board; the ones who thought that the intention had been to control them were on the defensive and the situation was rather like a typical exam.

The selection made by students of the topic for the monograph, and the appropriate argumentation, has developed the inner interest for the task, which they perceive as useful and significant, attributing its successes or failures to controllable factors such as level of effort invested, showing more stable and responsible commitment and persistence. Nowadays it exists the conviction that it is not possible to understand how and why we act the way we do when we face academic or cognitive works without taking into account both metacognitive and motivational factors.

The teaching should promote comprehension, critical analysis, and reflection on what is believed and done. It should not promote so much the consumption, mediated and accelerated by technology, of beliefs and ways of doing made outside of us. It should create necessary and favourable conditions to put to work adequate learning processes.

The necessity to promote skills of management of own knowledge in students has been evident, making them capable of using them strategically to tackle new problems and situations; as well as the need of forming reflective professionals, a must in this society of knowledge, in which the latter is in constant change.

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