



normes de formation professionnelle dans le domaine des télécommunications

SEMINAIRE D'EVIAN - 6 AU 22 MARS 1972

SEM/TR/72 - Doc 82 - E

ORIGINAL : SPANISH

A.T.I. METHOD

(APPRENTICESHIP, TEST, INSTRUCTION)

Fernando SAEZ VACAS
Telecommunication Engineer.
Professor in charge of the
Technical college for
Telecommunication Engineers,
MADRID.--

I - DEFINITION OF THE METHOD

The A.T.I. method is based on the control theory and is the result of the author's personal experiences and observations. The academic year 1971-72 has so far shown that the practical results that may be expected from it can not as yet be evaluated ; all we can do for the present is to look at how it is being applied. However, as the reader will later perceive, most of our arguments are based on general theories, as it is felt that those which relate to the system are not as important as those which refer to the means, since it is the latter which later condition the application of the method to other systems.

The A.T.I. method has been established by the author of this article and is being used experimentally in the teaching of the subject known as "computers" in the 5th grade of the course at the technical College for Telecommunication Engineers, at the University of Madrid.

II - METHOD OF INSTRUCTION = FUNCTION (AIMS, SYSTEM, MEANS)

All instruction methods are the product of reaction to a given problem. For the sake of simplicity, let us assume that any method is made up of three parts : for example the Professor - class system (1), where the teacher is the means of achieving - the aims through his instruction. These three factors have an indeterminate but real inter-relationship, consequently if we consider them as stable (for example at a given moment during an academic year) the means and the other components of the system may achieve certain aims*, depending on the form they take, in this case it is the didactic form. In other words, the method used, greatly influences the results, and this method which is a part of the system predetermines it and the means - and in order to conform to the control theory - also predetermines the results obtained, at an earlier stage of its application.

III - A DETAILED DESCRIPTION OF THE CONDITIONING FACTORS

III - 1 - THE AIMS

This consists of the "hope" of giving to all students a basic and thorough grounding in the study of "computers". This will be of use to them when later they come to specialise in electronic data processing, in drawing up programmes, or the scientific management of the utilisation of computers, or merely use their knowledge of computers as a tool in their technical work.

The aims are in essence the following :

* By aims is understood that which one hopes to achieve, and by results that which is actually achieved.

1.- Theoretical and practical knowledge of the programming of computers and the use of different language codes : one is a mechanical type called SAMOS, made up of a set of 20 bits, and the other is a more sophisticated type called FORTRAN. The students are required to make at least two programmes, one in each language.

2.- Theoretical knowledge of the working and structure of computers, up to microprogrammes. Practical knowledge should aim at the students being able to design a small computer capable of handling 16 bits.

III.2. - THE SYSTEM

The 1964 study-plan states that all the students of the 5th - that is to say final grade - attending the course for Telecommunication Engineers in MADRID, must study computers. This subject is included in the two specialities into which the discipline is divided, being one of the seven subjects for each speciality, it is taught in groups of 60 - 100 students.

As computer-programming is not an obligatory subject until the 5th grade ; on reaching the 5th grade some students know how to make computer-programmes, others have a slight knowledge of this work, and yet others know nothing about the subject.

III.3. - THE MEANS

The means may be said to be all the factors which affect the course of the system we are considering. In any case, it is vital to identify and describe those factors which profoundly influence the evolution of the system. It is obvious, that often one is dealing with forces that appear to be far removed from the academic field, and which cannot be controlled by it, but nevertheless, in relation to which, the system is pre-eminently sensible.

Instruction must be efficient and practicable. At the Technical College for Telecommunication Engineers - as in any other Colleges of Madrid University - once the students have chosen their speciality, the set syllabus allows for no further choice of subjects ; instruction is given by the traditional method using the blackboard ; by a middle aged teaching staff with little personal appeal ; it is measured in numbers of class/hours. Little attention is paid to teaching techniques, or modern didactic methods. The instruction given does not stimulate the students and is generally insatisfactory mainly owing to a lack of teacher / student communication because the classes are too big and a large percentage of the students are basically uninterested. Funds are limited, and the manner in which they are spent at present, does not allow for more to be done either in manpower or in the provision of teaching aids.

I will quote two considerations which I consider to be pertinent from the social point of view. One is of a general nature, and the other applies specifically to the system under review. First, we have the socio-economic position of the student body which is generally drawn from the social classes traditionally labelled upper and middle classes ; rarely from the poorer classes.

Secondly, the lack of choice, is once again important ; here it concerns jobs. As there is a great deal of unemployment, it discourages engineers to pursue their studies, which leads to 5th grade "psychoses" that is to say on obsessive and premature search for employment which in turn leads to a situation of pre-employment (disguised as grants and such like). This job is undertaken whilst the student is completing his studies. Often the student, once he has had some experience in industry, makes disparaging - but real comparisons between what he is being taught, and the technical level of knowledge which the job he hopes for, demands. This causes him to lose interest in some subjects ; he even begins to question their importance and validity, whilst at the same time he is puzzled by how difficult and demanding they are. Why they should be so he just cannot understand.* Many students try to take extramural courses or studies which they consider to be more "practical". The consequences are obvious ; a good proportion of 5th grade students give priority to their secondary interests ; as soon as they have passed the examinations they look for a job, and being already caught up in the consumer society, their long-term career prospects are sacrificed to immediate material gain.

IV - OBSERVATIONS ON AND CRITICISMS OF THE TRADITIONAL METHODS CONSIDERED IN THIS PAPER.

The method, is the way in which students are taught. Let us take the traditional model of a class taught by a teacher using a blackboard and chalk. From the point of view of the system and means - as described earlier - the results achieved fall far short of the aims. It is understandable, that when a teacher merely transmits information, the results, unfortunately, are not good(1). When a barrier exists between the professor and the apprentice, the whole system deteriorates to the assembly-line or "off-line" level.

If one could photograph what takes place, it would be seen that none of the elements that go to make up the system, are fulfilling their role ; - the instructor is teaching little or nothing , and the student's ability to learn is not being taxed to its full capacity. Possibly teacher / student communication is minimal, and according to Passeron, there exists a common and tacit agreement between the two. One might add that both parties are unconscious of it.

* The aims, implicit in the teaching of any subject, are developed without taking note of all the various elements of the media. In some circumstances this could hamper the teacher, who is not able to adapt himself satisfactorily to the means, but usually, it is society which does not know how to harness the means in such a way as to encourage individuals to acquire learning.

It may be that the teacher is aware of his inefficiency but is unable to correct himself. Perhaps he feels that his lessons do not come across well, that he frequently has to repeat himself because his students have failed to assimilate his lectures ; may be he does not know at what level or how his lectures should be prepared and presented - some students seem to understand nothing, whilst others are openly inattentive or bored, and a third element considers the level of instruction to be infantile or even ridiculous. Even if the teacher comes with time to change his presentation and teaching methods, he still somehow fails to "get across" to the students.

There is another type of teacher, who, although he has a thorough knowledge of the subject, nevertheless, owing to its nature, is unable to keep abreast with the new developments, and is embarrassed, when he has to give a detailed lecture in class.

Naturally, for many reasons, examinations are valueless as a practical means of measuring results ; it is assumed that the apprenticeship has been completed, or, as mentioned above, it is presumed that the results will meet the expectations. Experience has shown that this is never the case.

V - THE A.T.I. METHOD

A.T.I. stands for Apprenticeship, Test, Instruction because the method uses these three successive stages. At the beginning, it was called A.C.I. the C stood for control, but later C was replaced by T, as the word control recalls slavery, oppression or something similar.

The method is based on the theoretical and practical concept, that Apprenticeship - here understood not only as a means of receiving ideas, but also as acquiring information (knowledge) - is always a gradual process. I am sure that everyone has had the experience of seeing a particular concept in a completely different light, after having studied it and put it into practice on various occasions and in different circumstances. In other words, apprenticeship is the task of the apprentice, or the student ; the teacher can only offer general guidance. The most a teacher can do is to facilitate a student's first steps (I am referring here to the traditional method).

The apprentice's task is made up of three components :

- a) motivation
- b) assimilation of knowledge
- c) putting into practice the knowledge he has acquired

Motivation is very important, as an interested student identifies with his subject, whilst a disinterested student divorces himself from the subject.

Effective assimilation of knowledge, leads to an ordered and effective dissemination of what he has been taught.

The both is that each student would need an individual teaching method. Neither planning of instruction nor any other type of organisational approach have been able to solve this problem, as the psychological variations and mental attitudes of students differ widely. The value of the instruction is born out when the concepts taught are put into practise, in an effort to bring results more into line with aims. In the last analysis, it should not be forgotten that we are recalling concepts learned in childhood, and the only explanation of this phenomenon (if we exclude the high level of malleability of children) is that we are told the same things over and over again.

Before we come to the stage which is the sole responsibility of the teacher, it is necessary to establish a standard by which the qualitative and quantitative degrees of comprehension may be measured (always having in mind the final aim). This is the TEST stage, which must necessarily develop in such a way as to reflect the student's competence.

Having analysed the outcome of the test (by samplings) the teacher has the necessary elements to prepare efficiently, that is to say "on line", the INSTRUCTION stage, during which he puts into practise his teaching abilities, lecturing to a group - which has been prepared and is interested in the subject - on a higher level, correcting errors, synthesising, drawing parallels with similar topics, and extrapolating on professional motivations towards non-academic but practical ends. This stage is the specific and real task of the teacher and no one else could replace him. This the teacher not only transmits ideas to people on a similar wave-length, but also orients and educates (which etymologically means to take someone from one state to another).

VI - APPLICATION OF THE METHOD

The material to be taught is divided into parts, units or themes, and each part is implemented in three separate stages : Apprenticeship, Test, Instruction. To substantiate this method, we use the best material available to attain our objectives*.

The first stage, motivation, consists of a short lecture during which the background to the subject that will be treated is briefly outlined. The next lessons are given over to replying to questions on, and only on, the exercises, which are graded in difficulty and correspond to the topic which the students have been asked to study.

Now the two stages of "sequence" and "validation" meet, for the specific purpose of bringing about a mutual reaction.

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- * In 1971-1972 we are using the following works :
- in the first term : "Computer Science. A Primer"
and "Computer Science" : "Fortran Language Programming"
John Wiley -1970-
 - both from : Forsythe, Keenan, Organick and Stenberg.-
 - in the second term : "structure et fonctionnement des ordinateurs"

The student at home, attempts or does not attempt as the case may be, to solve the problems which are set, and either comes or does not come to class with concrete results. Naturally, attendance is not obligatory, but if the student comes to class he can ask questions, or hear questions raised by others, in an informal atmosphere, agreeable to all kinds of students. The phenomenon known as group dynamism develops, and each student has the opportunity to hear the same idea considered from various standpoints. In later discussion groups - which are always by young assistant lecturers familiar with the subjects in question - the more complicated topics are treated again, and are thus dealt with more thoroughly. The assistant lecturer sometimes goes over again some important theoretical points which the student has already come across when doing the set exercises. Even, for those students who do not make the necessary effort to do the set exercises - and so throw away their apprenticeship - the end results are still better than they would be when the traditional method is used.

The second stage, the test stage, is carried out through exercises, which are obligatory and for which marks are given (only to put up the notes). They are of the same standard as the final qualifying examination, but they do not imply the end of the apprenticeship or prevent the student from continuing with his studies. Any texts may be used to test the students. Only a part of the test is corrected and the remainder is filed to be considered at a later stage.

After the test, the teacher prepares the third stage, the instruction stage, which is given 4 or 6 days later. These are classes in synthesis which should embody all the important ideas raised in the subject just dealt with ; stressing - those points which the test has shown to have been least well assimilated. They should be re-introduced either in an exercise which the students have already done, or through a lecture which deals with the subject in great detail. The teacher should use visual aids apart from the blackboard (depending on the nature of his lecture) and hand out written texts, at least in stencilled form. The teacher should not stint his time in the preparation of this lesson.

The need to limit the number of exercises for each subject, so that the discussion periods should not be too dispersed, make it necessary for discussion groups to be held outside of the regular time-table, so that the students have an opportunity to raise points which were not beaten in class, or about which they still have doubts. The teacher must also arrange his time-table so that he is able to devote about 2-3 hours a week to more advanced students, or hold a seminar for the benefit of those who are interested.

At the end of a term, an examination must, unfortunately, be set. But this examination is set at the same standard as that of preceding examinations (a standard which the student is thus already familiar with) and in the same conditions to which the students have become accustomed during the term, so they will not be taken unawares. Moreover, the students know that should the need arise, they still have on file other examination papers which can be used to show that they have profited from the course.

Although this is the first year that the A.T.I. method has been applied, it is already clear that we have come closer to the desired results, there it was possible to do through the traditional method. Moreover, these results have been achieved despite the fact that some of the texts used were only available in a foreign language. We had two assistant lecturers with very little teaching experience (one had been a student the previous year). However, they firmly believe in the method as does the professor in charge.

We hope that in the years to come, the texts will be available in Spanish (this is difficult, given the proliferation of material in this field) and that the students will come to feel (through the oral transmissions handed down by preceding classes) that our only concern is to make the standard of their apprenticeship as high as possible, within the limits of the (aims, system, means) which surround us and of which we are a part.

(1) See : F. SAEZ VACAS (In Spanish).-

"An analysis of the professor - class system with the aid of the simplest model of the re-cycle system".
Automatica Review, No. 4. 1969.-