

Strategies for academic entry leveling

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Abstract: *This paper deals with the description of the project termed Program for Academic Leveling and Integration, presently under design at the Division of Basic Sciences and Engineering of the Autonomous Metropolitan University, Campus Azcapotzalco. It aims at improving the learning process in order to reduce problems associated with the rate of failure, desertion and the period taken by students in the first year of the undergraduate engineering programs.*

The first attempt to find solutions to such problems was the Program for Academic Integration (PAI), which was tried four times during the admission periods of spring and fall 1994, spring and fall 1995. The objectives focused mainly upon the search for a strategy to detect and solve the problems of newly admitted students, and to devise means to introduce them to the particular dynamics of our school of engineering.

The professional programs in the Universidad Autónoma Metropolitana are divided in eleven week terms (trimesters), three per year (winter, spring and fall). The first three trimesters of the undergraduate programs integrate the Tronco General (Basic Level), which is shared by the different careers of the same division. In the case of the Division of Basic Sciences and Engineering, where nine undergraduate engineering programs are offered, the Basic Level includes the fundamentals of mathematics, physics and chemistry. The Tronco Básico Profesional (Intermediate Level/ 6 trimesters) focuses upon teaching the sciences of engineering and the Área de Concentración (Advanced Level) comprises applied subjects.

The problems of the Basic Level are characterized, particularly, by the following elements:

- a) High desertion: a significant percentage of newly admitted students decide to give up studies. Desertion approaches 50 % in the Basic Level. As a result of this, wastage of financial resources ensues. As a matter of fact, teaching at this level demands the use of laboratories and computers, which represent high expenditure for the institution.
- b) High failure rate: the indexes found out are as high as 50 %

- c) Regulatory severance: in accordance to the institutional regulations, five failures of the same subject cause severance; this problem is located mostly in the Basic Level.
- d) Deficient performance: students in the Basic Level show serious deficiencies in learning habits, knowledge and its adequate comprehension and application.
- e) Overall period of studies: the average time required for a student to complete the Basic Level largely exceeds the nominal number of trimesters assigned for the purpose.

The *Program for Academic Leveling and Integration* is being thought as a transition stage between the high school and the university, and will include courses in basic sciences, particularly mathematics and also tutorials to promote the acquisition and improvement of study habits.

Introduction

The Universidad Autónoma Metropolitana was created in 1974 by a decree of the Federal Government. The following scheme gives an indication of its organization into three campuses or academic units, and the academic divisions which each unit comprises respectively.

The Division of Basic Sciences and Engineering of the Unidad (Campus) Azcapotzalco (UAM – A), situated in the northern part of Mexico City, offers aspirants nine possibilities to study engineering, which can be listed as follows: Civil, Electric, Electronic, Environmental, Industrial, Mechanical, Metallurgical, Physical and Chemical. For the purpose of explaining the study program, each of them can be understood in terms of the nature of the subjects; this is, the basic part of the studies, the *Tronco General* (Basic Level) focuses upon basic sciences. Consequently, the second set of subjects, the *Tronco Básico Profesional* comprises mainly the teaching of sciences of engineering.

As expected, there is a diversity of high schools which have a given capacity to offer preparatory studies leading to university; however, there exists scant homogeneity because

the imparted studies vary significantly from one high school to another.

Students who aspire to enter UAM - A could come from schools that make emphasis in technical subjects, these do not disregard introductory scientific overviews, though their aim is to contribute with a solution for the strong need of technicians felt in the country. Other aspirants, come from schools which were created as a response to critical needs for education, taking basically into account various perspectives and trends for the design and contents of their study plans and programs. The various factors composing the said diversity are such that it is rather difficult to establish an academic profile for the student wishing to enter UAM-A.

In that sense, there is an admission exam which conforms a set of criteria applicable to all students entering the university, in such a way that general requisites emerge which must be complied with to be eligible for bachelor studies. Due to the said diversity in backgrounds, it is possible that newly admitted students have deficient performances in elementary courses such as differential and integral calculus, as well as in analytic geometry or trigonometry. It may seem that the study plans for some students have made stronger emphasis on supplementary disciplines, such as technological or humanistic.

The study plans and programs at UAM are organized in trimesters. For engineering, newly admitted students may take a maximum of six subjects: Differential and Integral Calculus, Complementary Maths, Force and Equilibrium, Reactions and Chemical Bonds and its corresponding laboratory, and Engineering and Society. The trimester plan demands considerable effort for first entrance students which come from semester or annual plans, even though they might have a good background in chemistry, mathematics and physics, and abilities for self learning. Some of them adapt to the dynamics of university life, being able to organize themselves harmonically and achieving their goals; however, this is not the same for very many of them.

The failure and desertion indexes at UAM reach, and may exceed, 50% in the Basic Level. This means that less than half of the registered new pupils terminate the studies they strove for in the first place.

It is a matter for conjecture that the heterogeneity found in the study plans of the high school level, influences the academic development of students within the Basic Level. Allegedly, a deficiency of basic elements in mathematics is one of the most significant hindrances for the development of a student registered in an engineering career.

There are previous research projects in education in which a strategy has been sought to improve the learning conditions for students that have a lack of theoretical - methodological support in maths. In one of these projects, an effort was made to offer tutorials as part of a sort of open learning plan, in which it was observed that students that registered in formal courses,

were not able to make up for the lack in algebraic tools. Due to this factor, it was not possible to obtain a substantial change in the failure indexes for the subjects for which the tutorials were designed to give support.

Also, other conjecture appears even more marked, that a significant set of new entrance students lacks in enough mathematical *baggage* to face more complex situations that have to do with the engineering field of study. This problem has led to a search for teaching alternatives that may bring in support during learning.

Program for Academic Integration (PAI)

The Division of Basic Sciences and Engineering offered the representatives of the student's community a program to improve their academic level, in order that the newly admitted students could find better opportunities to achieve the credits required in their careers.

Based upon the said compromise, the *Program for Academic Integration*, PAI (PIA after its initials in Spanish) started, with a group formed by teachers-researchers and the representatives of the engineering students. The basic organization for the PAI changed gradually each one of the four occasions that was conducted, since the date that marked the beginning in May 1994, then in October at same year, April and September 1995.

Relevant Observations of the Four Stages of Implementation

1st stage) Teachers and students in charge decided what kind of material and strategies would be applied. The trial period was to be one week, in which a list of exercises in math's (arithmetic, algebra, geometry and trigonometry) from traditional and well-known textbooks had to be solved. One of the teachers-researchers had in mind to gather information about the most common mistakes found in the solutions to exercises from the given list.

The new entrance students which at the time were in the last stages of the process of registering, were invited to do so at a given place in the company of the organizing students. The response was positive, with about 200 students registering out of 800.

A daily diagnostic test was applied. The plan of activities indicated that the teacher in charge was to attend during the whole period of four hours as mentioned in the program, with the exception that he would only explain some of the themes which were going to be reviewed from the long list of exercises. A rotation of the academic personnel was proposed, similar to that which operates under normal circumstances, but keeping the group of student tutors.

The teacher in charge should have promoted group dynamics, in order to get better integration. Working in

the classroom was oriented to build groups. Solving problems was tried collectively.

Advanced students working in this program copped with more than their technical advise: they supplied the new students with valuable *underground* information, with added value which came from young fellows.

At the end of the week, a qualitative assessment was made on the program achievements, to focus on the performance of the students tutors; it was observed that it was satisfactory, despite their limited experience.

2nd stage) Adjustments were made to the materials in order to detect and characterize the most frequent mistakes made by the students.

A diagnostic evaluation test was applied to the students, at the beginning and at the end of the week with the same questionnaire. The result was not satisfactory in terms of academic improvement but it was observed a change in the student's attitudes.

Based on previous experience, a group dynamics (*microteaching*) session was organized with the aid of the tutor students who had already enrolled in the social service project to backup the PAI. The gist of the session was to make a brief presentation, for two minutes, in front of a group of teachers and students involved in the PAI, to record it with a video camera. Every participant of the group presented the topic as best as possible, because this was the way to check the attitude usually taken to perform in front of a group of students.

Afterwards, the recorded session was projected and at the end of each presentation, the expositor would pass self criticism and request observations from others. In such a way, it appears relatively easy to become aware of any change that the students may have achieved from their previous performances in the video of that related *microteaching* session.

In this occasion, basic elements of chemistry, directly related with basic arithmetic operations, were included. In this program, reflection rather than the drilling of exercises was considered as the fundamental goal.

3rd stage) Exercises on physics were added so that the students could become conscious about the text that he was dealing with at the moment, and in this way he or she could become independent of the use of the electronic calculator as a tool. The main objective was to obtain logical interpretation for the answers to the exercises instead of the results that they could have obtained from the use of a calculator.

4th stage) In this occasion, all the students whose admission exam mark was low were personally invited to take part in the course. The reply was good as far as the invitation was concerned, although the students with the above-mentioned characteristic had a much greater difficulty in solving the same set of designed exercises than the students enrolled in previous occasions.

Results

The teachers-researchers who worked in the planning and those who conducted the sessions have been doing it as part of their research project and with the purpose of applying similar strategies for the implementation of a much more ambitious academic program.

It was observed that the focus applied on physics, chemistry and mathematics was better accepted whenever it was possible to relate it to everyday life situations. Therefore, this contextual approach of the concepts strengthened the perception of the things they worked on.

A change of attitude of the group of new students was also noticeable in relation to previous generations. The experiences of their own classmates in advanced courses worked better than the literature and leaflets distributed during the enrollment period. The group dynamics allowed a faster socializing process, based on the search of learning strategies suggested by the professor in charge of the subject, with the support of the student tutors.

The working sessions previously presented allowed to liberate the traditional stress that the student shows in the solution of problems. It was noticeable the presence of mythical concepts related with mathematics teaching, which affect not only the students' performance but also the professors'.

As it happens in other levels of mathematics teaching, there exists a number of students with difficulties for achieving a mathematical model which allows them to find the solution to a given problem, as much as they are not even capable of plotting a graph or working out other relevant aspects pertaining to the latter.

Further actions

Teachers - researchers expect the students of this university to persevere in establishing their own study habits so that they become professionals with creativity and initiative.

After this experience, a new leveling program with a more ambitious impact is under analysis at present. A commission was specially designed to work on this project. The main aspects to be considered for its purpose are the following:

- Maximum duration period of one trimester.
- Every newly admitted student should present a selection exam, specially designed for the purpose; those who are not able to pass it should attend the leveling program.
- It would have a compulsory character, according to the result of the selection exam, but without credits.
- Contents of basic sciences, mostly mathematics, and tutorials to promote acquisition and improvement of study and communication habits.

- Teachers specially trained for the conduction of the program.
- Application of group dynamics.
- Permanent evaluation of results and improvements.
- Participation of advanced students

