

HOW TO PREPARE STUDENTS FOR A SUCCESSFUL FIRST YEAR AT UNIVERSITY: AN EXPERIENCE

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ABSTRACT

During the last years, the basic mathematical knowledge with which Belgian students have enrolled has decreased a lot. This phenomenon results from various causes that we will try to outline. As a direct consequence, most of the students do not possess enough mathematical skills to follow the usual curriculum and face enormous difficulties from the start. In fact, only the better of them will go through these obstacles. In an attempt to give a chance to everyone, we have set up since 1999 a special system of support. Here are its main characteristics: a course has been added to the first year curriculum with the goal to deepen the understanding of high school mathematics. During this course, the students benefit from individual help from the teacher but also from a set of more advanced students who intend to become high school teachers. We will explain the organization of this course (unfolding, material covered,...) and will assess the students progresses. Our students also have access to another kind of support, more targeted to specific courses of the curriculum. A special session takes place once a week which focuses on the problems encountered by the students. Although this session is optional, the participation rate is high. We will show what makes this system work well and will analyze the positive effects on students successes.

Introduction

Year after year, Belgian French speaking students come to university less and less prepared. Not only is their mathematical knowledge poor but also they do not possess a good working method and are unaware of the efforts they will need to make. We do not mean they are fundamentally less capable but that without additional help, most of them will face huge difficulties to follow the usual curriculum.

These findings have been confirmed by the OECD Programme for International Student Assessment (PISA 2000) whose goal was to assess the knowledge of the fifteen years old students in the Organisation for Economic Co-Operation and Development (OECD) countries in the fields of readings, mathematics and sciences. Among the 32 countries, the performances of Belgian French speaking students are below average. The results of our best students are worse than many of the OECD countries. Moreover our High School teaching system appears unfair in the sense that socially unprivileged students have a greater chance to be among the weaker students. Would we be powerless against social inequalities? In fact, the problem essentially lies in the different demands of schools. It is true that being given the violence and the lack of interest for the studies, teaching often is an impossible mission. Will the current reforms (the formation of teachers, the material of scientific courses,...) solve a part of these problems? It is another debate on which we are not going to comment here.

This sad description does not obviously dissuade our students to enroll in university. That is why we are looking more than ever to give a chance to everyone without lowering the level of our training. To succeed, we think that is necessary to give students specific support and it is evident that this task requires a big pedagogical investment.

In 1999, on an initiative of the French Community Government, a support system was set up in universities. We will describe the one developed at the “Université de Mons-Hainaut”. It is called *Système Transition Secondaire-Université*. We will give its main characteristics and explain why it works and which positive effects we can observe on our students.

1 Description of the Support System

Belgian High School aim to give a general training during six years. However the students can choose to focus on a particular field like sciences, economy, foreign languages,... each of which still allowing a panel of options. So the students who engage scientific studies, and in particular mathematics, come from very different backgrounds and therefore have uneven mathematical knowledge.

Here is the first characteristic of our support system: we added an *Elementary Mathematics Course* to the curriculum of the first year. Because of our concern in mathematical teaching, we create this course in 1994, that is long before it was made mandatory by the Government. At the beginning, the course was optional with a charge of thirty hours. Today it is compulsory and covers sixty hours. Its main goal is to bring the students at the same mathematical level. The material we teach is considered to be the basis necessary to follow the first year of the undergraduate level. The more important material covered in the course is:

- complex numbers,

- an introduction to linear algebra,
- an introduction to logic,
- study of proof mechanisms,
- elementary functions,
- analytic geometry in 2 and 3 dimensions,
- manipulation of the sum symbol.

Normally the students should not learn any new material during the course as it aims to recall High School notions. That is why the rhythm is rather fast. The course unfolding is a little bit particular. No theorem is proven. Our work is focused on the comprehension of mathematical concepts, on their fluent manipulation and the development of some intuition. The main points are exposed on the blackboard and are immediately apply to some exercises in order to confront the students to their own difficulties. During this course, the students benefit from individual help from the teacher but also from a set of more advanced students who intend to become high school teachers. We estimate that one person manages about fifteen students. This is important. Indeed the students are always supervised when they try to solve exercises and are encouraged to provide a personal effort. In return, they obtain personal help when they encounter obstacles. *Elementary Mathematics* is given during the first six weeks of the academic year, that is between mid September and the end of October. This is the first course that the students are confronted to. Time tables have been adapted, so the courses which need a certain mathematical background, like for example Analysis, start after the completion of this elementary course.

In our support system, Monday morning is free of courses. This half day is reserved to *Guidance Sessions* and *Evaluation Tests*. During the first six weeks, a two hours weekly test in relation with *Elementary Mathematics Course* is organized. These tests are followed by a correction, so the students can immediately correct their lack of understanding and that allows us to continue the course on good grounds. In November, an exam is organized. A student who obtain a note greater or equal to twelve on twenty passes. If he fails, he has another chance in January. For some people, it may be inconceivable that a student who did not meet elementary expectations can succeed in January and accesses the second year without problems. This however happens. We think an explanation of this as follows: we talked before about the difficulties for the students to dedicate enough time to their studies. Their failure to the November exam may wake them up as they realize they only have one chance left. They may thus decide to really involve themselves in their studies. To help them to prepare the January exam, facultative sessions are organized every week between November and December.

We also propose a twelve hours seminar in which we approach mathematical questions with an emphasis on algorithmic. In this way, we offer to the best students more elaborated subjects.

From November onwards, i.e. at the end of *Elementary Mathematics Course*, the Monday morning is dedicated to sessions called *Remediations*. Their goal is to help the students to achieve a good understanding of the material covered in the different courses. During these sessions, the students devote themselves to projects like drawing

up cursus plans, solving additional exercises,... in collaboration with a teacher. They also have the opportunity to ask questions and to again assimilate what they have not yet grasped. Moreover the teacher gives pedagogical advice and helps the students with their working method.

Three persons are currently involved in the *Système Transition Secondaire-Université*. They share the teaching of the *Elementary Mathematics Course*. Two of them are scientific members of the Mathematical Department. The third one has been engaged at the creation of the system to manage the full time sessions.

2 An Analysis of the System

To sum up, the *Système Transition Secondaire-Université* is composed of the following activities:

- a compulsory *Elementary Mathematics Course*,
- *Evaluation Tests*,
- facultative *Elementary Mathematics Sessions* to prepare the January exam,
- *Guidance Sessions* every Monday morning in relationship with the courses,
- *Sessions* to prepare exams.

Our work is made up of two phases. In the first one, we try to make the students conscious of the important efforts they will need to provide during their studies. This takes place during the first six weeks with the *Elementary Mathematics Course* and the *Evaluation Tests*. We then focus on the mathematical evolution of our students. At this stage, the Monday morning and the facultative sessions start. Please note the graduation of our system: we begin with a daily support and pass after a few weeks to a weekly support.

The good results given by our system show that our efforts are not vain. First, our students look more active from the beginning of the year. Moreover, each activity has its own beneficial impact. The *Elementary Mathematics Course* provides the students with a good basic mathematical knowledge. For the better of them, it may also be the opportunity to discover the High School material with a different approach. The *weekly tests* force the students to have some regularity and autonomy in their work. They are also able to follow their evolution because they obtain every weeks their tests results. After the six weeks, the *Facultative Sessions* help the students to mature their comprehension of *Elementary Mathematics*. During these sessions, the small numbers of students guarantees that they receive a personal help and benefit from presentation tailored to they need. It is not rare, during the months of November and December, to see a real evolution of several students. During the same period, the Monday morning *Guidance Sessions* offer the possibility to the students to complete their notes, to have a more global view of the courses and to obtain individual explanation. Two weeks before the exams, some *Preparation Sessions* start. At this time, the students are very interested to put it to practice all the advice they have received. The exercises are especially designed to show the students the level of understanding they have reach and thus which kind of effort they have to make if they want to succeed.

The fact that a person is full time in charge of the guidance activities is a real asset. Indeed, she needs to dedicate four hundred hours of work a year to these activities. Because her contact with the students is good, they naturally come to her office to discuss their problems in various courses. They also often come to bring her additional exercises to correct.

We made a survey of the students opinion to try to analyze objectively the above described system. All the results point in the same direction. The students feel that the various kind of support contribute to increase their mathematical skill and help them to improve their work method. This investigation also shows a point we will like to emphasize: the severity of the *Elementary Mathematics Course* (constantly supervised work, weekly test,...) is not felt like a punishment. On the contrary, the students appreciate we have taken care of offering them a good basis to start university. Let us mention yet another positive point. With the exception of *Elementary Mathematics Course*, all the other proposed activities are facultative even though they are incorporated in the schedule. In spite of that, the participation rate is almost ninety per cent. Although the most activities are targeted to students who have mathematical difficulties, the better students nevertheless recognize to benefit from the system. Since its creation in 1999, our success rate is close to sixty per cent.

Some people may wonder about the necessity to create such a system. After all is not learning by oneself one concept of the university studies? Are not we neglecting this aspect? This question is fundamental especially because the management of the system requires a considerable amount of work and a great pedagogical investment. As an example, the *Weekly Tests* and the November exam represent the correction of six thousand pages in six weeks. However we strongly believe that a good success rate can not be obtained without the incorporation of a such system in the cursus. The current students are indeed much different from those we had only a few years ago. This is an inescapable fact with which we have to deal.

Provide enough resources are dedicated to this support system, we hope to have convince you that is an interesting way to explore.

In October 2001, a Commission of international experts evaluated the teaching quality of mathematic sections in the Belgian French speaking Universities. The commission was chaired by Professor Ivar Ekeland, President of Université de Paris-Dauphine from 1989 to 1994, General Director of Institut des Finances de Paris-Dauphine since 1995. The report described our system as innovated and efficient.

3 Conclusion

Guidance sessions have been created following a significant failure rate. *Elementary Mathematics*, *evaluation tests* and the several kinds of *facultative sessions* were grafted to form what we call the *Système Transition Secondaire-Université*. As we already mentioned above, the level of knowledge of the students who start university decreased. The system first aims at learning what means “to make mathematics”. Accordingly we have voluntary choosed not to incorporate technological means. For example, neither computer support or slides are used during *Elementary Mathematics*. The students have like only tools a paper sheet and a pen, so the course is more centered on the

analysis and the drafting of exercises, but also on the dynamic of an oral presentation using blackboard. In our opinion, this method makes the learning more effective.

Currently we reach a point where the system is fairly stable. The actors are the same ones and the activities are well ground. That is why we now try to assess the effectiveness of our support program. We have some reasons to think that our work has some positive effect. At first, the system is completely integrated in the schedule and that contributes to have a high participation rate. With *Elementary Mathematics* and *weekly tests*, we individually follow the mathematical evolution of every student. The good success rate at the exam means that a lot of them reach the necessary level to follow the curriculum. We also have a positive feedback of the other professors. They think that *guidance sessions* somehow mature the students. In particular they become more autonomous. Finally our success rate in the end of the first year increased since the creation of the system.

The described experience is specific to our university. We think that the students probably have the same problems in other universities but we have few informations about the pedagogy developed outside Belgium. The next stage will be to discover if similar experiences are tried in other countries.

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