THE IMPACT OF AN INSTANCE OF QUATERNARY EDUCATION

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In Argentine Legislation it is considered that one of the basic functions of the University is the preparation of professionals and teachers who are able to act with efficiency according to both individual demands and national and regional requirements. To achieve this goal spaces for education at post-graduate level are provide with the objective of offering disciplinary and pedagogic preparation in the areas of Mathematics and Statistics. A method for providing this training for teachers of Mathematics called "Postgraduate Studies in Mathematics and Statistics" which was adopted at the National University of Rosario in 2003 is described. This program is intended for graduates at the tertiary level who work as teachers in the areas of Mathematics and Statistics at different levels of high school. The profile of the entrance beginners is described along with the impact that these post-graduate studies have in the development of Mathematics and Statistics.

INTRODUCTION

Responding to the requirements of education of different places of the Province of Santa Fe, Rosario's National University, Argentine Republic, creates in the Faculty f Economic Sciences and Statistics a Post-graduate Study of University Formation in Mathematics and Statistics approved by the Superior Council by Resolution N° 231/03 and sustained officially by the Ministry of Education, Science and Technology (Resolution N° 291 of the year 2004), whose purpose is the formation of graduates of tertiary level, not university students ,of official or private institutes that possess titles of: Mathematics Professor, Physics and Cosmography; Professor of Mathematics and Computation or similar, with educational competition in Mathematics areas and Statistics. Specifically their objective is to offer formation in the discipline and pedagogic formation in Mathematics areas and Statistics.

This Post-graduate Study is framed in the Program that enhances the capacities of the investigation system and development, in the Province of Santa Fe through the support of the post-graduate formation in areas of provincial interest whose objective is to support careers of postgraduate formation, existing in the provincial territory, in areas of knowledge with strong impact in the economic and social development of the Province of Santa Fe.

This support is centered in the post-graduates studies that are developed in the National Universities whose objective is the formation of human resources.

This way, the "extension" of the University is materialized in the Region, in an instance of quaternary education, in fact framed, in the areas of high-priority topics defined by the Secretary of Science, Technology and Innovation of the Province of Santa Fe.

The prestige of the Institution that offers it, the title that grants and the fact that it is the only one with these characteristics in the whole Province, especially as regards the formation provided by professors of the School of Statistics of our Institution, make that this educational offer is sustainable and necessary.

This Post-graduate Study reinforces the curricular national organization since Statistics is considered from 1993 in the different levels that it contemplated the Federal Law of Education: General Basic Teaching (E.G.B.) and Polimodal and at the moment, the National Law of Education: primary and secondary, as an incorporate block to the Mathematics. In these organization it settles down that the Mathematics teaching has as fundamental purposes that the students might have: outline and solve problems with variety of strategies, discovering that the Mathematics is a human ability to which all can consent, relate the mathematical knowledge with the real world, among its diverse branches and with other sciences, granting them significance and functionality, understand the Mathematics potentiality for modeling problems of other disciplines, starting from its logical structuring and its language, value the new technologies like resource for the construction of the mathematical contents and acquire outlines of mathematical knowledge that allow them to enlarge its daily experience. It is supposed that the Mathematics teaching, as long as

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it has occupied a privilege place in the school programs, has also influenced implicit or explicitly in the formative and informative dimension directed toward the fellow. Today, the social thing is added since the Mathematics from their language and from their method has been constituted, at least outside the school environment in means of understanding and improvement of the scientific, industrial and technological world in which we live.

It is from this potentiality where the Mathematics contributes (or should do so) in privileged form to the attainment of the objectives that the New National Law of Education offers. In such a sense it is thought that this discipline can collaborate with the individual and social development of the students propitiating in them "the search of the truth" and in connection with this, the critical trial, the force in the work method, the honest presentation of the results, the simplicity and accuracy in the language and the valuation of the other people's ideas and of the shared work. Here lies the importance of this Post-graduate Study that seeks to form teachers as for new methodologies and contents. It is hence that we will outline the entrance profile and graduates of this Post-graduate Study to be able to specify their reaches.

ENTRANCE PROFILE

Teachers working in primary or secondary level that gather the following requirements: to be graduate of tertiary level, graduates of official or private Institutes that possess title of Professor of Mathematics; Professor in Mathematics, Physics and Cosmography; Professor of Mathematics and Computation or equivalent whose study plan has the curricular organization of the tertiary title, with structure of the study plan organized by subjects, matters, disciplines, nucleuses, workshops, seminars and with a timetable minimum total of 2000 hours clock.

GRADUATES PROFILE

The graduate is a teacher with a solid formation in Mathematics and Statistics with integration of the knowledge of the educational field and of the processes of teaching learning from a socio-political cultural perspective.

As regards the discipline related to Mathematics and Statistical areas, he has carried out studies of historical epistemology foundation; and an upgrade and appropriate amplification of the contents imparted in the graduate program. It has educated him in: the conceptual understanding, the ability to outline problems and to solve them with variety of strategies, the valuation of the significance and functionality of the Mathematics through their connection with the real world. He understands the Mathematics power for modeling problems of other disciplines starting from their logical structuring and of their language, and the value of the new technology that incorporates to the classroom and that it facilitates to experience enriching the perceptual field and facilitating the mental operations involved in the construction processes, structuring and analysis of contents. Its specific formation in Descriptive Statistics and Probability, Statistical Inference, and Methods Statistics grants him capacity for statistical reasoning and analysis of data; in particular, in the problematic concrete situations linked to the Social Sciences and of the communication and discernment to recognize the reaches and the limitations of its uses in the resolution of the problems and in the taking of decisions in situation of uncertainty.

Their didactic upgrade reinforces the capacity to develop teaching and learning strategies, the resolution of problems linked to the improvement of the quality of the educational processes and the institutional participation. This preparation culminates in a final work of investigation in Mathematical Education, directed to the improvement of the Mathematics teaching or Statistics in its teaching own practice. All this together to an intense formation in critical and flexible attitudes that impel the teacher to the permanent upgrading of their knowledge and the work in interdisciplinary teams, grants exceptional characteristics to this profile.

We present the pursuit of the last two cohorts in Table 1.

We observe that, in spite of the effort that implies to study, to present works and to sit for exams of different subjects, working respectively in the schools, 73% and 61% of the two analyzed cohorts has graduated.

Table 1. Entrance teachers and graduates of the last two cohorts

Year	Nro. Cohort	Entering	Graduates
2005	2	75	55
2007	3	38	23

THE TEACHERS OF THE POST-GRADUATE STUDY

The educational body is constituted by Professors of the Department of Mathematics of the School of Exact Sciences of FCEIyA (Faculty of Exact Sciences, Engineering and Surveying), Professors of the Department of Mathematics of the School of Basic Formation of FCEIyA, Professors of the School of Statistics of FCEyE (Faculty of Economic Sciences and Statistics) and Professors of the Careers of Education of the Faculty of Humanities and Arts.

These, when belonging to the University and being in their competed majority and some of them with titles of Schoolmaster and Doctors, enrich an articulated horizontally and vertically professional stage with the University.

The academic systematic proposal focuses in the superior formation in the disciplines Mathematics and Statistics but also the upgrading in didactic topics. This way, it is sought that the teachers of the course carry out a professional depth at university level with orientation in these areas. From the academic point of view the project intends to present the contents and the teaching-learning strategies responding to approaches framed in the current currents, in what refers to: epistemological basis, procedures and attitudes, and developed contents.

The epistemological foundation is outlined from different tendencies: Brousseau, Chevallard, Duval, Godino; so that the students can have a vision of wide spectrum, to choose based on these theories, the place in which they are positioned for their classroom work.

The procedures and attitudes that are analyzed are based on those proposed in the curricula sent by the Ministry of Education of the Nation and from the Curricular Jurisdictional Designs.

The curricular organization includes an introductory module with three subjects; and three quarters with seven subjects, an integration workshop and a final work, with a total load of six hundred hours clock.

The introductory module (3 subjects with a load of 144 hours clock) will have for object to establish uniform base of knowledge of university level in the central subjects of the program, as well as to provide a general mark for the understanding of the process of educational reform. In the first quarter the first module (3 subjects with a total load timetable of 144 hours clock) will be developed, in the second quarter the second module (2 subjects with a total load of 144 hours clock) will be developed and in the third quarter the third module (2 subjects, an integration workshop and a final work with a total load of 168 hours clock) will be dictated.

A chart with the subjects that are dictated, the load of hours and the correlativity is presented in Table 2.

The contents are directed to topics that, in general, they don't talk to with enough depth in the formation that the undergraduate programs impart. They are developed as it has already been specified, in four quarters, in those that subjects related to the area of Statistics, area of Mathematics, development historical-epistemological of those sciences and investigation in education are studied.

The methodological strategies that are used in the formation of the teachers are in fact those that they will use in the formation of their own students.

The pedagogic strategy applied in this Post-graduate Study is sustained in the ideas that diverse educators introduced in the last decades:

- the conception of the student as an active fellow of the educational processes.
- the conception of the interactive relationship between the teacher and the student whose result is the change of attitudes, behaviors and grade of knowledge of both fellows, without implying the loss of its identities and specific roles.
- the value of the motivation and the personal experience to obtain significant and lasting learning.
- the value of the interaction among the cognitive and affective aspects that intervene in the learning processes.

Table 2. Timetable signatures, and correlativity of the Post-graduate study

	Introductory Module		correlativity
1	Discreet Mathematics	56 hs	--
2	Descriptive Statistics and Probability	40 hs	--
3	Laboratory of Matricial Analysis	48 hs	--
	First Module		
4	Theory of the Integration	72 hs	--
5	Statistical Inference	40 hs	2
6	Educational Politics	32 hs	--
	Second Module		
7	Statistical Methods	72 hs	5
8	Didactics of Mathematics and the Statistics	72 hs	6
	Third Module		
9	Historical – Epistemological Development of the Mathematics	40 hs	1 - 4
10	Methodology of the Investigation in Education	32 hs	8
11	Workshop of Application centered in Resolution of Problems	96 hs	1 - 4 - 7 - 8
12	Final Work		
	Total timetable Loads	600 hs	9 - 10 - 11

The methodology that is applied in didactics of the Statistics is that of the Method of Project. This method is characterized by the realization of a work project whose objective is an individual and social better adaptation. It is about a previous certain activity whose dominant intention is a real purpose that guides the procedures and it confers them a motivation. The work in the classroom around projects is linked with the movement of the New School that was postulated in the first decades of this century and it took to the practical experiences sustained in a conception centered in the student's activity. On the base of the ideas of Dewey (1961) that affirm that the reflexive thought doesn't take place in the abstract but with problems, it was systematized by Kilpatrick (1982) for whom the project constitutes an intentional activity and with sense that is carried out in a social atmosphere. These American educators developed their theories at the same time that groups of teachers experienced in agronomic schools and of arts of secondary and university levels, a system that spread to unify the isolated subjects around the problems proposed by the professors or chosen by the students.

THE PROPOSAL OF A PROJECT AS DEMAND OF EVALUATION

As teachers in Didactics and aware that the best learning is that, in that in which we learn by doing, the following work proposal was put forward to teachers and students.

During the second class the students in groups of three, presented a project outline on a topic that could motivate their own students in their respective classes and they analyzed a possible didactic trajectory, advancing all the statistical techniques that they would use, justifying and arguing their application. In the following classes, they advanced with the Projects applying all that was developed in the theoretical classes on the topics that belonged to the Project presented by each group.

This work, when the subject related with Didactics concluded, was given in writing and evaluated, through its defense in groups and individually on a certain date arranged by teachers and students.

Some of the projects presented by the educational-students are attached next:

- Help Health.
- The World cup from the multimedia optic.
- The school desertion and the sports.
- How do the students of secondary use Internet?
- The adolescents and the presence of the addictive substances: tobacco and alcohol.
- The maximum scorer's of each soccer World cup profile.
- The use of the mobile telephony by adolescents.
- Does the use of the safety belt save lives?

As a result of the work, applying this methodology, the teachers-students have proposed different projects that make of the Statistics a strategic tool for the analysis of different problems of the applied sciences and of the school environment.

THE IMPACT OF THE POST-GRADUATE STUDY

It is expected that this Post-graduate Study constitutes an alternative transformation regarding a diversified and no systematic offer of courses of upgrade that, many times they are not integrated in projects and curricular specific designs. It is assumed, also, the necessity to intervene in front of the demand expressed by the teachers.

The contents of Mathematics in the proposal are topics that, in general, have not been treated or they have not been treated with enough depth in the formation of professors and that, on the other hand, some of them are necessary for the boarding of questions of Statistics. To this, it is added that the contents of this last subject have not been appropriately contemplated in the programs of some graduate programs.

Regarding the importance of this Post-graduate Study for the development of the Region it is undeniable that education in the basic sciences, the improvement of its teaching methods and the incorporation of tools for computer science constitute a necessary condition for the development of the Country. In this sense, it is necessary to mention the importance of this environment of improvement and upgrading that includes the teachers in a constructive process of improvement of their teaching and that for their conception and development, they imply didactic premeditation and reflection on the teachers' own practice.

The Mathematics contributes a language whose concepts and relationships are defined with a grade of such abstraction that they provide the universal language with a tool that facilitates understanding in the most diverse fields of knowledge and still of the social life. To dominate the mathematical reasoning, it is necessary to model and to analyze technical, productive or scientific methods , using in them so much analytic as approximate methods and making efficient use of the computation techniques and it is to this that the formation of teachers in this science aims at.

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