Mathematics at Distance Education for Students in Prison

Genoveva Leví, Eduardo Ramos, María Pilar González and Luis Tejero
Universidad Nacional de Educación a Distancia
Calle Senda del Rey 9, 28040 Madrid, Spain   eramos@ccia.uned.es

Abstract

The purpose of this paper is to analyze the academic yield of students in prison involving matters of scientific fields, in particular Mathematics. The study included the group of students enrolled in the careers of sciences and engineering at the *Universidad Nacional de Educación a Distancia* of Spain. We present a statistical summary of the results achieved by the group in prison in comparison with the rest of students. Using statistical tools we can state some conclusions about the yield obtained by students in prison.

INTRODUCTION

One of the features that best characterizes the development of a society is the ability to create an educative system capable of reaching all its members. This ambitious goal frequently faces the challenge to be able to give cover within the system to social groups with special needs demanding a differentiated educative processing. There are many differentiation sources to be considered; not only those that derive from physical or mental disabilities, known within the scope of the special education, but also those that are consequence of social situations, like, for example, the individual's economic level and social status, the fact of belonging to ethnic or religious minorities, the condition of being an immigrant in a foreign country, being held in a penitentiary center, etc.

Although, with no a doubt, the ideal situation would be that these groups could be integrated in the conventional educative system, for the sake of a more equitable processing, it is evident that, even in high-developed societies, this is far from being a reality. Elements like the economy scale, the need for specialized educators, or simply the impossibility to attend conventional classrooms, makes distance education essential when it comes to giving educative coverage to certain social groups.

Indeed one of the reasons that led to the creation of the National Distance Education University of Spain (UNED) was to facilitate the access to higher education to all the people who, being enabled to follow university studies, cannot attend the university classrooms due to labor, economic or residence reasons, as well as any other of similar consideration. In this scope, and among other performances, the UNED has developed since the beginning a Program of Penitentiary Studies, designed to take care of the educative demands of the people in prison. This program was developed in collaboration with the *Dirección General de Instituciones Penitenciarias*, main office responsible for the Spanish penitentiary system.

As it is well known, the models of distance education have proven to be effective in all the educative scopes, (Garcia-Aretio, 1994, 2001). Nevertheless, constant reflection must be made about the educative objectives pursued and in what degree such goals are achieved. In particular, it is useful to study the effectiveness of the distance studies followed by groups that display special educative needs, effectiveness that can be observed through their profit or academic yield.

The academic yield would be the level of knowledge registered or shown in a course or level of studies, compared with the average, age, objectives, etc, Rodriguez Espinar, 1982, Medina Rubio *et al.* 1992. A number of studies confirm that the academic yield is influenced by different psychosocial and personal variables. Thus, for example, age, intelligence, verbal understanding, space conception, reasoning, numerical calculation capacity, socioeconomic level, motivation, emotional, social self concept, social interrelation professor-student and student-peers, classroom size, methodology of study, educative model, are all factors that affect the academic yield.

Research has focused in the stages of elementary and secondary education, however the studies of adult education and those related to specific methodologies such as the methodology used in remote education are limited, Pérez Serrano, 1981, Latiesa, 1986, García Llamas, 1986, García-Aretio, 1987, Castejón y Vera, 1996, Leví y Ramos, 2000.

The objective of this work is to present some facts about the academic yield in matters of scientific fields, in particular in Mathematics, obtained by students shut in penitentiary centers, following the careers of science and engineering at UNED. The methodology used is to do a statistical analysis of the results obtained by this group and compare them to those obtained by the rest of the students. The work is organized as follows: first of all, the context of the study will be exposed, describing the group, the variables used as indicators of the academic yield and the samples used; then, a statistical analysis, descriptive and inferential of the sample, will be made; finally, the most significant results will be discussed and some conclusions will be extracted.

OBJECTIVES AND HYPOTHESES

Studying at UNED

The UNED follows a distance methodology, based on printed, audio-visual and computer material designed by the educational team of the Head Quarter, located at Madrid (Spain). Tutorial assistance is provided by local teachers at the Study Centers distributed all around the state and foreign countries; virtual courses in internet, videoconference, radio and television programs are available; professors from the Head Quarter are on duty through telephone, electronic mail, virtual tools, etc.; periodic meetings between the Head Quarter professors and students are scheduled in the Study Centers as well as evaluation tests.

Currently at UNED it is possible to study several careers at graduate level as well as doctorate. In the scientific field the University offers the following titles: Mathematics, Chemistry, Physics, Environment Science, Industrial Engineering and Computer Engineering. A graduate degree lasts five academic years and includes about three hundred credits distributed in, more or less, twenty five matters which must be individually passed. The course lasts nine months (October-June) and at the end students must take an exam that is held at the Study Centers and is supervised by the Head Quarter professors. Although there are different levels of qualification, numerical as well as categorical, the relevant final grade is Pass/Fail; passing means a positive evaluation forever. There are also recuperation exams in September.

The Students

The profile of a typical UNED student is a person between 25 and 45 years, urban resident, with job experience. In the year 2006, the number of students following a graduate degree was 118100. The percentage of students attending the course in prison oscillates around 0.75%. Students following studies in prison are included in a collaboration program between UNED and the office responsible for the Spanish penitentiary system. They benefit from a free enrolment, free didactic materials, and they must show a minimum yield not to be expelled from the program. Although one can think that students in prison have a lot of free time, isolation and other circumstances that can make studying easy, the fact is that the atmosphere in prison is not propitious to study, due to the influence of other inmates and the ordinary regime of prison life, with strict schedules, unexpected routine changes, etc. which demand an additional effort of control to dedicate time to study, Frezzoti *et al.*, 2000. The program has a special center, the jail Madrid V, where there is a module integrated solely by inmates who follow studies in UNED. In this center, and some others as well, students have tutorial assistance from prison teachers. The only way to make direct consultations to the Head Quarters professors is ordinary mail. The exams take place in the penitentiary centers in the presence of Head Quarter professors.

METHODS

The Sample
The frame of reference is the student population of years 2003-04, 2004-05 and 2005-06. Due to the way of obtaining a graduate degree that has been mentioned before, the experimental unit is the individual matter, for instance, Algebra, Geometry, Probability and so on. We first consider the group of students that follow the Mathematics career. Because of the fact that the sample size of this group is small and, therefore, the results could be not sufficiently clear, we extend the analysis to the group of students that follows a scientific or engineering career.

The Variables
In Spanish official agencies of evaluation, it is customary to measure the academic yield by the following rates: "*presented rate (PR)*", that is, the ratio between students who take the exam to those that are enrolled in the matter; "*success rate (SR)*", that is, the ratio between students which passed the exam to those who take the exam; and "*efficiency rate (EF)*", that is, the ratio between students who passed the exam to those that are enrolled in the matter. We use these rates as variables to measure the results. We can note that these variables are proportions.

Tools
We show a statistical description of the results and we do a classical statistical test of hypothesis to compare the proportions mentioned above.

RESULTS

Statistical Analysis of the Yield
 The numerical statistical descriptions of the examined groups are shown in Table 1 for students of Mathematics and in Table 2 for students of scientific and engineering careers.

	Academic Year 2003-04			Academic Year 2004-05			Academic Year 2005-06		
	Matters			Matters			Matters		
	Enrolled	Take exam	Pass	Enrolled	Take exam	Pass	Enrolled	Take exam	Pass
General	2926	1103	837	2926	979	750	2570	862	653
Prison	24	6	3	12	4	3	13	5	3

Table 1: Mathematics Career

	Academic Year 2003-04			Academic Year 2004-05			Academic Year 2005-06		
	Matters			Matters			Matters		
	Enrolled	Take exam	Pass	Enrolled	Take exam	Pass	Enrolled	Take exam	Pass
General	68683	20111	14369	67975	21615	16011	79487	23823	17336
Prison	474	169	97	498	166	96	488	161	117

Table 2: Scientific and Engineering Careers

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	Academic Year 2003-04			Academic Year 2004-05			Academic Year 2005-06		
	Rate Presented	Success	Efficiency	Rate Presented	Success	Efficiency	Rate Presented	Success	Efficiency
General	0.38	0.76	0.29	0.33	0.77	0.26	0.34	0.76	0.25
Prison	0.25	0.50	0.13	0.33	0.75	0.25	0.38	0.60	0.23

Table 3: Rates of yield for Mathematics Students

	Academic Year 2003-04			Academic Year 2004-05			Academic Year 2005-06		
	Rate Presented	Success	Efficiency	Rate Presented	Success	Efficiency	Rate Presented	Success	Efficiency
General	0.29	0.71	0.21	0.32	0.74	0.24	0.30	0.73	0.22
Prison	0.36	0.57	0.20	0.33	0.58	0.19	0.33	0.73	0.24

Table 4: Rates of yield for Scientific and Engineering Students

In Tables 3 and 4 we can see, respectively, the measures of yield for Mathematics students and scientific and engineering students.

We wanted to do a statistical comparison between the two groups of students: general and prison. For this, we used the classical test of statistical hypothesis: $H_0 : p = p_0$, where p_0 is the corresponding proportion in general group, that is, the population proportion, and p is the rate in prison group, that is, the sample proportion. This means that the null hypothesis is that there is not difference between both groups of students. The results for the above test are included in Tables 5 and 6, respectively, for student of Mathematics career and for scientific an engineering students.

	Academic Year 2003-04			Academic Year 2004-05			Academic Year 2005-06		
	Rate Presented	Success	Efficiency	Rate Presented	Success	Efficiency	Rate Presented	Success	Efficiency
z-value	-1.2835	-1.4821	-1.7459	-0.0092	-0.0760	-0.0502	0.3758	-0.8220	-0.1931
p-value	0.1993	0.1383	0.0808	0.9927	0.9394	0.9600	0.7071	0.4111	0.8469

Table 5: Results of the statistical test of hypothesis for Mathematics Students

	Academic Year 2003-04			Academic Year 2004-05			Academic Year 2005-06		
	Rate Presented	Success	Efficiency	Rate Presented	Success	Efficiency	Rate Presented	Success	Efficiency
z-value	3.0492	-4.0446	-0.2444	0.7355	-4.7753	-2.2493	1.4566	-0.0283	1.1584
p-value	0.0023	0.0001	0.8069	0.4620	0.0000	0.0245	0.1452	0.9774	0.2467

Table 6: Results of the statistical test of hypothesis for Scientific and Engineering Students

The results of Table 5 and Table 6 show that, in general, we can accept that there is no difference in the academic yield, measured as the above mentioned rates, for students in prison and general students. Nevertheless, we must be cautious with this conclusion because of the small size of the sample in the case of Mathematics students. Also, in the case of science and engineering students the results are not uniform; in particular, we must reject the null hypothesis of equal proportions in several cases, as the "success rate" for years 2003-04 and 2004-05.

DISCUSSION

The most relevant conclusions that can be extracted from the conducted statistical analyses in this work are:

A system of distance education is a valid alternative to give educative coverage to those groups with special needs such as people shut in a penitentiary center.

When the methodology is suitably used, the academic yield that can be obtained by these groups had to be, in theory, similar to the one obtained by the rest of the students.

Nevertheless, the results indicate that the borderline is weak. It would be interesting to deepen in the analysis to find pedagogical channels able to make these possible differences totally disappear.

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