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INTRODUCTION

Doctoral programs began in Mexico around the middle of the twentieth century. These programs evolved as an outgrowth of the existing scholar tradition within the humanities (philosophy) and through the initiatives of research-oriented faculty who had obtained their training mostly in Europe and in the United States. The generation of Spanish scholars that came to Mexico fleeing from Spain's Civil War enhanced this tradition. Therefore, the beginning of doctoral programs in the country may be better understood as the result of international forces rather than the normal development of its higher education (HE) system.

The exogenous nature of the origins of doctoral programs in Mexico explains some of their present characteristics. The introduction of doctoral programs created a tension between the professional and academic views of HE, as well as between the science and humanities communities regarding their positions about "truth" and their different attitudes towards research and scholarship. These differences had important effects also beyond doctoral programs, extending to other facets of university life and even further.

Before the creation of doctoral programs, universities in Mexico had very limited academic personnel in the modern sense. Professors were mostly learned professionals who taught at the various professional schools around which the universities were organized. In addition to teaching, the professors' main commitment was to satisfy their everyday practice obligations. There was little expectation of research or scholarship. However, some faculty members did in fact produce scholarly books, mainly used

as textbooks. Society recognized them as distinguished professionals who spent a significant part of their time outside the universities' walls. A notable exception to this state of affairs was to be found among the professors in the relatively small schools of philosophy, literature, arts and, later, science. These, however, were then few in number and had no real influence in the running of the universities.

Even after universities evolved and full-time academic staff became the leading voice in university affairs, the professions continued to dominate the undergraduate curricula up to the current state of affairs. Thus, undergraduate education is profession-oriented and generally known as *licenciatura*, a term that indicates that graduates are *licensed* to practice their professions. The same term is applied even to graduates in academic or disciplinary fields such as philosophy, arts, humanities, and science. This means that the undergraduate syllabus is specialized, rigid and takes between 9 to 12 semesters to be completed. In contrast with bachelor's degree programs in the United States, Mexican *licenciaturas* provide less general education and more field or area content (King 1971; Osborn II 1987).

ORIGIN AND EVOLUTION

The origins of doctoral programs in Mexico can be traced back to the early 1940s when Mexico had only about a dozen public and five private universities (Rangel Guerra 1979). As with many other aspects of higher education in the country, these doctoral programs were initiated at the *Universidad Nacional Autónoma de México* (UNAM). They began in its School of Philosophy and Literature, from which the School of Sciences soon emerged as a separate entity. Doctoral programs spread out to other schools from these two and, later on, to other universities.

Three distinct periods can be appreciated in the evolution of doctoral studies in Mexico when we consider the number of programs offered and degrees awarded. These periods also constitute stages during which diverse forces can be identified as acting on the HE system. These forces resulted in different general concerns and attitudes towards doctoral programs.

The Beginnings: 1940–1970

During almost thirty years, doctoral programs remained an academic oddity. Only two or three degrees were awarded annually (Malo 1981). It was only after 1960 when other universities (including some private ones), the *Instituto Politécnico Nacional* and the *Colegio de México*, began to offer a significant number of graduate programs, although they did not award doc-

TABLE 8.1. Evolution of enrollment in the educational system

Year	*Primary School*	*Secondary School*	*Middle School*	*Higher Education*
1950	2,997,054	69,547	37,329	29,892
1960	5,342,092	234,980	106,200	76,269
1970	9,146,460	1,082,377	335,438	271,275
1980	14,666,257	3,033,856	1,265,741	935,789
1990	14,401,588	4,190,190	2,100,529	1,252,027
2000	14,792,500	5,349,700	2,955,700	1,718,000

SOURCE: 1950–1990 figures from OCDE (1997); 2000 figures from SEP (2004)

toral degrees on a regular basis. It was not until late in the sixties, once the *Centro de Investigación y Estudios Avanzados* (CINVESTAV) was fully established, that Mexico began to have constant sources of newly trained PhDs.

During this period, most Mexican PhD graduates were individuals who studied abroad either by their private means or through loans or scholarships. The *Banco de México* ran a loan program used mainly by those wishing to pursue graduate studies in economics and related fields. In addition, the *Instituto Nacional de Investigación Científica* as well as some of the recently created national research facilities (the Nuclear Energy Research and the Petroleum Institutes are two good examples) awarded graduate scholarships to students interested in pursuing research careers.

Although limited, these financial aid programs accounted for a steady increase in the enrollment of new Mexican PhD students from their inception to well into the seventies, mostly in overseas programs. Most of these doctorates received their degrees in the USA, the UK, or France. By 1976, Mexican institutions had awarded 447 doctoral degrees out of an estimated total number of 1,480 PhDs in the country. At that time, Mexico had seventy-three doctoral programs, with sixty-eight of them offered by universities situated in Mexico City (CONACYT 1976a).

During this early period, *licenciatura* enrollment increased many times over, starting from 29,892 students in 1950 to 271,275 in 1970 (table 8.1). Most of this expansion was absorbed by UNAM and a few other state universities, thus making them large universities at this early stage in their development.

Three kinds of graduate programs existed in Mexico. Specialization programs, that had the largest enrollment and also had the greatest variance in time to degree, with three-year duration for the medical profession and

one- or two-year duration for other professions. Masters degree programs, usually with duration of two years, tended to have an academic or professional orientation. Finally, the doctoral degree programs, with four-year duration, were devoted to research and scholarship. In general, doctoral programs were similar to the USA model.

Differentiation and Planning: 1970–1990

During the same period, the growth of the HE system started to generate an increasing demand for graduate studies. Government officials became aware of the urgent need to produce a more highly trained labor force and of the importance of creating capacity in science and technology.

In 1970, the Mexican Government created the National Council for Science and Technology (CONACYT) with human resources development for R&D as part of its mandate. By then, the emerging community of scientists consolidated into the Mexican Academy of Sciences, founded in 1959 by less than a dozen pioneer researchers. During the seventies, the rapid growth of HE led to the creation of a new secretariat at Mexico's Ministry of Education dedicated to promoting graduate studies and scientific research at Mexican universities.

These three organizations engaged in many different activities and programs to promote and plan graduate programs throughout the country to satisfy the increasing demand for quality in HE, research and development (AIC 1973; CONACYT 1976b; SEP 1982). In 1976, CONACYT produced the first long-term plan for Mexico's scientific and technological development (CONACYT 1976c), and established the first major program for human resources development that soon was receiving international financial support.

These organizations focused on the policies needed to increase the number of doctoral graduates in the country and their influence on Mexico's development. Centralization, low productivity and imprecise rules for the conduct of graduate programs were among the more frequently mentioned obstacles for the first goal, while lack of fiscal incentives, policies and goals were often mentioned in regards to the second goal.

During the 1980s, however, masters and doctoral programs both at UNAM and elsewhere multiplied at a fast pace. Thus while in 1967 the country had only around two hundred graduate programs, twelve years later there were over seven hundred (Malo 1983). This gave a further impetus to doctoral programs, which began to multiply nationwide, and by 1980 there were fifteen universities that offered fifty-two doctoral programs (Ruiz Herrera 1986) and awarded some two hundred degrees per year.

Existing universities grew in size while new ones were created in different parts of the country, all of them requiring academic staff in large numbers. This demand raised concerns about the quality of HE and an increased interest and demand for doctoral and masters graduates. Although growth took place everywhere, it was particularly noticeable in Mexico City: UNAM expanded from about 60,000 students in 1970 to 140,000 by 1980 (Blanco 2001); it created five new campuses in the larger Metropolitan Area of Mexico City; it increased the number and nature of its research centers and institutes, and improved its academic personnel. During this decade, CINVESTAV also consolidated its departments and began to create campuses in different regions of the country. Finally, the *Universidad Autónoma Metropolitana* (UAM), established in 1974, was soon operating three campuses in Mexico City and rapidly became one of the leading institutions in Mexico, particularly in the areas of research and new doctoral programs. In 2006, a fourth campus was integrated to the UAM system.

Since conditions for pursuing a career in research at the above-mentioned three institutions were much better than in others, many of the PhDs graduating in Mexican universities (most noticeably at UNAM) were absorbed by the institutions that trained them. Thus, an informal differentiation between "research-oriented, PhD-granting" institutions and "teaching-only" institutions began to appear by the end of the seventies. This enhanced the resolve of CONACYT, the Ministry of Education (SEP) and the *Asociación Nacional de Universidades e Instituciones de Educación Superior* (ANUIES) to have state universities increase their number of graduate programs and research activities. However, no national planning policy was produced that would establish some kind of balance between the number of research oriented universities and the society's need for sufficient and good quality technical and professional institutions. By the end of the seventies a differentiation of graduate programs had also occurred. Doctorates in the medical and health fields were practice oriented whereas doctoral degrees were all research oriented.

The economic crisis that took place in 1982 changed the country's views and attitudes regarding science and HE. The fear of losing many of its best scientists to other countries or to better paid jobs led to the creation of the *Sistema Nacional de Investigadores* (SNI), a nation-wide program by which scientists' individual productivity over a period of years is assessed. Those that receive a positive evaluation obtain a regular, tax-exempt financial stipend in addition to their salary. The SNI bylaws favor individuals holding a doctoral degree.

Expansion, Privatization and Diversification: 1990 to Date

For several years—what some analysts call the *lost decade* due to the nil economic growth through the period—public HE reduced its rate of growth and the progress of public research institutions and laboratories virtually stopped, while private HE increased its size and its role. Paradoxically, during the same period graduate programs, doctoral graduates and the number of research papers produced by public universities multiplied.

The private sector expansion in the last fifteen years is the most significant phenomenon affecting the Mexican HE system. The increasing enrollments in private establishments of HE were observed for many years, and Daniel Levy (Levy 1986) anticipated the challenge this expansion posed to public dominance. The rate at which this has been taking place in the last years is remarkable. As Rollin Kent indicates, the number of private institutions grew from 358 in 1990 to 735 in 1999 out of 1,250 HE establishments (Kent 2004). Nevertheless, the enrollment in public HE establishments is still larger than in private ones. Public institutions also include the non-*licenciatura* establishments (two-year colleges) created during the last fifteen years.

Private graduate education has followed the developments at the *licenciatura* level. Since the early forties, the *Universidad Iberoamericana* (UIA) and the *Instituto Tecnológico de Estudios Superiores de Monterrey* (ITESM) offered graduate programs. During the eighties, many additional private institutions entered the provision of graduate education, most of them by way of *diplomados* (short graduate courses) and masters programs, but only UIA and ITESM and a few others had institutional doctoral programs that also comprised research activities by full-time faculty.

Over the last fifteen years the two federal government agencies directly related to HE and scientific research, the *Subsecretaría de Educación Superior* (SES) and CONACYT, have promoted different initiatives, many of which relate to doctoral studies. The former operates several programs that provide universities with grants to increase the number of their academic staff with PhD degrees or to support institutional development. In addition, SES has been instrumental in the establishment, operation and improvement of several non-government quality assurance, testing, accreditation, and certification agencies.

CONACYT on the other hand, operates the *Sistema Nacional de Investigadores*, manages the *Padrón Nacional de Posgrado* (Graduate Program Registry)—an assessment instrument that recognizes the best masters and doctoral programs in the country, the largest scholarship program for stu-

dents that wish to pursue graduate studies in research related areas, and several R&D funding mechanisms.

GOALS, STRENGTHS, AND WEAKNESSES OF DOCTORAL PROGRAMS

Quality assurance mechanisms established by the above-mentioned federal agencies led to the consolidation of several doctoral programs at public universities. Moreover, students enrolled in these programs are expected to complete their degree through a PhD thesis that produces at least one publication in reputed international research journals. These programs share similar operation procedures among themselves and with the doctoral programs of US universities, such as assigning a mentor to each student admitted into the program whose main responsibility is to plan, along with the student, academic activities and supervision of the student's dissertation project. In addition, the large research institutions rely on the assessment of specific tutorial committees assigned to each student. These committees supervise student progress, assign basic course schedules during the first four or five semesters and approve the dissertation projects and the individualized students' academic plan. The tutorial system at UNAM has been remarkably successful in programs related to the natural sciences, and less so in the humanities and in the social sciences since full-time students are more numerous in the former (UNAM 2001). In spite of the increase in the number of full-time students in the humanities and social sciences, a significant number of them are still part-time.

By the end of the 1980s, UNAM, CINVESTAV and UAM together with three or four of the other larger public universities were producing a steady supply of new doctoral graduates in the country. A distinct characteristic of these graduates was that almost all of them came from public institutions and received their PhD degree mostly on basic research areas in natural sciences, life sciences and humanities. Faculty personnel at large public institutions had already reached a critical mass to compete successfully for government and institutional grants to set up laboratories and infrastructure facilities. Private universities, in contrast, had very limited experimental infrastructure and therefore focused most of their doctoral programs on areas of knowledge that did not rely on expensive investments in the operation of modern laboratories, libraries, and information facilities.

During the last two decades Mexican scientists have participated in ambitious research projects that involve graduate students and considerable subsidies through international collaboration agreements and networks to use specialized resources abroad such as particle accelerators, telescopes, or historical archives, to name but a few examples. This practice enhances graduate student and academic international mobility but it sharply contrasts with the feeble exchanges of students in different programs *within* the country, except for the intense flow of graduate students towards the leading institutions in the Mexico City Metropolitan Area. Once the student obtains his doctoral degree, it is a favored practice to apply for a faculty position at these large universities rather than return to his home institution unless he is a candidate of one of the federal, faculty-development programs mentioned elsewhere in this chapter.

International collaboration by graduate programs and research departments is exhibited by the number of publications they produce that include authors from institutions in different countries. Graduate students are encouraged to be continually aware of new developments in their fields of specialty regardless of where they originate. In fact, to avoid endogamous faculty growth, most graduate programs refrain from hiring their own students in tenure-track positions, or at least, invest considerable effort to persuade them to do postgraduate work at other institutions overseas for a minimum of one year before their job applications are considered. At UNAM, this practice has become mandatory in the exact and natural sciences areas, although it is less frequent in the social sciences and humanities programs.

Doctoral programs recognized by CONACYT as being of high quality are generally equivalent to those found in the best universities in the US or Europe, and therefore one may conclude that individuals that receive their training in these programs have the skills to make an independent contribution to the advancement of knowledge through original scholarly research. However, it is a fact that most PhD graduates involved in high-level research work in academic centers, with a negligible fraction of them stationed at the very few industries that have advanced research facilities. Thus, the increase in doctoral graduates has had a negligible influence in the country's overall growth in productivity.

One of the main weaknesses of doctoral programs in Mexico is *system inbreeding*, that is, a system devoted to the advancement of knowledge that is self-referenced. This system has doctoral programs of good—even high—quality, with ample international recognition and first-class training for graduate students, but it has not yet developed a relationship with the country's non-academic sectors and, in some cases, not even with the undergraduate programs offered by the same institutions. One may argue that one of the main objectives of a doctoral program is to produce individuals with particular skills for original research, but the job perspectives should go beyond the work at academic institutions. Additional effective

mechanisms still need to be implemented to create a more innovative and synergistic relationship between industry and doctoral programs. Naturally, there are some individual exceptions, but it is a fact that many doctoral programs do not consider a wider horizon beyond the academic environment itself.

According to the Institute for Scientific Information, in 2003 Mexico produced 5,783 papers representing about 0.72 percent of the world publications, ranking twenty-first in total number of papers published of the OCDE countries and second in the Latin American region, after Brazil. About a fifth of these publications were in Physics, followed by Health Sciences (12.5 percent), Plants and Animals (12 percent) and Chemistry (11.5 percent). Each of the other disciplines represents less than 8 percent of the country's scientific contribution. The *impact factor* provides a more detailed indicator of the publication data. It is proportional to the number of citations a particular paper receives in the five-year period after its publication. This indicator shows that the disciplines that represent the largest fraction of the country's publications and also those that receive more citations—Physics, Chemistry and Plants and Animals—have an overall impact factor *below* worldwide average whereas those having the largest impact factor are, in decreasing order: Astrophysics (6.6), Immunology (5.6), Molecular Biology (5.4), Neurosciences (4.4), and Microbiology (4.3) (CONACYT 2004).

During the five-year period 1999–2003, UNAM published 12,667 articles in international journals with an impact factor of 3.1, the largest in the country. CINVESTAV follows, with 5,029 articles with impact factor of 2.8. The UAM is the third research institution, with 1,922 articles with an impact factor of 2.4.

Senior staff at research universities in Mexico still enjoy enviable intellectual freedom: professors are at liberty to choose to work on any disciplinary subject that inspires their intellect with few external pressures to modify their research agenda or adapt the methodology according to departmental or institutional planning guidelines. During the differentiation and planning period (1970–1990) mentioned above, it was assumed that in order to build critical masses of reputed researchers, it would be sufficient to require high quality in the research products instead of pressing young PhDs to contribute to the institutionally established research goals. This might be quite satisfactory to a true or potential scholar but, paradoxically, the number of respected and recognized scholars (in the universal sense) has decreased.

The *scientometric* data suggests that Mexican doctoral candidates are

exposed to a very competent academic base, at least for those who pursue their degree at the main research universities. Graduate students receive good training in their specialized fields of knowledge but they do not benefit from *scholarship* in the traditional sense, as the relative number of true, multidimensional scholars in the country has diminished below what one could consider as the minimum critical mass.

There is an additional effect arising from the distinction between full-time professors devoted mostly to research activities and those that are concerned with teaching. The large public research universities in Mexico are organized in professional schools, where most of the teaching activities are carried out, together with institutes and centers, where research activities occur. The separation between the main objectives of schools and those of institutes has created an effective two-class system, where different assessment and reward programs coexist in the same institution to address the needs of "teaching" professors and those of the "research" professors. An additional inconvenience of the separation between schools and institutes is the lack of everyday contact between undergraduates and the research faculty at the institutes. The loss of the direct transmission of the research experience—the sense of discovery—to undergraduate students cancels some of the most gratifying aspects of the research university environment.

The other face of the coin is related to the question, what measures has the productive sector adapted to attract young high-level researchers? Small and medium enterprises comprise the core of Mexican industry, and they seldom invest in R&D activities to increase productivity. Large enterprises that do have a potential to benefit from innovation derived from in-house research groups prefer to rely on technological transfer and acquisition activities rather than invest in the former. The net result is a growing divide between doctoral programs and the demand for high-level researchers from the productive sectors. Recently, CONACYT launched a strategy aimed at linking researchers and business firms. The strategy includes thirty consortium projects, each with seventy researchers. Most projects consist of partnerships between enterprises and research centers sharing efforts to improve competitiveness in Mexican industry. To support this initiative, on May 2005, a World Bank 250 million USD loan was secured to fund the long-term project (2006–2015) "Innovation for Competitiveness."

FORCES OF CHANGE

The rapid expansion of the educational enrollment shown in table 8.1 reveals the strong pressures acting on the system. During the period between 1950

and 2000, the population of Mexico quadrupled from 25.8 million, with a national average age of 23.3 years, to 100.6 million at the end of the period with a national average age of 26.1 years. The education system was able to respond to the rapidly growing number of children demanding basic education services to the extent that the Ministry of Education built a large number of schools and sufficient teachers graduated to satisfy this demand.

In 2000, 34 percent of the population was under fifteen years of age and 61 percent was the economically active population (ages between fifteen and sixty-four). During the next fifteen years, the demographic distribution will demand additional HE services at an increasing rate that is stressing public finances. The nation was able to provide basic education to a population that had a considerable higher rate of growth fifty years ago, but today, when the rate of growth has diminished, the main challenge for the system is to provide more expensive HE facilities to more students while it will be closing down less expensive basic education schools. This trend explains, in part, the rapid expansion of the HE system and the proliferation of private institutions.

Although many of the new graduate programs at public and private institutions created during the last twenty years followed the pattern set by UNAM, it was soon perceived that there were marked differences in the institutions' faculty and research staff abilities. Such a state of affairs stimulated the Federal Government to develop external assessment procedures for programs, faculty and institutions. This led to the creation of peer-review evaluation organizations since the early nineties, and to the improvement and strengthening of the graduate program registry administered by CONACYT. More recently, formal program accreditation organizations have begun to operate in collaboration with the existing professional colleges and certifying bodies. Although program accreditation procedures are not yet mandatory, society perceives this distinction as a mark of good quality.

In addition to the above-mentioned changes that deal with increased interest in external and objective assessment of HE, there has been a renewed interest in increasing assessment of doctoral education. For example, the Mexican Academy of Sciences initiated an examination of doctoral programs at UNAM in collaboration with the US National Academy of Sciences, also assisted by the Mexican academies of engineering and medicine in a combined effort to identify the best Mexican programs in these areas and to promote new networks, mostly within the Latin American context.

Perhaps the most important force of change is the rapid and multifaceted internationalization of HE. Several factors intervene in this phenomenon caused by the expansion of a global economy. In addition, the negotiation of trade agreements within large geographical regions; the availability of scholarships and financial aid programs to attract graduate students to North American and European universities, and the trends to increase the mobility of students and academic staff such as the Erasmus and Socrates programs of the European Union (EU) have also contributed. Internationalization of HE, in its many forms, is an interesting development and in fact, science has evolved as an essentially international endeavor. However, it may also represent a risk to national educational systems, particularly in the area of doctoral education. Students are lured by extremely attractive programs offered in several countries. For example, the creation of a European Research Area (with an extraordinary funding as a fraction of the European Union GNP) will attract many of the most brilliant minds involved in R&D activities in Mexico and other countries in Latin America. Furthermore, European universities are also providing generous financial aid to bring foreign graduate students to their institutions, and many may not return to their home countries after obtaining their degrees. According to current European projections, "In order to have the same proportion of researchers in the labor force as the high performing US, the EU needs an additional 550,000 researchers by 2010. This is equivalent to roughly 50,000 extra researchers per year with the proviso that the US does not increase its proportion of researchers in the short to medium term" (European Commission 2003).

A historical perspective of the paradigmatic transformation in the economies of several countries demonstrates the enormous importance of long-term planning for R&D as an essential condition for advancement and progress. The examples are plentiful, of which we only mention the following: the drastic reforms introduced by emperor Meiji, in Japan at the end of the nineteenth century that brought Western science and culture into that country; the large investment in scientific research promoted by Vannevar Bush's report to the US president in 1945 that laid the blueprint for the impressive growth in American science and technology during the next fifty years, and the well known economic growth of South Korea, Taiwan, Singapore, India, Ireland and Israel based on knowledge. In contrast, it is unfortunate that such long-term national policy plans have not yet been developed in Mexico. Current federal legislation mandates each new federal administration to produce a state plan for education and,

specifically, for the much-needed influence of doctoral training in research and technological development activities. But these plans almost never survive beyond the next administration.

THE CURRENT STATUS OF DOCTORAL EDUCATION

Academic personnel in science and technology in Mexico is limited. It represents only 0.7 people devoted to research and development (R&D) per 1,500 persons of the economically active population, with a total annual graduation of doctors of about 1,000 individuals. Only ninety institutions of HE in Mexico offer doctoral programs and most of these are concentrated in a handful of universities: thirty-seven of them have just one program, and three quarters of the total offer less than five programs. Institutions with more than ten doctoral programs account for 10 percent. Table 8.2 shows those with the highest number of programs.

It is worth noting that only two of these institutions are private: the UIA and ITESM. The others are concentrated in five states in the country (out of thirty-two). According to ANUIES, in 2004 universities and other institutions of HE offered 3,628 graduate programs, of which 897 were at the specialization level, 2,223 were at the master's degree level and 508 were at the doctoral level (ANUIES 2004)

Total enrollments in Mexico's Educational System for the 2001–2002 academic year accounted for almost thirty million students (29,023,459), of which 81.9 percent attended elementary school; 10.81 percent secondary education; 6.9 percent HE; and only 0.4 percent graduate studies. More than two million students (2,147,075) enrolled in HE. The number of graduate students was 132,473 (6.1 percent of the total), distributed in professional schools (22.4 percent); masters (70.3 percent) and only 7.3 percent at the doctorate level (SEP 2002).

A historical review of enrollment patterns in HE shows that in 1970 the number of students was 252,236. This number grew to 853,239 in 1980 and increased to 1,252,027 in 1990; figures for 2002 accounted for an enrollment of 2,236,811 students. However, at the graduate level, the increase in enrollment has been rather moderate: it has grown only 23 percent from 1998 (107,149) to 2002 (132,473). Table 8.3 shows the number of graduate students since the mid-1980s.

In the school year 2005, 70.5 percent (105,594) of graduate students attended masters programs, and 20.9 percent pursued a professional program, while only 8.5 percent enrolled in a doctoral program. Moreover, the enrollment in graduate programs was highly concentrated in a few states. In the year 2000, of the total enrollment (118,099), 38 percent of

TABLE 8.2. Institutions with the highest number of doctoral programs in Mexico

Institution of Higher Education	*Programs*
Universidad Nacional Autónoma de México	32
Universidad Autónoma de Nuevo León	23
Centro de Investigación y de Estudios Avanzados	22
Universidad de Guadalajara	20
Colegio de Graduados. Universidad Autónoma de Chapingo	19
Instituto Politécnico Nacional	18
Universidad Autónoma Metropolitana	15
Instituto Tecnológico de Estudios Superiores de Monterrey	13
Universidad Autónoma del Estado de México	11
Universidad Autónoma de Puebla	11
Universidad Iberomericana	10

SOURCE: COMEPO, *Plan de Desarrollo del Posgrado Nacional* (National Graduate Studies Development Plan), p. 15.

students were located in Mexico City; 8 percent attended graduate studies in Nuevo León; 7.9 percent in Jalisco; 7 percent in Puebla; and 6.7 percent in the State of Mexico. At the doctoral level, near half of the total enrollment is located in the country's capital. As expected, the number of doctoral graduates per million inhabitants has remained rather low, despite its increase during the last decade: it went from 2.5 in 1990 to 8.7 in 1998 and to 10.9 in the year 2000 (CONACYT 2000). Table 8.4 shows the slow evolution of doctoral enrollment in Mexico during the 1990s and the beginning of the twenty-first century.

As the leading institution for teaching and research in Mexico, it is worth noting that UNAM employs the largest number of research personnel in the country (more than 4,000 researchers). It also has the highest number of SNI members of any institution of HE (2,733). UNAM allocates 25 percent of its total budget to research activities. Scientific research is conducted at its eighteen institutes and ten centers. Research in the humanities and the social sciences is carried out in nine institutes and seven centers. (UNAM 2003; UNAM 2004). In addition, it has a considerable number of major research facilities (including two ships to conduct oceanographic studies) scattered throughout the Mexican republic.

CINVESTAV, created in 1961, is the second most important research institution. Today, it employs more than five hundred researchers (almost

TABLE 8.3. Enrollment in graduate education by levels of study, 1985–2002

Year	*Total*	*Doctorate %*	*Masters %*	*Professional*
1985	37,040	3.5	63.2	33.1
1990	43,965	3.0	61.2	35.6
1995	65,615	6.8	64.5	28.5
2000	118,099	7.1	69.6	23.2
2005	149,676	8.5	70.5	20.9

SOURCE: ANUIES 2002, *Anuario Estadístico* (Statistical Yearbook), México, 2002

TABLE 8.4. Evolution in the number of doctoral students in Mexico (1990–2006)

Year	*Students*
1990	1319
1991	1438
1992	1617
1993	2133
1994	3075
1995	4462
1996	5127
1997	6139
1998	7501
1999	7899
2000	8385
2001	9413
2002	9670
2003	10,415
2004	11,711
2006	12768

SOURCE: COMEPO *Plan de Desarrollo del Posgrado Nacional* (National Graduate Studies Development Plan), p. 16; ANUIES 2006.

all of them are SNI members) that work in its eight departments located in Mexico City, and in the cities of Guadalajara, Irapuato, Mérida, Querétaro and Saltillo. During the 2003 academic year, CINVESTAV granted 151 doctoral degrees in natural and exact sciences; biological and health disciplines; technology and engineering, and social sciences and humanities (CINVESTAV, web page). Among the public universities, UAM, *Universidad de Guadalajara* and *Universidad Autónoma de Nuevo León* also have significant numbers of researchers with a large fraction of which are SNI members: 629, at UAM, 201, at UdG and 183, at UANL (quoted from the institution's web pages).

Research constitutes a substantial activity only in a handful of the numerous private universities in Mexico. ITESM, the *Universidad de las Américas* (UDLAP), and UIA are good examples. In ITESM—one of the best well-known private institutions—research is focused on innovation, technological development and competitiveness; planning for sustainable development; protection of the environment; and the improvement of education. UDLAP's main areas of interest are anthropology, political science, economics, history, international relations, sociology, computing and communications. Research at UIA is organized in different departments where scientific and humanistic disciplines are strong. Although the number of researchers at these three universities that are SNI members was until recently low (less than 100), their number is growing. Recent figures show ITESM and UIA graduating each some twenty-five PhDs per year and ITESM as having 194 members in their staff belonging to SNI (UIA 2005; ITESM 2005)

In order to strengthen the quality of masters and doctoral programs offered by the Mexican system of HE, in 1991 CONACYT began to operate the *Padrón Nacional de Posgrados* (PNP), a registry of good quality graduate programs. It classifies masters and doctoral programs in two categories: a) Competitive at an international level, *i.e.*, excellent, and b) High-level. This is the most important instrument of the Federal Government to assure the quality of graduate education and in fact, it is the most widely accepted form of accreditation within the Mexican academic community (Alcantara and Canales 2004; Rodriguez 2004). During the 1999–2000 academic year, only 406 (13.9 percent) programs were incorporated into the PNP out of 2,908 graduate programs (masters and doctoral).

This instrument, along with the *Programa Integral para el Fomento del Posgrado* (PIFOP) is part of the *Programa para el Fortalecimiento del Posgrado Nacional* (PFPN), launched by the federal government at the beginning of the 2000–2006 Federal administration. The PFPN's main

objective is to improve and assure the quality of graduate programs offered by the country's institutions of HE. Another goal of this national program is to expand opportunities for training scientists, humanists and technologists through good quality graduate education.

It is worth acknowledging that during the last decades, the growth of graduate education in Mexico has been an uneven process, both in terms of program quality and in the scope of different fields of knowledge. In some cases, there exists a weak relationship between doctoral education and the needs of the social and productive sectors. The strong concentration of enrollment in a few fields of knowledge has also restricted the creation of a diversified scientific and technological basis in order to overcome the challenges facing the nation. The Mexican scientific community is small and it is strongly concentrated at the public institutions of HE. This is in part due to the low levels of investment in research and development made by the productive sector. Therefore, the flux of technological transfer from universities to industry is very weak.

According to CONACYT's 2001–2003 report, of the total number of doctoral students enrolled in the year 2000 (8,385), only 1,220 completed their degrees (CONACYT 2004). Distribution of enrollment by field in doctoral studies shows that the highest concentration is in the natural and exact sciences (29.7 percent), and the social sciences and administration (20.7 percent), followed by engineering and technology (16.5 percent); education and humanities (16.2 percent); health sciences (11.3 percent); and agriculture (5.6 percent). Table 8.5 shows the evolution of new doctors by field from 1986 to 1998.

According to the COMEPO development plan, it is likely that the number of doctoral programs and doctoral students in Mexico will continue to increase in the near future due to the current policies being implemented through several programs, such as the Program for the Improvement of the Professoriate (PROMEP), launched in 1996 by the Ministry of Education. During the last three years, this program has granted 2,461 scholarships to pursue graduate studies in Mexico and abroad. Another important instrument is the National Program for the Improvement of Academic Personnel (SUPERA), established by ANUIES. In addition, CONACYT's Integral Program for the Consolidation of Graduate Studies (PIFOP) provided support to 372 graduate programs in 2002 (COMEPO 2004)

As most public universities in Mexico have an autonomous status, they have the prerogative of establishing their own admission policies. Usually, applicants for graduate studies must meet some requirements, including an interview with one or several professors, a review of previous studies,

TABLE 8.5. Evolution of new doctorates by field (1986–1998)

Fields	*1986*	*1988*	*1990*	*1992*	*1994*	*1996*	*1998*	*Total 1986–1998*
Natural and Exact Sciences	53	54	66	85	98	143	185	1249
Agriculture	5	4	3	12	22	44	61	242
Health Sciences	8	21	36	39	44	71	87	594
Engineering and Technology	7	13	9	27	44	52	91	456
Humanities and Education	13	26	32	21	33	75	144	538
Social Sciences	46	63	55	81	83	125	166	1175
Total								4254

SOURCE: COMEPO, *Plan de Desarrollo del Posgrado Nacional* (National Graduate Studies Development Plan), p. 17.

a presentation of a research project, proficiency in a foreign language, and professional and research experience in order to be admitted into a doctoral program.

Although tuition and fees at most public institutions in Mexico are negligible, there are agencies that provide scholarships and financial aid for doctoral studies, either in Mexico or abroad. Since its creation in 1970, CONACYT has offered students and academic personnel a large number of scholarships and research grants. Scholarships for doctoral studies in Mexico help students to dedicate full time to their academic programs. In 2003, Mexico's federal agencies awarded 23,804 students with scholarships to pursue graduate studies (CONACYT 2004).

A COMPARATIVE EXPERIENCE IN DOCTORAL EDUCATION

A recent study conducted by Clements and Alcantara (2005) attempted to investigate primary stakeholder perspectives of doctoral education at three research-intensive institutions in Mexico and the United States. By exploring the insights of doctoral students, faculty and administrators using surveys, taped and transcribed interviews and content analysis of documents, this study triangulated observations of doctoral programs at three locations. The purpose of this array of methodological approaches was to analyze in depth the varied viewpoints of students, faculty and administrators on their

experiences of, satisfaction with, and importance of, mentor-protégé relationships with regard to student degree completion in the two countries.

The authors observed that mentoring at the doctoral level is comprised of a number of both perceptible and barely visible activities, behaviors, experiences and interactions between professors and doctoral students. For this critical relationship to rely so heavily on the goodwill and conscientiousness of a single mentor may indicate one of the haunting problems of doctoral degree programs.

In this study professors and academic coordinators identified the factors that, in their view, favor or make difficult the mentoring association. The positive aspects include: personal trust (empathy), students' involvement in research projects preferably lead by mentor, full-time faculty and students, clear lines of research, strong commitment of the professor in the students' academic progress, and so on. On the other hand, a failed mentoring relationship could be due to the lack of the "pedagogical authority." This situation may happen when the student does not recognize that his/her mentor is an expert in a specific field and that he/she is able to support and conduct the entire academic process that would eventually lead to the completion of the student's dissertation. Lack of authority may be attributed to little experience in the field and insecurity, as happens with young professors.

Student autonomy is also required to find and process data; autonomy also implies initiative and the search for new ideas and methodologies. A mentoring relationship could also fail when there is not enough empathy between the two partners, or when either the professor or the student is not able to dedicate enough time to the program. It is frequent, particularly in the Mexican case, that students have to work twenty to thirty hours per week outside the university. Problems exist also when the professor does not have tenure and has to comply with heavy teaching loads. Good academic facilities are a necessary condition for a program to be successful. These are taken for granted in the prestigious institutions, but, for example, at some of UNAM schools not all full-time professors have office space and a computer.

CONCLUSION

Although graduate education has long been present in Mexico, its development has been slow and its productivity is still low. It is only in the last score of years that it has become widespread, rather than being limited to a handful of universities in two or three cities; when the total number of graduates each year have consistently reached more than a thousand; and

when program diversification has allowed many fields of study to be covered instead of just a few.

Doctoral programs have followed the above trends, but at a smaller scale and lower pace of development. The annual number of PhD graduates is small when compared to Mexico's total population, and the numbers of students enrolled in programs leading to a doctoral degree remain less than 1 percent of total enrollments in HE. In addition, the numbers of institutions offering doctoral programs are still limited, mostly public, and concentrated in few geographical locations.

It is worth noting both that public policies keep supporting programs that assist universities to administer good doctoral programs as well as to have more PhDs in their staff. And there is a growing interest shown by private institutions in recruiting doctoral graduates and offering doctoral programs. In addition, while it is true that yearly PhDs output is low, most doctoral programs have good quality.

However, the demand for PhD graduates from business, industry and even government continues to be small, and the non-university positions open for them every year are quite limited. Furthermore, the slow pace of the Mexican economy, the absence of clearly stated and well known national development policies, and the country's narrow interest in innovation, science and technological development indicate that the demand for PhDs will remain restricted to that exerted by the HE sector.

GLOSSARY

AIC	Mexican Academy of Sciences
ANUIES	National Association of Universities and Higher Education Institutions
CENEVAL	National Assessment Center for Higher Education
CIEES	Peer Review Committees for Higher Education
CINVESTAV	Center for Research and Advanced Studies
COMEPO	Mexican Council for Graduate Studies
CONACYT	National Council for Science and Technology
COPAES	Accreditation Council for Higher Education
FOMES	Improvement Fund for Higher Education
ITESM	Monterrey Technological Institute for Higher Education

OCDE	Organization for Economic Co-operation and Development
PFPN	National Program to Consolidate Graduate Studies
PNP	National Registry of Graduate Programs
PROMEP	Program for the Improvement of the Professoriate
SEP	Ministry of Education
SES	Under Secretariat for Higher Education
SNI	National Researchers System
SUPERA	National Program for Academic Improvement
UAM	Metropolitan Autonomous University
UDLAP	Las Americas University, Puebla
UIA	Iberoamerican University
UNAM	National Autonomous University of Mexico

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