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Computer science higher education in Chile

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Abstract. This paper is analyzing the Computer Science higher education system in Chile. A case study was chosen: Pontificia Universidad Catolica de Valparaiso. The problems regarding higher education in Computer Science are, generally speaking, similar in all countries. The system has to develop in harmony with the systems used abroad, taking advantage of the experience of others.

1. Introduction

Beside important differences, a changing process similar to what happened in Romania, approximately in the same period, the '90s, affected the education system in Chile. Nowadays public, private and private-subsidized educational units are present among all levels, from kindergarten to higher education.

Higher Education system cannot be analyzed without considering the previous education cycles. The primary and secondary education system in Chile is organized in a 4 + 4 + 4 years scheme, like in Romania:

- Primary education (*enseñanza básica*) – lower level, 4 years,
- Primary education (*enseñanza básica*) – higher level, 4 years,
- Secondary education (*enseñanza media*), 4 years.

Public (*municipales*), private, and private-subsidized schools are present at all levels. There is no exempt from fees in the education in Chile, scholar fees being required in all educational units. There are two kinds of fees, an initial fee (*matricola*) at the very beginning of the classes, and monthly fees (*aranceles*) all year long, excepting vacations. There is a wide range of fees, and there are big differences between different type of schools, but also from one school to another, within the same category. The smallest fees are required in public schools (approximately 10 USD/month), and highest fees are used in private schools (up to 300 USD/month, or even more). Generally, higher fees lead to better quality; the best schools are usually the private ones. There are also notable exceptions, but few public schools manage to accede to the top part of the ranking.

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2. Overview of the Higher Education System in Chile

Higher education quality is better in private-subsidized universities, followed by public universities, and private universities in the third place. There are few exceptions that contradict the rule. Public and private-subsidized universities (*universidades tradicionales*) are grouped in "Rectors' Council" (*Universidades del H. Consejo de Rectores*).

The admission process in "traditional" universities is centralized in the whole country. The system was used for 30 years, as *Prueba de Aptitud Academica* (PAA), and recently changed in some aspects (content) in 2003. The new exam, known as *Prueba de Selección Universitaria* (PSU), took place for the first time in December 2003, as the admission selection process for the academic year 2004. It consists of two compulsory (*Language and Communication*, and *Mathematics*) and two optional subjects (*History and Social Sciences*, and *Sciences*). *Sciences* have a general part, and optional modules of *Biology*, *Physics* and *Chemistry*. The scores obtained in PSU are weighted according to the specific of the program for which the candidate is postulating applying, taking also into account the average qualification during high schools.

The admission contest takes place in December, and represents a good criterion for ranking colleges, by the score of their graduates. Minimal score for admission in traditional universities is 450; the highest scores are closed to 800. Candidates postulate to more than one university and undergraduate program, being selected according to the scores they obtained. There is an important system of preparatory schools for the admission exam (*preuniversitarios*).

Most of the private universities are less selecting. They do not require a minimal PSU score, and sometimes do not even require the PSU exam. The graduates of this kind of universities have little chances to find employments that would recognize their studies and their condition of graduates.

School fees in public universities are slightly lower than in private-subsidized universities, and generally higher in private universities. Fees level (*matricula + aranceles*) usually depends on how prestigious a university is. These fees are comparable or sometimes even lower than fees in private schools. Scholarship system (*becas*) is quite restrained, more performance-oriented, and offering little social protection. However, a fairly good system of long-term credits for financing university studies has a long tradition.

Usually all Chilean undergraduate programs last an average of 2 semesters more than the similar programs in Romania. The explanation consists mainly in the higher complexity of the fundamental sciences programs (*Mathematics, Physics, Chemistry, Biology*) in the Romanian high schools. For instance, teaching *Calculus* in the Romanian high schools is a rule, but it is usually omitted in the Chilean high schools.

3. Computer Science in Chilean Schools

There are no special high schools of Informatics (Computer Science) in Chile. There certainly are classes of Computing, at all levels, from primary schools to high schools, but not special, systematic programs of Informatics, like in Romania. There are technical-oriented high schools (*Liceos Técnicos*), but not exclusively Informatics-oriented. The technical-oriented high schools are not elite schools, like Informatics high schools in Romania.

4. Undergraduate Programs in Computer Science in Chile

The Higher Education in Computer Science in Chile is quite heterogeneous. Various academic units are offering programs in Informatics, as a response to the market demand. Unfortunately, the response is rather empiric.

The traditional three branches existing in Romania, *Informatics*, *Computer Science*, and *Business Informatics* (*Informatics applied in Economy*) are not present in Chile. Undergraduate programs in Computer Science are generally called *Informatics Engineering* (*Ingeniería Informática*).

There are two traditional types of programs, *Ingeniería Civil Informática* (6 years), and *Ingeniería de Ejecución en Informática* (4 years). The first one is quite similar to the Romanian long cycle programs in *Computer Science (Engineering)*, existing in the Romanian Technical Universities (*Technical University of Cluj Napoca, Faculty of Automation and Computer Science*, for instance). The last one is similar to the Romanian short cycle programs in *Computer Science (Engineering)*, in the Romanian Technical Universities.

A third type of program is gaining popularity lately, a 5 years program (*Ingeniería Informática*). The differences between *Ingeniería Civil Informática*, and *Ingeniería de Ejecución en Informática* are quite obvious, but it is more difficult to establish the specificity of *Ingeniería Informática*. Analyzing the case of a traditional university that runs all three programs, *Universidad Técnica Federico Santa María* (Valparaíso) the university states the professional profile of the graduates of the three programs as following:

- *Ingeniería de Ejecución en Informática* (4 years) – Professional with a technical and scientific formation, which allows one to participate in developing and managing of information systems,
- *Ingeniería Informática* (5 years) – Professional with a technical, scientific, and managerial formation, which allows one to leadership, and participate in Informatics projects inside organizations,
- *Ingeniería Civil Informática* (6 years) – Professional with a strong technical, scientific, and managerial formation, which allows one to leadership, optimize, and evaluate the technological and business processes.

One could think that an *Ingeniero Informático* has a "weak" technical, scientific, and managerial formation, comparing to an *Ingeniero Civil Informático*.

The Chilean curricula are more flexible than the Romanian ones. Students have open possibilities to plan their study program, according to their abilities and specific interests.

The only teaching activities in Chile are courses. There are additional "practical" activities ("*ayudantías*"), but these are taught by students, so their quality is pretty questionable.

Unfortunately all programs that run in Chile are thought in Spanish. There are no English programs in Informatics in Chile, neither undergraduate nor graduate. Not all programs teach English classes or subjects in English. This is a major handicap when graduates want to work abroad.

5. Graduate Programs in Computer Science in Chile

There are many undergraduate programs in Computer Science in Chile, but not a proportional number of graduate programs. There is a lack of Master Degree programs, and especially PhD programs. The rather small number of Master programs that are currently running usually last from 2 to 3 years. The few PhD programs in Computer Science are lasting 4 years. There are two kinds of Master programs:

- "*científico*" – more research oriented,
- "*profesional*" – more technical oriented.

The PhD programs are not exclusively research-oriented. They include courses, for at least 4 semesters, then a graduation exam, that leads to the preparation of PhD thesis.

6. Informatics Engineering School of Pontificia Universidad Católica de Valparaíso

Pontificia Universidad Católica de Valparaíso (PUCV) is a private-subsidized prestigious and long tradition university, being considered one of the best universities not only in Viña del Mar – Valparaíso region, but also in Chile. The university was founded on September 21, 1925, as a result of the donation of Isabel Caces de Brown and her daughter. Classes began more than 75 years ago, on March 1928, with 250 students, being the first university ever opened in the 5^{th} Region (Valparaíso) of Chile. It continuously developed itself, as an academic and research establishment, having nowadays more than 12000 students, enrolled in over 65 undergraduate (*carreras*) and 40 graduate programs (*diplomado*, *magister*, and *doctorado*).

PUCV has 9 faculties and 16 campuses all over Viña del Mar – Valparaíso metropolitan region. The region is an exceptionally important academic

pole, the second Chilean one after Santiago metropolitan region. There are other three traditional universities in Viña del Mar – Valparaíso, besides PUCV: *Universidad de Playa Ancha* (public university), *Universidad de Valparaíso* (public university), *Universidad Técnica Federico Santa María* (private-subsidized university). There is also an increasing number of private universities or branches of universities that have central bases in other cities, mainly in Santiago. The existence of such a large number of universities generates a strong competition, which leads to high academic quality.

The Center of Computer and Information Sciences (*Centro de Ciencias de Computación e Información*) of Universidad Católica de Valparaíso was created in 1972. Later, in 1981, it was incorporated into the Faculty of Engineering, and became Informatics Engineering School (*Escuela de Ingeniería Informatica* - EII) in 1982. A four-years undergraduate program of Informatics Engineering started the same year, being the first program of the new academic unit. Fifteen years later, in 1997, a new six-years undergraduate program was initiated. The two programs are presently running, *Ingeniería de Ejecución en Informática* – INF (8 semesters), and *Ingeniería Civil Informática* – ICI (12 semesters), with over 650 students.

The research activity inside of EII is developed in two working groups, (1) *Information System Research Group*, and (2) *Communications & Distributed Systems Research Group*. A Master Degree program in Informatics Engineering will be initiated in late 2004 or early 2005.

We will now analyze the curriculum of the long cycle undergraduate program of EII, *Ingeniería Civil Informática* (ICI). The ICI program normally lasts 12 semesters, but not more than 18 semesters. The admission process in the ICI program is ruled by the following weights:

Average qualification in high school: 25%
Language and Communication: 20%
Mathematics: 40%
Sciences: 15%

The ICI curriculum is divided in 4 areas: (1) *Fundamental Sciences & Engineering* – FSE, (2) *Managerial Sciences* – MS, (3) *Information Technology* – IT, and (4) *Specialized Informatics* – SI. Actually, a fifth area is present, consisting of *General Studies* – GS, which complement the formation of the students not only as engineers, but also as persons. The distribution of the subjects by semesters is showed in table no. 1.

As table 1 shows, the distribution of subjects by area is as follows: FSE - 29.31%, MS - 12.07%, IT - 39.65%, SI - 10.35%, GS - 8.62%. We included in the SI group the optional subjects, and the projects (that are designated to prepare the graduation thesis). All the optional subjects are computer science subjects.

Joining the groups IT and SI, we obtain a total percentage of 50% specialized preparation in Informatics. So, half of the subjects are designed to prepare professionals in Informatics, and the other half are designed to complete their preparation, in order to be able to work in a wide range of fields, not only as computer scientist, but also as engineers, or managers. An exceptional high percentage of MS subjects are present (12.07%). It proves the importance that the EII politic grants to the managerial preparation of the students.

Semester	**FSE**	**MS**	**IT**	**SI**	**GS**
1	2		1		
2	3		1		1
3	4		1		1
4	3		1		1
5	3		2		
6	1	1	3		
7	1	1	3		
8		2	3		
9		2	2	1	1
10			2	2	1
11			2	2	
12		1	2	1	
TOTAL	**17**	**7**	**23**	**6**	**5**
%	**29.31**	**12.07**	**39.65**	**10.35**	**8.62**

Table 1. Distribution of thematic areas in ICI curriculum.

The *Ingeniería de Ejecución en Informática* (INF) program normally lasts 8 semesters, but not more than 13 semesters. The admission process in the INF program is ruled by the same weights as in the ICI case. The distribution of the subjects by semesters, using the same areas as in the case of ICI, is showed in table no. 2.

As table 2 shows, the distribution of subjects by area is as follows: FSE - 13.51%, MS - 13.51%, IT - 37.84%, SI - 18.92%, GS - 16.22%. Joining the groups IT and SI, we obtain a total percentage of 57.76% specialized preparation in Informatics. The percentage is higher than in the ICI case. The percentage of FSE group is approximately half of the percentage in the ICI case, and the percentage of GS is double than in the ICI case. An exceptional high percentage of MS subjects are present (13.51%), even a bit higher than in the ICI case. It proves once again the importance that the EII politic grants to the managerial preparation of the students.

Semester	**FSE**	**MS**	**IT**	**SI**	**GS**
1	2		1		
2	1		3		1
3	1	1	2		1
4	1	1	2		1
5		1	3		1
6		1	2	1	1
7		1		3	1
8			1	3	
TOTAL	**5**	**5**	**14**	**7**	**6**
%	**13.51**	**13.51**	**37.84**	**18.92**	**16.22**

Table 2. Distribution of thematic areas in INF curriculum.

7. Conclusions

The Higher Education system in Computer Science has to be dynamic, to adapt itself to the continuous IT changes. The problems of high education in computer science are, generally speaking, similar in all countries. The system has to develop in harmony with the systems used abroad, taking advantage of the experience of others.

It is hard to rank education systems. Experience of foreign countries should be selectively used, adapting it to national realities, and to the policy and strategy of a particular university.

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