ANEXO 5

GASAT 8

Tema: Desarrollo de las ciencias computacionales en México.

8TH INTERNATIONAL CONFERENCE ON GENDER AND SCIENCE AND TECHNOLOGY

Towards Sustainable Development: Achieving The 4E's Education, Employment, Equality, Empowerment

January 5-10, 1996
Ahmedabad, India

Volume 2

Papers

SATWAC Foundation,
Ahmedabad, India

gasat Association

Recibí 270197

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GASAT 8 International Conference.

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PREFACE

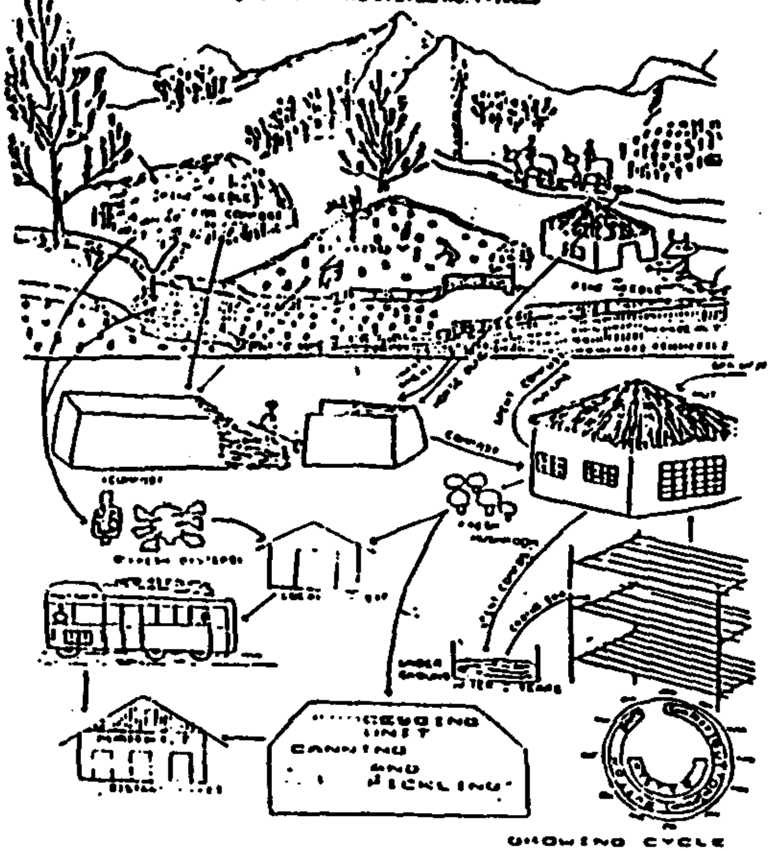
The number and variety of papers received from participants for consideration during GASAT 8 are truly significant. The response for the conference from all corners of the world, particularly from the developing countries is tremendous. They indicate clearly and unambiguously the rapid strides made in creating awareness of gender issues throughout the globe. It has become clear that education and employment are vital for women and girls, not merely in the urban areas but in rural areas as well. Only through education and employment can equality and empowerment of women be achieved. Indeed, the well-being of a nation can be measured by the degree of the active contribution of its citizens, both men and women, to its social, cultural and economic progress. If half of the population, i.e. women, are denied access to Science and Technology (S & T), the nation will be poorer to that extent, because S & T properly used are the tools to improve the quality of life of the people at large and eradicate poverty.

Science and Technology must also include indigenous knowledge which can be extremely valuable. Tried and tested local systems of education or indigenous medicine based on the knowledge of the properties of local herbs and plants, for instance, are vital resources.

Concerted efforts should continue to make S & T socially responsible. A point that has emerged from a perusal of these papers is that gender discrimination in the areas of education and employment is not confined to the developing countries alone. It is a phenomenon that cuts through all socities. Attitudes that produce gender discrimination vary according to socio-cultural conditions prevailing in individual countries.

Several papers have analyzed specific situations in the countries concerned and have also sought to find ways and means of dealing positively with these wherever possible. It is hoped that such papers will prove to be a valuable resource and, apart from providing information, will be of help in finding solutions which can be applicable when required. The idea, as stated already

Figure 5. FARMING SYSTEM NO. 1 - HILLS



OLD BOUNDARIES IN A NEW FIELD OF KNOWLEDGE? THE CASE OF THE MEXICAN COMPUTING SCIENCES

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Abstract

The case analyzed is the introduction and development of [illegible] computing sciences. The purpose of this study is to recover, th[illegible] interviews, the personal experiences of some of the active partic[illegible] of that process, both men and women, and to interpret their mul[illegible] voices within the framework of a gender perspective.

When dealing with social processes like these many differen[illegible] sometimes opposite, opinions arise. Our aim is to reinterpret the se[illegible] layers of a living tissue: the introduction and development of a new [illegible] of knowledge which faced a controversial reaction from both [illegible] academic staff and the administrative authorities.

Several questions guide this study: To which extent does a new fie[illegible] knowledge, where women were allowed in an apparent egalita[illegible] position, faced old epistemological obstacles derived from histor[illegible] consolidated sciences such as mathematics and physics? Did the dra[illegible] changes within computing sciences affect its position in the acade[illegible] arena? Were they considered only as a tool and denied the scien[illegible] status? Was this process mediated by institutional gendered struct[illegible] and by culturally dominant prejudices, as well?

Our analytical framework comes from the social study of science (Woolgar, S. 1988, 1995; Barnes, B. 1985), and from the feminist epistemology, as well (Harding, S. 1986; Keller, E.F., 1985; Tuana, N., 1989; Wajcman, J. 1991). The qualitative methodology has allowed a richer approach to our analysis and preliminar conclusions.

Key Words

Computing Science, multiple voices, Gender prespective,, acadamic demand.

Computing professionals in figures

Before entering into historical data, let us see some information which will help to context our local academic community and its presence within our population. First of all, let us consider the last 1990 General Population and Home Census. There, we find that women are over the 50 per cent of the total population, which amounts over 80 million inhabitants. Nevertheless, from the total number of professionals, which raises up to 1 million 897 thousand, only 33.8 per cent are women, that is 641,186 professional Mexican women. But if we analyze this figure, we find that only 63.6 per cent of those women, 408 248, belong to the economically active population, and that those women who have studied mathematics, physics or engineering, do not count even for the 0.5 per cent of the total amount of professionals. (See Table 1).

Table 1. Distribution of the total professional population and the economically active professional population, by sex, 1990

TOTAL	PROFESSIONALS			ACTIVE PROFESSIONALS		
men and women	25 years old and more	men	women	25 years old and more	men	women
over 80 million inhabitants	1,897,000 100%	1,255,814 66.2%	641,186 33.8%	1,539,040 81.1% from the total professional population	1,130,792 [illegible]	408,248

Data taken from INEGI (1993). Professionals in Mexico. XI General Population and Home Census, 1990, Mexico. data from table 8.3.1, p. 60.

Future computing professionals are formed either in science or in engineering undergraduate programs, which differ in contents and length. In order to obtain a closer approach to their increasing number during the last decade, only those computing programs offered at engineering faculties are traced. (See Table 2).

Table 2. Mexican Undergraduate Computing Students in Engineering Faculties, 1977-1991.

Yr.	Total =100%	% of total unser graduate population	men	%	women	%	% of women in computing vs undergraduate population
1981	5132	0.65	4 166	81.17	966	18.81	0.12
1986	11477	1.16	8 664	75.49	2 813	24.50	0.28
1989	19352	1.80	13 641	70.48	5 711	29.51	0.53
1991	29703	2.72	20 768	69.91	8 935	30.08	0.81

Source: Built with data taken from Quintanas, I. and Ramrez, L., 1994

The initial enthusiasm due to the increasing participation of female students in these programs is followed by a certain skepticism when figures are considered in relation to a broader context, as shown in the last column at the right. According to these figures, women in computing undergraduate programs do not reach even the 1%, and their real presence in the 90's is not growing in the same proportion as it did during the 80's.

A series of facts might explain this situation, such as the last policies in some public universities, which restrain access to computing sciences for both, men and women. Therefore, women face an additional obstacle to the cultural dominant prejudices which consider scientific careers as a male domain. Young women enrollment in these programs is discouraged with arguments such as time and intellectual effort invested, which are greater when compared against traditional female careers. Women are not expected to provide but a complementary budget to their families, if any, specially if they get married.

Anyway, as the social demand for this kind of professionals grows univiersities face a doble challenge: to increase their number and to give the new generations a higher specialisation. To face this academic demand several graduate programs are offered. In the following table, the last decade of sciences and engineering official statistics is considered, since they are the two main curricular areas where graduate programs in computing sciences are found. (See Table 3).

Table 3. Mexican Graduate Students in Sciences and Engineering. 1984-1994

year	graduate student national population total = 100%	science		engineering	
		students	%	students	%
1984	35 390	2 129	6.0	4 576	12.9
1985	37 040	2 509	6.8	4 862	13.1
1986	37 955	3 331	8.8	4 893	12.9
1987	38 214	3 210	8.4	4 818	12.7
1988	39 505	3 001	7.6	4 911	12.5
1989	42 655	3 163	7.4	5 471	12.8
1990	43 965	2 971	6.8	5 333	12.1
1991	44 946	2 956	6.6	5 669	12.6
1992	47 539	2 883	6.1	6 093	12.8
1993	50 781	3 288	6.5	6 779	13.3
1994	54 910	3 437	6.3	8 078	14.7

Source: ANUIES Graduate Programs Statistics Year Book, 1994

As we see, the previous statistics do not give information about men and female students. Nevertheless, we know that female students population is minor in science and engineering. Exceptions to this tendency are biology and actuary programs, both in the science group. Anyway, although engineering programs have the third position after medicine (health) and social programs, they are the only ones to show an increasing steady tendency.

A growing rate of graduate computing programs might be expected from the previous figures. Unfortunately it is not the case, since graduate computing programs increased only from 0.01% in 1980 up to 0.03% in 1990, in relation to the national total. This percentage means less than 400 students for 1980 and 1,200 students for 1990 (Oktaba, H. 1992).

What the previous data shows is a paradox: even a 200% growth of graduate computing programs in a decade is still far away from the required amount of highly qualified professionals in this area. The lack of these professionals affects production and services, as well. Therefore, we might be suspicious about some recent higher education policies and the resulting improvisation of professionals to face an increasing social demand.

This seems to be the national setting for computing sciences in general. But why have we arrived to this point? And particularly, how does this situation affect women enrolled in computing graduate programs?

Back into history

Figures begin to make sense when we consider one case in depth. That is why we have chosen the case of the National Autonomous University of Mexico (UNAM), since it is the largest university in Mexico and, besides, it develops the main research in science. Nowadays, UNAM has about 3,00,000 students in different campus, considering undergraduate and graduate programs.

And UNAM was also the birthplace of the first computing research center in the country, when in 1958 the Electronic Calculus Center (CCE in Spanish), was founded. It homed an IBM-650, which was inherited from the University of California, and became the first computer in an academic setting in Latin America. Young physicians, mathematicians and engineers gathered around this center, to learn computing and to try to find new applications to their particular fields (Caldern, E. 1988; Durn, R. 1988; Lemaitre, Ch. 1988; Negrete, J. 1988; Prez de Celis, C. 1988; Soriano, M. and Lemaitre, Ch. 1985).

Computing was emerging as a new academic field which needed to form its own professionals and to attract researchers from other disciplines, as well. Creativity and enthusiasm were the signs of the first computing applications made by researchers and students gathered at the Electronic

Calculus Center (CCE), who became followers of the new technological achievements. Their main goal was to gain sympathy from the rest of the university community to support the conformation of a critical mass in computing sciences.

Nevertheless, women's participation and gender relationships during this early period of computing have not been studied. There are few documents available of that period, but we may presume that female students were scarce, since they necessarily came from disciplines where women nowadays still represent small percentages: mathematics, physics and engineering. Anyway, to follow the track of those few women who became involved in the process of introduction of a new discipline has become a challenge. Their own interpretations of this process would enable us to analize whether a new academic group developed a more flexible set of gender relationships, therefore giving up old prejudices, or, on the contrary traditionally intolerant values and attitudes found a new setting to be reproduced. Whichever of the two cases might turn out to be the dominant we do not exclude completely any of them. In any case, if we want to recover the richness and complexity of the simultaneous processes we are studying, even a wider spectrum of possibilities has to be considered.

How did individuals and groups face and redefined their daily relationships in a new work setting? And which is more interesting, did they share viewpoints about their own tasks?, about science in general and computing sciences in particular? Their answers to these questions will show us how science and technology are socially constructed, therefore involving gender and power issues. (Barnes, B. 1985; Wajeman, J. 1991; Woolgar, S. 1988, 1995).

What we have already found is that the introduction and further development of computing sciences became part of the institutional contemporary history. Several departments were created but we have traced just the case of the CCE, which changed its name and functions in 1970, to give birth to the Center for Research in Applied Mathematics, Systems and Services (CIMASS in Spanish). As its name shows, computing sciences were considered only as a part, although the main one, of a new institutional setting where staticians and mathematicians worked too (Garza, T. 1979: 7).

Some governmental offices also became clients of the CIMASS, since computing equipments were scarce and expensive. In 1974, university authorities decided to split computing into two separate institutions: one devoted to academic research, the Center for Research in Applied Mathematics and Systems (CIMAS in Spanish), and the other to administrative work, the Computing Services Center (CSC in Spanish). This separation institutionalized two oppposite tendencies which had been present since the birth of computing in our university:

- Or it was seen as an emerging theoretical field of knowledge, with a great potentiality, and therefore within the institutional criteria which ruled research in every other field of knowledge.

- Or it was understood as a new technology which speeded work in consolidated sciences -such as physics, mathematics and engineering-, and in administrative tasks, as well -such as school services and payroll.

Both points of view were mainly understood as antagonistic and only seldom as complementary. Consequently, both were assigned different status in an academic setting. If computing was a science, even a new one, its future development was supported by those who believed in its potential to become an important and autonomous field of knowledge. This attitude welcomed the growing number of its followers, students and researchers. If on the other hand, computing was seen as a set of tools, no matter how complex they might seem, its epistemological rank was inferior to scientific knowledge and a larger and independent finantial

support was questionable.

The previous characterisation may seem ridiculous to someone whos academic community differs from our Mexican case. Some remarks abou this one may be helpful to understand the controversial reaction computir sciences arose. In the first place, our scientific community was a heterogenous one. By those times, mathematics and physics wer considered as 'hard sciences', thus having a solid theoretical corpus. Bo had a long tradition which enabled them to legitimate or underestima different academic communities. This close interrelation betwee knowledge, tradition and power was not new in our country; moreove some outstanding scientific leaders were politicians during the last centu and also during the first decade of this one.

Mathematical community, for example, was quite conservative I members showed little tolerance towards mathematical applications, whic were considered as the less scientific part of this science, even in th same field or in others, such as engineering (Mayer, L.: 1989a). Hence to accept computing as the latest scientific and technological developmer meant, in the 70's, a great epistemological and political risk. Oppositio to financial requirements for the emerging computing group came fro this academic group and others (Lemaitre, C. y Soriano, M. 1985a: 136- specifically from those who feared that the new computing professional might dispute their influence in topics such as budget, political positio and design of educational policies.

But as every social process, the introduction and development of computin was full of contradictions. From the mathematical and physica community came, as well, the young generation who was not complete suspicious about applications. Some of them followed computing course which were optional, instead of others which offered them a classica conservative vision of their own disciplines. This situation explains th growing demand for computing undergraduate courses, which were offered in the mathematics program. at the Science Faculty. Consequently, when the first Master Computing Program was opened in 1975, many students applied to it. This graduate program was offered at the Applied Mathematics and Systems Research Institute (IIMAS), name given to CIMAS' succesor in 1976. This name has remained and it has been known as the institute where research in computing has traditionally been made.

Women in a Master Computing Program

In this section we discuss some aspects of the Master Computing Program we refered above. This program will be twenty years old this year, and it has been referred as the first academic serious effort to introduce a graduate program in this area (Oktaba, H. 1990: 1; 1992).

Some of its original characteristics enabled it to become a program with an immediate impact in the university community and in the outside public service sector, as well. First of all, it was a program which belonged to the new Undergraduate and Graduate Academic Unity of the College School at UNAM (UACPyP CCH in Spanish), but which was offered in a research institute environment. So its academicians fulfilled a desired qualification: they were engaged either as research leaders or as research assistants. This situation differed greatly from the common undergraduate professor at the Science Faculty. And this difference was an important one after 17 years of the introduction of the first computing office in our campus. It represented the rapid growth of the former computing group and its succesors, and its increased acceptation among the academic community as a whole.

Another interesting characteristic of this master program was the youth of the majority of its academic staff: under 40 years old. Another peculiarity was the high qualification of some of them, who had recently

followed Ph.D. computing programs in the United States or in Europe where this field of knowledge had showed an impressive development both in theoretical and applications achievements. Compared with the average age and with the traditional dominant epistemological point of view of those academic hegemonic groups which initially opposed to the introduction of computing sciences, this master program involved youth in every aspect but, at the same time, became rather vulnerable in some others.

First of all, computing community lacked strong and permanent academic and political links with members of the Dean's staff. Access to this kind of nonformal networks was seen, by some of our informants, as an important challenge to legitimate and strengthen this new program. In other words, some of its research leaders were well aware that important decisions about their present and future, such as budget and planning policies, were being made without even taking them into consideration. Neither were they asked, nor understood the specificity of their academic work, which explicitly involved an interdisciplinary approach where both theoretical issues and applications were considered. In other words, mathematicians, physicians and engineers of the previous generation or from the same age, but against the computing sciences, were legitimizing institutional processes of a new group whose members were still denied scientific status.

At this stage we have found some female voices who have shared their interpretations about the daily gender relationships among students and teachers at the masters program. Women were still a numerical minority but those who were enrolled in this program became aware that a new professional gate was being opened for them. These female students came mainly from the Science Faculty, where they had followed undergraduate mathematics, physics or actuarial programs. Most of them had already taken optional computing courses in [illegible] research assistants at CIMAS, where they had had access to the new world of computing sciences from a particular project. Some of them had accepted to work in the same center, without receiving any pay at all, just for the fun of being there and learning more about computing. This enthusiastic slave laboral condition and academical backgrounds were shared by both, female and male students (Lpez, C. 1995).

Official students statistics were not avaible but for a short period: 1980-1985. Although uncomplete, they provide information about female students and their achievement in the program analyzed. (See Table 4).

Table 4. Students at Master Computing Sciences Program

from UACPyP-CCH, UNAM. Period: 1980-1985

students	men	%	women	%	total 100%
enrolled	208	79	55	21	263
graduated	75	79	20	21	95

Source: Dra. Hanna Oktaba, Coordinator of the Master Computing Sciences Program, 1995.

By early 90's, this program reported the following data, which is unfortunately not divided for men and women:

- total students population since 1975: 427
- percentage of graduate students who present receptional research project : 15%
- drop out percentage: 47%
- percentaje of graduate students who fulfilled all credits: 25%

Women's underepresentation continues when analyzing figures concerning

graduate students who followed Ph.D. foreign programs. Nevertheless, women's presence is slightly higher in these programs. (See Table 5).

Table 5. Master Computing Sciences Program from UACPyP-CCH, UNAM. Graduate Students who follow Ph.D. foreign programs.

students	men	%	women	%	total 100%
enrolled	8	61.5	5	38.5	13
graduated	7	78	2	22	9

Source: Dra. Hanna Oktaba, Coordinator of the Master Computing Sciences Program, 1992.

Through all these years, this program has maintained its status as one of the pioneer high level academic programs in its field. Many of its graduates work either in public services or in private enterprises, where they get jobs even if they do not finish all the regular credits. This situation reflects the increasing social demand for highly qualified computing professionals in our country.

The previous figures are small if we consider our young population and its future requirements. As for women, they are still underepresented in graduate programs in general, and in science graduate programs in particular. Optimistic voices point to the increasing female presence in undergraduate computing programs. Nevertheless, suspiciousness arises when university authorities declare the lack of budget to attend these increasing applications. Instead of promoting enrollment in these undergraduate programs, they have restricted it. They seem to forget that among sciences there are some which achieve higher laboral success, and computing sciences are a good example. Thus, recent policies are reinforcing an additional obstacle to our hegemonical cultural context, where women in sciences are rather exceptions. Maybe this is another example of how old gender prejudices remain, no matter how new a field of knowledge is.

To focus everyday gender relationships among different and equal academic hierarchies, students and researchers as well, may provide us a better understanding of the subjective and group processes which progressively conform a specific professional identity. What kind of interactions took place between individuals whith diverse professional training but who were equally interested in a new field of knowledge? Did they share opinions and epistemological backgrounds? If not, which were the main topics of their academic controversies? Have we recovered their contributions, either theoretical or applied? Feminist epistemology provides helpful insights to these and many other questions relating epistemological issues. (Harding, S. 1986; Keller, E.F., 1985; Tuana, N., 1989)

In a complementary way, attention to the institutional setting where the action was taking place is focused. Were they, both men and women, initially aware of the institutional reluctance they were to face and of their need to develop individual and group strategies to survive in the campus? If so, were these strategies gendered? Did they affect the enrollment and further professional development of young men and women who decided to become computing professionals? Once again, our initial interpretations are being enriched with a feminist theoretical framework which acknowledges the importance of women+s work, traditionally neglected when assessign sciences and technology international and local history. (Light, J. 1994; Lipscombe, J. 1979; Lopez, C. 1995; McNeil, M. 1987; O+Neill, J. 1995; Wajcman, 1991).

Whose voices and which boundaries need to be broken?

As an attempt to recover men's and women's voices of those involved in the processes mentioned above, there are some ideas which will lead to

further interpretations. First of all, some or our informants share an opinion which relates, the numerical reduction of computing professionals with the decreasing power of the group. This loss was not only academical, but political as well, since the social prestige and institutional importance of the whole group were constantly diminished in two directions: inside and outside their work setting. Consequently, the group was not represented, or perhaps only partially, when new scientific and technological policies were being discussed inside and outside the campus. And this absence had negative effects in issues such as budget and the formation of the future generations.

Another fact to be considered is the traditional reduced female participation among computing professionals. Nowadays this situation is changing and our data shows a growing female presence in this group, specially among teachers. Nevertheless, this change is accompanied by lower salaries and a reduced social prestige of the academic staff when compared against computing professionals outside the campus. University authorities are, however, reluctant to introduce rational and attractive programs to retain those who have devoted their time and careers to the consolidation of computing sciences.

Recently, the number of computing academicians with long expertise has considerably decreased. Those few who still remain in our university are facing difficult times to combine their teaching and research activities. Either they become full-time researchers, looking desperately for an opportunity to publish in foreing computing reviews, or they continue exclusively with their graduate courses. If they choose the first option, they compete disadvantageously with American and European colleages. Besides, they are trapped in a frenetic +publish or perish+ dilemma which paradoxically restrains them from collaborating in some of the local computing reviews. If, on the other hand, they decide to devote themselves to teaching, they are soon overloaded with undergraduate courses, due to the growing demand of computing professionals in this level, besides the graduate courses they usually teach. Consequently, they lack time to give highly specialized graduate courses in recently developed topics, which are needed in our university graduate programs and better payed in private universities and technological schools.

Finally, our initial findings raise questions about changes in the gendering of this professional work that probably ocurred with changes in technology and computational sciences theoretical development. The type of work women and men performed as a result of an increase in computing skills and academic qualifications needs to be addressed.

Acknowledgements

I want to thank all those researchers and teachers who shared with me their valuable time and memories. Special acknowledgement is given to Hanna Oktaba and Antonio Angeles, who do still believe that the present and future of computation sciences in Mexico go far beyond expertise alone, but involve personal commitment and an integral education.

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