

# An Expanding Pipeline: Gender in Mauritius

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## Abstract

The gender imbalance in computer science in the U.S. and other countries has attracted much attention. This paper presents — for comparison — the computing-related gender ratios in Mauritius, a developing country in the Indian Ocean. These ratios suggest that far from being a universal phenomenon, the gender imbalance in the U.S. is a cultural problem.

## Categories & Subject Descriptors

K.3.0 [Computers and Education]: General.

## General Terms

Measurement, Economics, Human Factors.

## Keywords

Computer science, gender, culture, United States, Mauritius.

## 1 Introduction

The dismal representation of women in the computer science (CS) and information technology (IT) fields has been well reported. Tracy Camp [1] has documented the declining percentage of CS bachelors degrees in the U.S. that were awarded to women from 1984 to 1994. Figure 1 shows this data from 1970 to the most recent data currently available from the U.S. Department of Education [11].

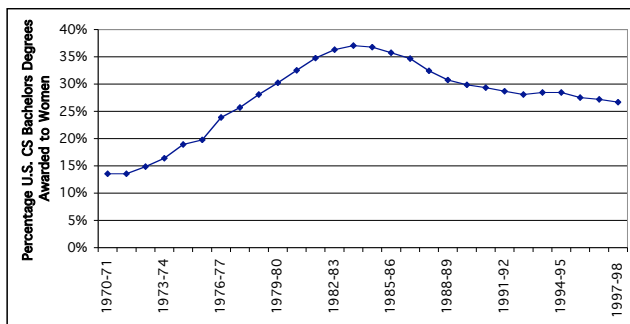


Figure 1. The Shrinking Pipeline in the U.S.

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In her paper, Camp also notes that the percentage of bachelors degrees a CS department awards to women is consistently and significantly lower if the department is in the College of Engineering than if it is in the College of Arts and Sciences. She calls this phenomenon the “College of Engineering Effect.”

In a different study [2], Camp compared data collected by the U.S. Department of Education (PhD and non-PhD granting institutions) against the CRA Taulbee Surveys data (PhD granting institutions only). The differences in these statistics suggest that women are better represented at non-PhD granting institutions than at PhD-granting institutions. For example, Figure 2 presents the percentage of women CS graduates in each survey from 1994 to 1996:

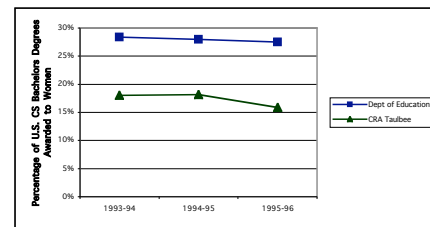


Figure 2. Dept of Education vs. CRA Taulbee Data

### 1.1. A Universal Problem?

A survey of the literature leaves the impression that, aside from a few isolated exceptions (e.g., [4]), the representation of women in CS is decreasing throughout the U.S., if not universally. However an intriguing study from Antonio Lopez and Lisa Schultze [6] notes that at U.S. historically black colleges and universities (HBCUs), African-American women earned the *majority* of computer science bachelors degrees each year from 1989 through 1997. For some reason, HBCUs are markedly different from other U.S. schools in terms of gender and computer science.

It becomes apparent that our situation is more complex when one looks at the representation of women in CS outside of the U.S. Britte Schinzel [8] notes that the situation in “Anglo-Saxon, Scandinavian, and German-speaking countries” (ASGs) is similar to that in the U.S., but female representation in CS is comparatively constant and high (45-50%) in Greece, Turkey, and the “Romanic” countries (e.g., France, Italy). Schinzel’s data is fragmentary, but it offers intriguing hints as to the role culture plays in encouraging or discouraging women from studying CS.

What these and other reports (e.g., [5]) make clear is that while the problem is wide-spread, *the under-representation of women in CS is not a universal problem*. It is a problem confined to specific countries and cultures.

## 1.2. Rethinking Our Approach

How can this help those of us in ASG countries and the U.S.? Firstly, we must admit that other countries/cultures are better than ourselves at attracting women to CS. Secondly, we must admit that these countries/cultures have something to teach us. And finally, instead of *speculating* about why *our* women *aren't* studying CS, we must visit countries in which women *are* studying CS, and identify the cultural differences that attract women to CS. *Identifying what these countries are doing right will help us identify what we are doing wrong.*

Logistically, gathering enrollment data in a large country can be difficult. Many countries do not gather such data centrally, necessitating a visit to each of the country's universities, which may or may not gather the data. It is thus more pragmatic to study small countries instead of large ones, and countries with few universities instead of those with many.

In his fascinating book *Song of the Dodo* [9], David Quammen explains how an island's geographic isolation insulates it from outside forces, allowing development to proceed differently compared to a mainland. By studying such differences, scientists can gain insight into the underlying processes. Perhaps the most well-known instance of this is Charles Darwin's study of the various species of the Galapagos Islands, providing the foundation for his history-changing book *The Origin of the Species* [3].

With respect to the problem at hand, small island countries provide an interesting place to study the issues surrounding gender representation in computer science. Their small size can greatly reduce the logistical problems associated with the study of a larger country, and their isolation can allow the factors that affect the representation of women to develop quite differently compared to mainland countries.

## 1.3. Mauritius

In this paper, we examine the representation of women in computing-related programs at the *University of Mauritius* (UoM). Mauritius is a 25-by-40 mile island country 800 km east of Madagascar in the Indian Ocean, as can be seen in Figure 3:

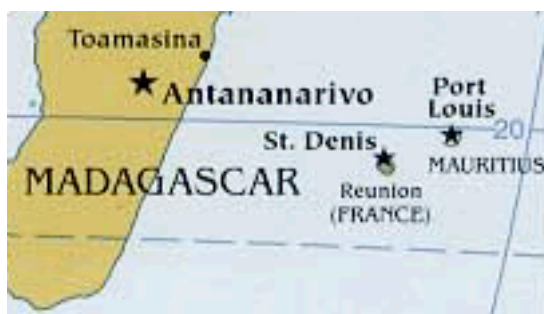


Figure 3. The Island Country of Mauritius

Geographically, Mauritius is associated with sub-Saharan Africa; however its culture is a dynamic mix of African, Indian, English, French, and Chinese influences. Its male-to-female ratio is 0.98, which is comparable to that of the U.S. (0.96) and the U.K. (0.97).

## 2 Computer Science in Mauritius

### 2.1. Background

At the University of Mauritius (UoM), students wishing to study computing enroll in the *Department of Computer Science and Engineering* (CSE), which is a department in the university's *Faculty of Engineering*. Prior to 1997, CSE offered one 4-year degree called the *Bachelor of Technology in Computer Science and Engineering* (B. Tech. CSE). This program was similar to undergrad computer science programs at U.S. technical universities, with all students taking required courses in programming, data structures, computer organization, operating systems, discrete mathematics, graphics, software engineering, automata theory, networking, compiler design, and so on.

In 1997, the department renamed its B. Tech. CSE degree as a *Bachelor of Engineering in Computer Science and Engineering* (B. Engr. CSE) degree. In 2000, the department revised its curriculum and began offering two 3-year degrees: a *Bachelor of Science in Computer Science and Engineering* (B. Sc. CSE), and a *Bachelor of Science in Information Systems* (B. Sc. IS). In 2001, the department added a 3-year *Bachelor of Science in Computer Science with Multimedia* (B. Sc. CSM) degree, and a *Master of Science in Information Technology with Management* (M. Sc. ITM) degree. In this paper, we will focus on enrollments in the bachelors degree programs.

### 2.2. Students Entering the Program

Prior to 2001, the University of Mauritius (UoM) was the sole university in Mauritius, offering bachelors and some graduate degrees to roughly 4000 students. The university is free, and admittance is based solely on standardized entrance exam scores. With roughly 1.2 million people in Mauritius, admittance is highly competitive and the admitted students are highly capable. Figure 4 presents the number of students in the first year class of the CSE department for each of the years 1990-2001:

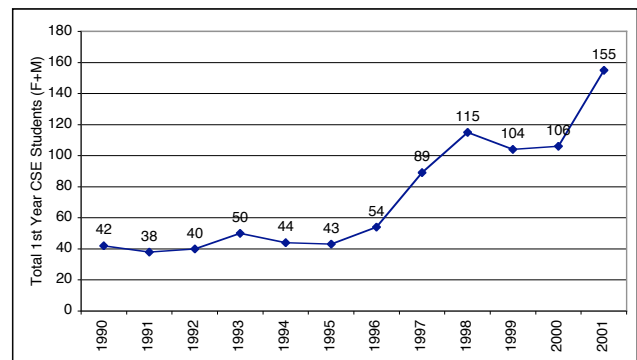
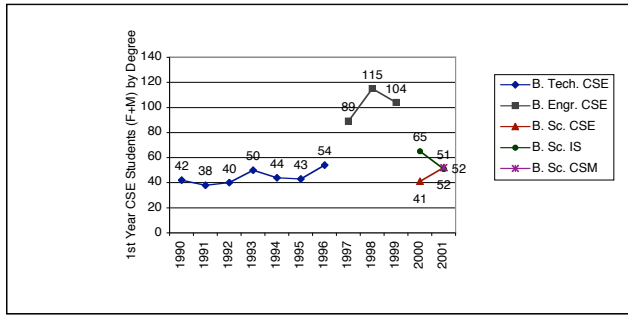


Figure 4. Total First Year CSE Students at UoM

Each year, each department at UoM accepts a number of students based on staffing, class sizes, and other factors. As Figure 4 illustrates, the CSE department has greatly increased its intake of students over the past ten years, in response to a national governmental initiative to increase the pool of workers with computing-related skills.

Applicants to the university indicate the program they wish to study, plus alternative choices should their first choice be full. Beginning with the top-scoring students on the entrance exam, students are matched to programs using their first choices unless a program is filled, in which case alternative choices are used.

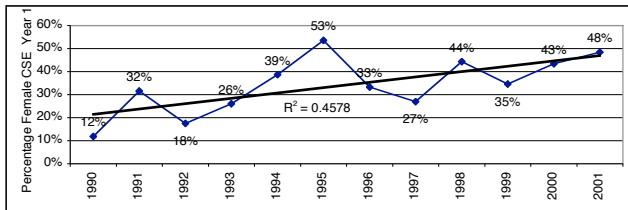
Figure 5 shows the number of first-year CSE students, broken down by student choice:



**Figure 5. First Year CSE Students by Program Choice**

A comparison of Figures 4 and 5 is interesting, to see the relative numbers of first-year students choosing the different options CSE has offered since 2000, even as the department continues to grow. As indicated, roughly equal numbers of first-year students chose to pursue the B. Sc. CSE, B. Sc. IS, and B. Sc. CSM degrees in 2001 (52, 51, and 52, respectively).

Figure 6 shows the representation of women in the first-year CSE class, ignoring the degree chosen; plus the trend line from a linear regression analysis:



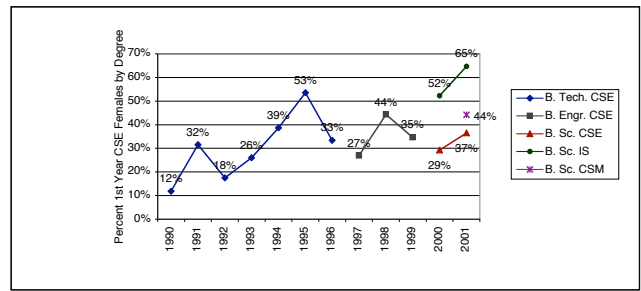
**Figure 6. UoM First Year CSE Female Percentage**

As this illustrates, the percentage of women choosing to study a computing-related discipline at UoM has increased, approaching proportionality with the general population. When coupled with the dramatic increase in the numbers of students admitted by the department, this increase reflects rapid growth in the number of women choosing computing.

This is in contrast to the situation in the U.S. and other ASG countries, where over this same time interval, the number of women choosing to study computer science declined significantly, as we saw in Figure 1.

It is worth repeating that UoM matches incoming students with a program solely on the basis of ability and interest. Put differently, UoM has no special program to maintain (gender or ethnic) equity; there are no special efforts to attract more women that might explain this increase. Instead, it appears that more and more Mauritian women are *choosing* to study computing.

Exactly what are they choosing to study? Figure 7 presents the percentage of women in each of CSE's degree options:



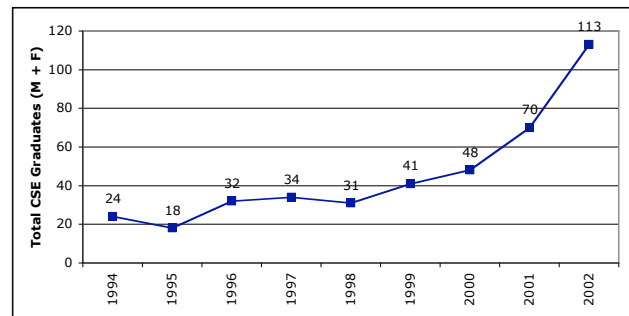
**Figure 7. First Year CSE Female Percentage by Degree**

Figure 7 indicates that more women are choosing the newer *information systems* and *computer science with multimedia* degree options than are choosing the older *computer science and engineering* option. The (increasing) majority of the students in *information systems* are women, which is interesting given the 2001 decline in B. Sc. IS enrollments in Figure 5. Unlike the B. Sc. CSE, the B. Sc. IS program does not require high school physics for admission to the program, and young Mauritian women reportedly tend to study biology instead of physics in high school.

Figures 7 and 5 also indicate that women account for much of the B. Sc. CSE 2001 program growth.

### 2.3. Students Graduating From the Program

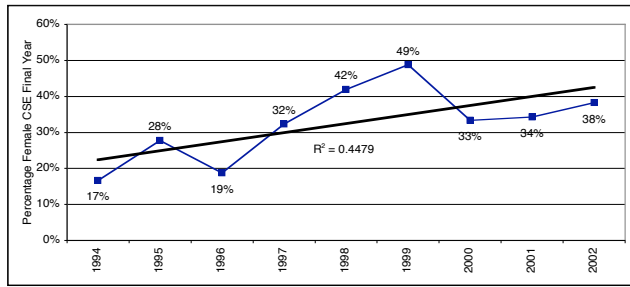
We have seen that Mauritian women are choosing to *enter* computing-related programs in numbers approaching the proportion of women in the general population. We now examine the rate at which Mauritian women *graduate* from the CSE department. Figure 8 presents the total number of graduates (male and female) of the CSE program, beginning in 1994 (i.e., the class admitted in 1990) and ending in 2002 (i.e., the class admitted in 1998):



**Figure 8. Total CSE Graduates at UoM**

When compared with Figure 4, we see that there is relatively little attrition among the CSE graduates. That is, the sharp upward trend that in Figure 4 begins in 1997 and 1998 is reflected in Figure 8 in the graduating classes of 2001 and 2002. The increased uptake in students has not led to a greater dropout rate. A relevant factor is that once a UoM student enrolls in a program, they cannot easily change major to a different program (unlike the U.S.).

Figure 9 shows the percentage of CSE graduates who were women, again beginning in 1994 and ending in 2002:



**Figure 9. CSE Female Graduate Percentage at UoM**

When compared with the 1990-1998 data points of Figure 6, we see that the patterns are again similar, indicating that there is relatively little attrition among the CSE women during their four years at UoM.

### 3 Discussion

In the preceding section, we saw that during the same time as representation of women in computing has been declining in the U.S. and other ASG countries, the representation of women in computing has been increasing in Mauritius, to levels approaching (and sometimes exceeding) that of the general population. Why?

The differences between Mauritius and the U.S. are many, but space limitations restrict how many we can explore. The authors are not experts in sociology, but we believe that some of the cultural differences we have observed shed light on the gender problem in the U.S.

#### 3.1. Developing vs. First World

Perhaps the most obvious difference is that Mauritius is a developing country with a year-2000 per capita income of US\$3,900, whereas the U.S. is a first-world country with a year-2000 per capita income of US\$29,469. Perhaps there is a fundamental difference in the culture of a developing country that makes computing attractive to its women that is absent in the culture of a first-world country.

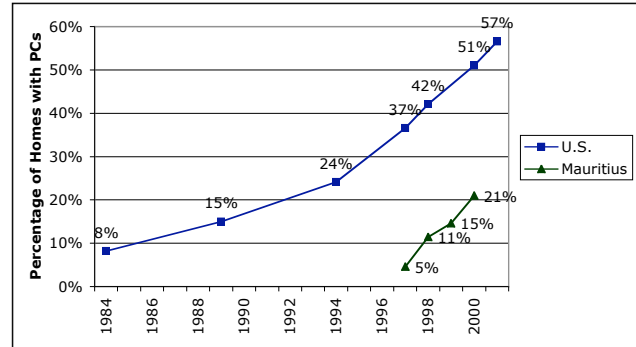
For example, given the choice, might women in a developing country choose to study computing because it is a means by which they can become working professionals? Put differently, perhaps women in the first world are choosing *not* to study computing because they have a plethora of other, seemingly more attractive career options?

Or might parents or family members in a developing country strongly encourage (or even pressure) their children to pursue a career in a field like computing, because of the associated prestige or financial rewards? Put differently, perhaps women in the first world are not choosing because of cultural differences in our families?

These are open questions that a trained sociologist or cultural anthropologist should explore.

#### 3.2. PCs in the Home

A related difference between U.S. and Mauritian cultures is in the number of households owning personal computers. As a developing nation, Mauritian home PC ownership trails that of the U.S. significantly. Figure 10 presents the percentage of Mauritian [7] and U.S. households with computers from 1984 through 2001.



**Figure 10. U.S. vs. Mauritian Homes with PCs**

In 2000, 68% of Mauritian households not owning PCs indicated that they planned to buy one in the near future, so the growth in home PC ownership seems likely to continue for now.

The decline in female interest in computing in the U.S. since 1984 (see Figure 1) coincides with the rising numbers of PCs in U.S. households, and some have suggested that these phenomena are causally linked. Figure 10 indicates that home computer ownership in Mauritius today is roughly that of the U.S. in the mid-1990s, by which time the decline in representation of U.S. women in computing was already a decade old. One might conclude that if there were a simple causal relationship between computers in homes and young women being turned off to computing, then we should already see a similar decline in the number of women choosing to study computing at UoM. As described in Section 2.3, no such decline is evident; in fact, the opposite is true. Figures 8, 9, and 10 thus suggest that the simple presence of computers in homes is insufficient to explain why fewer U.S. women are choosing to study computing.

#### 3.3. Secondary Education

Another significant difference between U.S. culture and Mauritian culture is that in general, Mauritian female and male students are educated separately at the secondary level. This permits Mauritian women to discover their academic strengths and weaknesses in an environment that is separate from (but equal to) that of Mauritian men. As a result, computing is not perceived as a male domain in Mauritian culture, even though other occupations (e.g., auto mechanic) are stereotyped by gender. Other negative stereotypes (e.g., CS is for geeks) seem to be nonexistent in Mauritius; instead, computing is seen as fresh, new, modern, and challenging (all of which are positive things).

Another difference is that at age 15, Mauritians must choose the general educational direction they intend to pursue (e.g., science, languages, technical, etc.), which determines the remainder of their high school program. A UoM program may require a specific high school program as a prerequisite, so this choice affects a student's program options at UoM.

### 3.4. Role Models

Teachers and other role models can play an important role in encouraging students to choose a particular field of study. Can female role models explain the rising numbers of women in CSE at UoM? Figure 11 presents a table showing the total number of CSE instructors (female + male) from 1990 through 2001:

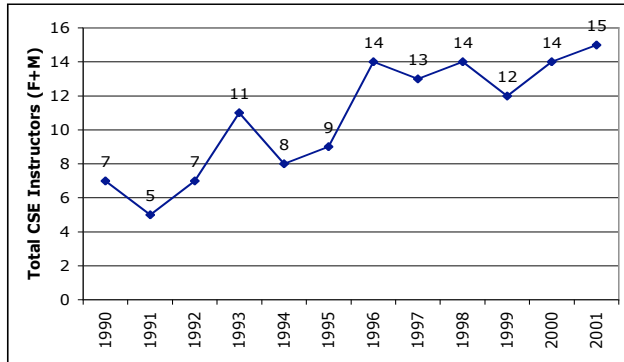


Figure 11. Total CSE Instructors at UoM

In 1990–2001, the numbers of *female* CSE instructors were 0, 1, 1, 2, 1, 1, 2, 2, 2, 2, 2, and 2, respectively. Figure 12 shows the percentage of female CSE instructors during these years, omitting 1990 (when there were no female CSE instructors):

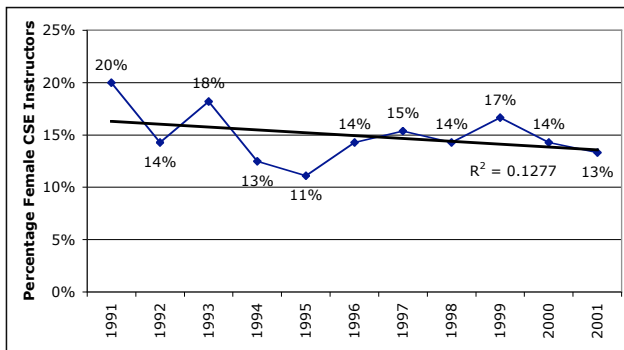


Figure 12. Percentage Female CSE Instructors at UoM

That is, the representation of women as a percentage of the instructors has *declined* even as the total number of instructors has increased. During these years, the median percentage of female instructors was 14% (average: 15%).

Additionally, there has been significant turnover in the female CSE instructors during the period we are studying:

- In 1992, the sole female CSE instructor was a visitor from the U.S.; she was also one of the two instructors in 1993.
- One of the female instructors was on leave in 1996;
- Both female instructors were on leave in 1997 and 2001.
- One of the two female instructors in 2001 was new.

The growing percentage of female CSE students (Figures 6, 9), plus the low and declining percentage of female CSE instructors (Figure 12) contradicts the hypothesis that women require female academic role models to be attracted to computer science.

## 4 Conclusions

We have seen that as the percentage of women studying CS has dropped in the U.S. and other ASG countries, the percentage of women studying computing in Mauritius has increased to levels proportional to the percentage of women in the general population. The decline of interest in computing by women is thus not a universal phenomenon, but is a reflection of the culture experiencing these declines.

The increase at UoM has occurred in the absence of any special initiative to increase the percentage of women in CSE. It has occurred despite rapidly increasing numbers of personal computers in Mauritian homes. It has occurred despite the CSE department offering a low percentage of female role models for its young women.

We believe that some Mauritian culture difference (from that of the U.S. and other ASG countries) is encouraging this increase. More study (by someone with sociological expertise) is needed to identify these cultural differences. Understanding why young Mauritian women are choosing to study CS will help us better understand why U.S. women are not.

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