In Sri Lanka, women represent more than half the population, yet their status is anomalous and contradictory. Sri Lanka produced the first woman prime minister as far back as 1960, and today the chief executive of the state is the daughter of that first female prime minister. Several women have served terms in the cabinet of ministers. Women dominate the university biomedical and arts faculties. But in the hard science and engineering faculties, they are poorly represented, especially so in engineering. Of the 80 senior members of the engineering faculty at the University of Peradeniya, the premier university, only two are women. While similar issues of underrepresentation have engaged the attention of educators in the West, Sri Lanka has hardly touched the problem.

We, the authors, became interested in it when one of us started planning Web-based education for the Open University of Sri Lanka, and the other was charged with starting a new computer science program under engineering at the University of Peradeniya. Another consideration is our daughter, who was brought up carefully without over-emphasizing pink clothes and Barbie dolls, and with access to computers. She is very good in her mathematics but is tuning it out and wants to do literature.

**Learning Attributes**

To establish a yardstick in looking at Sri Lankan data on women, we will briefly describe western findings. That women do not perform as well in science, mathematics and engineering (SME) has been established through sustained research from the U.S., Canada, Britain and Australia. Due to special programs, their performance has been significantly improved in the U.S. over the past 15 years, but it has not improved the lot of women in the lower 2/3 of the achievement curve. This establishes beyond doubt that the difference in male and female performance is not genetic, since genes cannot change over 15 years. Despite the diminishing gap, differences remain in complex mathematical tasks but not arithmetic. Other differences include boys' personal faith in mathematics and boys choosing to pursue mathematics when there is a choice. These differences become more pronounced with adolescence. Indeed, the psychological dimension is revealed by women who reject SME and go away with an abject sense of inadequacy despite having performance levels that are just as high as those of the men who continue on in mathematics.

Reasons for the difference have been studied extensively and the causes identified. There is a large body of literature that indicates the causes are both societal as well as having to do with how differently men and women learn. As for the societal reasons, two compelling statistics tell almost the whole story:

a) In 1990, 16 percent more male than female U.S. tenth graders reported ever talking to their parents about science and technology.

b) According to Mattel, the famous toy maker, for every four software programs parents buy for sons, they buy one for daughters!

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**Figure 1: The Educational Hierarchy (not to scale)**

<table>
<thead>
<tr>
<th>Management</th>
<th>Engineering</th>
<th>Designers</th>
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<tbody>
<tr>
<td><strong>Qualifies for University and Admitted</strong></td>
<td><strong>Engineering</strong></td>
<td><strong>Designers</strong></td>
</tr>
<tr>
<td>G.C.E. A. Levels</td>
<td>G.C.E. A. Levels</td>
<td>G.C.E. O. Levels</td>
</tr>
<tr>
<td>Art/Science</td>
<td>Science</td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
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</tbody>
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Another key factor is that most successful women in SME had a male role model to encourage them. Indeed, some of the best Sri Lankan women engineers and mathematicians have also had high performing engineers or mathematicians as fathers or elder brothers. In 1964, Dr. Premila S. Sivaprakasapillai became the first woman to graduate as an engineer in Sri Lanka. She went on for her Ph.D. from Oxford in 1969. Dr. Sivaprakasapillai's father was a professor in the engineering faculty at Peradeniya, and her two brothers and her husband all have Ph.D.s in engineering.

Combine the need for role models in engineering faculties with the few women teachers present, plus the finding that teachers call more frequently on males in SME, and it becomes clear that the situation favors boys. At the pre-college level, teachers both praise and scold boys more frequently. Boys are comfortable phrasing their answer as they speak while girls, because of the importance attributed to image, need to phrase the answer in their heads before giving it. These societal reasons alone sufficiently explain the difference in performance.

It has been established that men and women learn in different ways. Men perform well in a competitive environment, while women do better in a cooperative environment, because for women it is important how others perceive them; and for the same reason they have more examination stress. For, women often feel the need to be agreeable, compliant, and feminine; whereas men to be aggressive, assertive and autonomous. Thus, women are passive in coed labs but engaged with their work in female college labs. Further, men by nature, as established in several studies, blame outside causes for failure, and women themselves. This explains why women drop out of programs so easily. Furthermore, questionnaires have revealed that when men succeed, they say it is because they are clever and when they fail, it is because they were unprepared. In contrast women when they pass attribute it to luck and when they fail, put it down to their inability. Women want personal attention from the teacher, men don't. Sexual harassment is also a concern for women in SME, given that teachers are mainly male.
The Sri Lankan System and Data

With non-Sri Lankan readers in mind, it is useful to describe the Sri Lankan system, which was devised by the colonial administration with recruitment to the colonial clerical service as one of the chief objectives. In the year 1817, before the big schools were established, male literacy was estimated at about 20 percent and confined to the high castes. By independence, literacy had climbed to 89 percent, highly successful by any standards. This was mainly due to the efforts of missionaries whose focus was far from trade and the clerical service.

Despite this positive colonial legacy, the system of examinations for employment purposes assumed too much dominance. A key factor was certification being seen as a route out of the village and to government employment. The system is described as one in which we keep studying until we fail, and then seek employment with the highest certificate. Figure 1 describes this hierarchy. Thus, we all go to school and then at grade nine the best go in for science and the others into arts.

At grade ten, the G.C.E. Ordinary Level examination results in about 31 percent of more women having qualified for the A. Levels.

Only some 2 percent of the population is given the opportunity to study at the university, although far more are qualified. Education, therefore, is elitist. There are 13 national universities, of which Peradeniya is the oldest and largest. Admissions are regulated by the University Grants Commissions based on A. Level performance. For the physical sciences there is a split at the university into engineering and physical sciences; into medicine, dental science, veterinary science, agriculture and bioscience in the biosciences stream; and commerce/management and general arts in the arts stream. Referring to Figures 3 and 4, as a result of the high-end being cornered by proportionately more men — with women performing better overall — we find that:

- There are more women in universities, especially in the low demand general arts stream
- Women fail to hold up their superior performance in the biosciences in the competitive seats for medicine
- Women do not keep up their general superior performance when it comes to the physical sciences and fail abysmally in getting the prestigious seats in engineering. These figures are even worse if we note that more women sit the G.C.E. A. Levels in view of their having performed better at the O. Levels.

University admissions are highly competitive. While merit lists from the A. Levels are used, regional quotas are used for poor districts. However, our findings, based on ministry of education statistics, indicate that because women from the big cities have a more liberated environment, the admissions restrictions on the cities work against female numbers. As a result of the stakes, examinations are important events, unlike in the U.S. They are usually public examinations conducted by the government, following a tradition that goes back to the year 1862.

The situation regarding elitist education used to be the same throughout the British Commonwealth, but some countries have begun to adapt American methods, with modules, course units etc. In Singapore, where the switch to course units has been made at university level, examinations still continue to be in large halls with candidates separated by large distances and all window-panes papered over to prevent communications from outside. This legacy of formal examinations has made continual assessment difficult because of the heavy importance attached to examinations — doing them once a year was fine but how can the logistics be handled if the examinations are to be more frequent? Similarly, the course unit system also is not implemented as it is traditionally seen in the U.S., with students deciding what units to take. Instead, a one-year course is now seen as two “half courses.” So the problems of the old system with rigid examinations remain.

Having said that, the data we have obtained shows similarities to the reported international findings. But there are some startling points of departure. In the U.S. there was a massive effort from the mid-seventies to push female participation. But the gains in Sri Lanka with no specific push for women from anyone, have been spectacular:

- Girls’ pass rates have climbed to over 50 percent at the A. Levels (arts and science combined) while boys’ pass rates have also climbed — but to levels below 50 percent (see Fig. 2).
- At the upper end, a larger percentage of boys consistently get four As. That is, while overall girls are faring better, the high performers are the boys. This better performance of boys at the high end therefore is reflected in the data for university admissions as given in Figures 2-4:

- While more than half the girls do arts, the high demand fields of management and commerce from the same examination requiring mathematically oriented subjects like accounts and economics are dominated by boys.
- While girls get 20-30 percent of the places for the physical sciences, in the same competition based on the same A. Levels, they garner only 10-18 percent of the highly competitive engineering places. Even within the sciences, where a choice is possible, women seem to go for fewer mathematics-based courses.

- The figures for the biosciences are better with women getting just over a half the seats (50-60 percent) but again they lose in medicine at the high end getting only 40-45 percent.
anted for women working after hours. To address any possible concerns about sexual harassment office doors are always kept open and where air-conditioning is involved, we utilize glass partitions. Further, at least two instructors — full-time graduate teaching assistants in engineering — are in after-hours labs, in case a woman needs to work alone. Instructors monitor how partners function to ensure that a male does not play a dominant role. Rules on computer use and turns are posted. Instructors watch for women who are lost but too shy to call for help.

Guidelines for lecturers, which would be the equivalent of the various professional grades in the U.S., include:

- using a variety of teaching styles to cater to male and female learning styles;
- allowing a wait time of 2-3 seconds as suggested by NECUSE, before taking answers so that females are not left out;
- being very conscious of whom we call to answer our questions in class;
- personalizing the class and thereby easing girls and especially girls-school students, into a male environment;
- promoting discussion with neighbors, stressing group efforts, avoiding competition;
- and acknowledging female accomplishments in science when possible.

Since the recruitment of instructors is largely a departmental decision, we have an openly stated preference for female instructors to serve as role models — not that we have many of them. In a scarcity area like computer science; we have one out of eight.

What we wish to do

Our study indicates the need to take actions that, given institutional obstacles, we presently can't. These include:

- giving lecturers access to marks so as to advise students better and provide feedback on examinations;
- varying the examination structure;
- instituting more pass/fail courses in the first year than graded courses, so that students from both highly coached city and rural self-study environments, with very different entrance marks, can adjust to the common standard without stress.

We also recommend admitting more women into science, mathematics and engineering in the universities — affirmative action. After entering the engineering faculty it would be a zero sum game to admit preferentially to a department, since admitting more into computer science would, mean fewer in mechanical engineering and so on. Indeed, it could mean women getting pushed into the less attractive departments. This proposal being controversial, we will try to justify it in the Sri Lankan context.

It is now roundly accepted in Sri Lanka that highly coached students from Colombo have not necessarily proven themselves better than self-study students from, say, Ratnapura with lower marks. We affirm the correctness of the regional quotas we practice — especially after noting that those admitted from the poorer regions with a smaller A. Level aggregate often perform better at the university than some Colombo students who were coached for the A. Levels, but at the university are at a loss without a personal tutor.

Now, girls cannot go out so easily for tuition classes, and they do not internalize the laws of physics by riding bicycles and playing with other machines as boys do. Nor do they have all the advantages revealed by the above studies. Therefore, an A. Level aggregate of 300 by a girl is clearly superior to a 300 by a boy. If regional preferences are accepted, then is it not...
also correct to argue for gender preferences in doing admissions, as now done routinely in the U.S.? As an aside, we point out that our studies indicate that regional quotas come at the expense of women. This is because when, for example, Colombo admissions are reduced and Ratnapura admissions increased, female numbers will fall since city girls do better than rural girls at the A. Levels in the sciences. That is, addressing one problem worsens the other.

Another reason for preferential female admissions has to do with ensuring the success of the few women admitted. It is the experience of elite U.S. colleges that white children predominate. When Blacks and Hispanics are admitted in small numbers with the same admissions standards, they do not perform as well as the others. But when they are preferentially recruited in larger numbers, they succeed despite their lowered admission scores. The reason is networking. They had a network for information and this provided study groups so that they were able to succeed.

The same argument holds for women. At Peradeniya for example, all boys in engineering live at Akbar-Nell Hall. They can find friends with whom they can be comfortable and they are well-informed on all the ropes. The few girls in engineering are distributed across the various halls of residence since they are too few in number to have their own hall. Indeed, while we have not rigorously tested this, the girls who are properly networked are those who have found boy-friends through whom they get into the network. Increasing female admissions is therefore one way to make more girls succeed.

Likewise, for mentoring and role-model reasons, we would recommend recruiting females to the science, mathematics and engineering faculties preferentially. To try to do so would be routine in the U.S. but this will be extremely difficult, much more so than admitting more female students, given the traditions here. In this regard, it would be useful to paraphrase an Indian Supreme Court judgment: To treat unequals equally, you must treat them unequally.

Our Personal Experience: Sri Lanka Versus the U.S.

Having taught in the U.S. and now here, we would like to contrast our experiences. In the U.S. we found that, as a result of handing out graded assignments on a weekly basis, we knew most of our students by name in the first three weeks and almost all of them by the end of the semester. After mid-term examinations, we distributed the answer-scripts and discussed with students where they went wrong. We wrote words of
encouragement on the scripts for the students to read, even if they were sure to fail. Occasionally students pointed out if a friend received a point more for the same answer and we immediately corrected ourselves. More often, there would be no mistake and when it was explained to the student, the student went away with the feeling that everything was just.

In light of the research reported above, particularly the NEC/USE guidelines, the U.S. system was very female-friendly. Female students had personal contact and access; and the examinations had varying components left to our discretion — projects, papers, multiple choice questions, class participation, take-home examinations, un-timed examinations, final exam, etc., so that no one single method of learning and answering is stressed.

By contrast, in the conventional Sri Lankan system and that of the British Commonwealth, teachers do not see themselves as persons who ensure that their students learn and thereby succeed; we see ourselves as people who deal with a bunch sent to us by the government, to whom we give some lectures and then classify for purposes of employment as first class, second class, failure, etc. The system is based on the colonial need for certification. By the end of a course, we won’t have spoken to most of our students. This is seen as enhancing the integrity of the certification process. We usually do not know how each student fared at examinations since we deal with index numbers, and after the examination we are not allowed to look at the mark sheet. We cannot know their intellectual ups and downs to help them. The end-of-year examination and the absence of continual assessment also keep the distance between the teacher and the student.

This system is defended on grounds of integrity — conveniently ignoring the fact that if we really were crooked enough to help certain candidates, then we would feel no shame in asking them for their index numbers. In this system we must nearly always examine by one three-hour examination, even if it is a course involving a project. So we must not give project-based courses (which are female-friendly, particularly in their report-writing aspects) since different students have different projects and not all the papers will fit into the three-hour format.

A positive aspect of this system is that grades are fixed by the marks obtained rather than on a curve, as usually done in the U.S., where a student’s grade goes down if the class as a whole does well and vice versa. The latter is male-friendly since girls are known to generally avoid a competitive system.

**Hope for the Future**

A redeeming factor is that with the modular course unit system being pushed by government policy the system is set to become more flexible. A reform commission set up by the president has identified correctly the problems and the president has directed that the reforms be implemented. However, we have concerns over the way the new system is being set up. The new system has been imposed by the government with many academics not quite believing in it. Moreover, without intimate knowledge of the course unit system, many departmental administrators see the exercise as merely breaking up a year-long course with one three-hour examination into two half-year courses, each with an end-of-term exam. The scheme of implementation appears to limit the biggest advantages of the course unit system — students’ choice in what courses they follow, and teacher discretion in teaching and examination methods.

**Concluding thoughts**

The issue of computer science has assumed greater proportions with admissions. The first year, when the common class of 320 engineering students was streamed into specialties using student choice with the merit list from the first common examination in engineering, the pilot computer science class of 20 had two females. With its success, in the second year, with greater competition, no female was selected. Now in the third year, out of the 320 students 171 have asked for computer science. We now see taking the risk of increasing student numbers in a staff short and new program as the only way of preserving female enrollment across the faculty. It is now an issue of quality versus equity.

The ideas we posed here are being raised probably for the first time in public in Sri Lanka. They involve the well-being, development and flowering of more than half our population. These ideas may run on a many-pronged front, but to ensure our continued, proud view about how accurately our examination and certification system is. We do not do so far as a result of just, in saying there is a completely different mathematics called “feminine mathematics” which is different from the “male mathematics” that is now taught. Indeed, we reject it as of the same category of ideas as “Eastern science” and “Western science.” Moving beyond rhetoric, the evidence that women learn differently and therefore single-format examinations do not always examine accurately is very strong. If we can engage serious men and women, academics and policy-makers to discuss these points, we will have achieved something.

**About the authors:**

Dushyanthi Hoole is presently senior lecturer in chemical engineering at the University of Peradeniya, on leave from the Open University of Sri Lanka. Hoole earned her B.Sc. Honours degree in chemistry from the University of Peradeniya, the M.Sc. degree in chemical analysis from the University of Colombo, the M.S. degree in organic chemistry from Drexel University, and her doctorate, working under Nobel Laureate George Olah at the Loker Hydrocarbon Institute, from the University of Southern California. Her teaching interests are in green chemical processes, food technology, and environmental engineering. She has pioneered Web-based teaching in Sri Lanka for distance education. Her previous work experience includes stints as assistant government analyst for the Government of Sri Lanka, senior research associate at California State University at Los Angeles, and adjunct professorships at Pasadena Community College and Glendale Community College.

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**Acknowledgements:**

a) Work on this paper was supported by the National Science Foundation of Sri Lanka under Grant No. RG/99/SE/01.

b) Thanks to Mr. T. Gnanakumar, M.Phil candidate at the University of Peradeniya for the graphics.

**Endnote:**

1. Space constraints do not allow publishing the extensive references upon which the article is based. Please contact SWE editor for sources.

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