

Proceedings  
of the 11th International  
GASAT Conference

6th - 11th July 2003

Mauritius

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## CONTENTS

Acknowledgements	6
GASAT Association Board Members	8
Preface	9
Message from the Patron	10
Conference Chair's Report	11
Introduction	13
Home Groups	15
Report from Secretary	16
Recommendations of the Conference	19
Evaluation of the Conference	24
Opening Ceremony	31
Keynote Address: <b>Dr Nancy Lane</b>	43
Country Paper: <b>Dr A Suddhoo</b>	48
Keynote Address: <b>Professor J. G. M. Massaquoi</b>	57
Keynote Address: <b>Dr Ann Holmes</b>	65
Keynote Address: <b>Professor Lesley Parker</b>	81
Closing Ceremony	93
<b>PAPER PRESENTATION</b>	
Billings Deirdre	94
Dieckmann Francine, Barbara Earth	100
Sagebiel Felizitas	106
Holmes Ann, Marta Ecsedi	117
Reed R, Reed G	127
Bagilhole Barbara, Dainty, A., Gibb, A, Pepper, C.	135
Smandynch Susan, Karen Martinson	143
Agwubike C, Dr Canice N. Ikeoji	148
Gudmandsen Helle, Ramsarup Presha	157
Hawoldar S	164
Lindahl Britt	171
Ramroop Dhiren	180
Dahms Mona	188
Whitelegg Liz	194
Grundy Frances	202
Bunwaree Sheila	212
Athreya Krishna, Regina Clewlow	224
Bilesanni-Awoderu J	231
Manraj Meera	240
Du Xiangyun	248
Ukpore B A	258
Oogarah-Pratap Brinda, Bholah R., Cyparsade M., Mathoor K.	267
Ejale Anjala, Kadiri P	275
Prakash Nirupama	282
Parmessur Pritam, Yashwantrao ramma, Anita N Ramdinny	300
Hodgson Barbara, E. Whitelegg, E. Scanlon	304
Paull Shauna, Loshny Helen	312

Armour Nan	323
Ramguppy-Wong Anita, Priya Baguant	333
Marsh Cecille	343
Ferraz de Siqueira Vera, C. M. oliveira, W. R. Fernandes, E. Pina	353
Lotz-Sisitka Heila	359
Okon U A, M. Ekpo, O Ekong, E. Etim	370
Madill Helen,A Ermour, R.Campbell,I. Meglis, W Coffin, D Cullen	381
B Einsiedel,C Rothwell, L L Stewin, A L Ciccocioppo, T Montgomerie	
Dede Alice, E. O. Akpaja and C. Adjarho	389
Omoniyi Olubunmi	398
Frize Monique	409
Wiklund Karin	415
Gribble J, Bessoondyal H	423
Ekpo C M et al, M. Orok, U. Ekukinam, A. Okon	436
Dindyal D	447
Maini Yogita	453
Uzuegbunam A O	462
Reed Rosslyn	470
Kyomugisha Fiona	478
Nielsen Kirsten	484
Were Emily	494
Anderson-Rowland Mary, Donna Zerby	499
Kirkup Gill	508
Goel Ved, Naugah J.,Ramma Y, Ramful A, Ramroop D, Saddul S, Bessoondyal,	515
<b>POSTER PRESENTATION</b>	
Maia de Oliveira Cristiane, Ferraz de Siqueira Vera	524
Miranda Lucia et al.	525
Braga Oliveira Julio at al.	526
Igreja Maria Jose Miranda at al.	527
Fernades Wania Ribeiro et al.	528
Pillay Narrainen Rosy	529
<b>OTHER CONTRIBUTIONS</b>	
Kibria Ghulam, Mowla Runia	530
<b>Annex 1</b> – Programme of the Conference	540
<b>Annex 2</b> - Home Groups	549
<b>Annex 3</b> - Newsletter	558
<b>Annex 4</b> - List of GASAT II delegates	580

## ACKNOWLEDGEMENTS

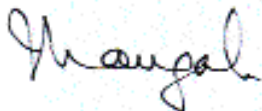
The Planning and Organising Committee and on my own behalf acknowledge with thanks the sponsors for their patronage and assistance in the organisation of GASAT 11 Conference which is the first conference organised in a small island state. It is also a unique event for the GASAT 11 Organisers to have succeeded in its attempt to have the participation of an Afghan female lady Engineer. That unique event was made possible by Mona Dahms, the outgoing well known Chair of the GASAT Association.

We are most thankful to all our sponsors for their immense generosity and their trustworthy commitment to the mission of our Association. Our Organisation recognises that the fulfilment of our ambitious objectives was made possible with the support of international organisations, reputable private companies, Governmental Ministries and institutions and also with the full participations of professionals who believe in the advancement of gender equity in the field of science and technology.

GASAT 11 Planning and Organising Committee and its Secretariat wish to place on record the invaluable contribution from a number of professionals and colleagues from all our tertiary educational institutions, volunteers, close friends and relatives for the resounding success of the Conference.

The GASAT Association fully acknowledges the invaluable inputs from Dr A Suddhoo and Professor S Bhoojedhur who are respectively the Executive Director and Chairman of the Mauritius Research Council. The following well-known personalities will always be remembered for their professional, timely and moral support afforded to me: Mona Dahms, all GASAT Board Members, Dr P Mohadeb from the Tertiary Education Commission and Philip Tse Wai Rai from the Mauritius Research Council. My close colleagues and myself cannot afford not to be appreciative of Dr Ved Goel's sincere belief and commitment in GASAT's pursuit of its mission. I am also very much indebted to the Chairman of the Old Council, Mr S. Bissoondoyal, and to my colleagues from the Mauritius Institute of Education who helped in the organisation of the conference as well as members from the Secretariat under the leadership of Dr Y Ramma, and the International Academic Committee headed by Mr Pritam Parmessur who worked very hard to make the conference a success. I am thankful to the International reviewers for scrutinising the conference abstracts.

I take this opportunity to thank all those who in one way or another who helped to make this conference a resounding success.



Jayantee Naugah  
GASAT Chair

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## PREFACE

It is with great pleasure that we are submitting the proceedings of the 11th Gender And Science And Technology (GASAT 11) International Conference.

Mauritius was very much honoured to have hosted the GASAT 11 International conference on Gender, Science and Technology from the 6th to 11th July 2003. As Chair of GASAT 11 Conference, I am thankful to the GASAT Association for choosing Mauritius to host the Conference. Initiatives were taken after consulting my colleagues who have been helping out throughout the Conference to consider that the hosting of the conference be made by the Mauritius Institute of Education with the collaboration of other tertiary institutions and appropriate Ministries.

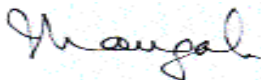
There was a rich diversity of papers on the different sub themes including formal education, all reflecting a growing commitment for gender inclusive science and technology so as to bring about advancement of knowledge, understanding and strategies on the issue of gender, science and technology.

In all, 55 papers for presentation were already circulated on CD and distributed to conference participants. Printed copies of the abstracts were also distributed to all conference participants together with their conference kits. The conference brought together 113 participants from 19 countries from across all the continents. The participants include experts in science and technology from both developed and developing countries who have come together in this very small island state of Mauritius to share their experiences and exchange their views and ideas on Gender, Science and Technology and to propose strategies and solutions for the continued empowerment and advancement of girls and women in gender, science and technology.

GASAT, as an organisation, is more than ever committed towards a socially responsible and sustainable gender inclusive science and technology. GASAT is experiencing a wave of change and this is being reflected in many countries. How we bring about these changes rest upon actions to be taken at individual, local and global levels. This conference has been a real challenge and it is up to us to convert that challenge into fruitful opportunities.

Action-oriented recommendations which are both country specific and focussed at international level have been worked out and we as GASAT members need to examine them thoroughly so that action plans could be formulated for bringing about positive changes for a gender inclusive science and technology education responsive to the emerging needs of society. As a matter of fact, as GASAT Chair, I have already initiated activities that are linked with the Ministry of Women's Rights, Child Development and Family Welfare's national projects in women centres.

GASAT 11 gratefully acknowledges the contributions of many individuals, institutions, organisations both local and international for the success of the conference and the positive outcomes reached. GASAT 11 has left an indelible mark on everybody. Ever since its inception, it is the first time that a GASAT conference had the honour to be inaugurated by a Prime Minister in the person of Sir Anerood Jugnauth. I am sure that all of you will share the view that Lady Sarojni Jugnauth as Patron was a great source of inspiration, encouragement and constant support to all of us.



J Naugah (Mrs)  
Chair, GASAT

## **Lady Sarojni Jugnauth, Patron GASAT 11**

### **An exceptionally innovative experience**

As Patron of the GASAT 11 conference I was amazingly very much satisfied with the entire process of the organisational team work that was so assiduously planned by the Convenor and Chair of the Planning Committee, together with the handful of highly efficient and loyal colleagues who, I am given to understand, are still involved with GASAT work. While I was perusing the written feedback and evaluation comments from the participants it became strikingly evident that the Secretariat of our GASAT 11 conference, in spite of having to bear with a few short-lived mixed signals, has really shown the evidence of optimum logistic and professional excellence. Given the International dimension and usefulness of this conference the Secretariat was able to ensure that all participants' needs and queries were promptly attended to by very well motivated and dependable staff and volunteers who were attached to the conference Secretariat. I should hasten to thank and congratulate our wonderful friend, Val Johnston from Canada, for providing up to date and timely ICT inputs throughout the whole conference week and for, simultaneously, doing on the job IT training for several staff of the GASAT Secretariat.

The GASAT 11 conference happened to be a challenging experience for our small Island nation. Given the scope and the structural nature of the conference research papers and keynote addresses, I am, therefore, quite sure that the GASAT Board members and the Convenor of the conference will appreciate the contribution of the Academic Chair who shouldered his responsibility with much seriousness of purpose compounded with his commitment of a correct code of ethics.

All the participants will be keen to note that there are two sets of final GASAT 11 Conference recommendations. The first set of the recommendations has been listed in a sequential order that reflects the four sub-themes of the conference. These recommendations appear to be scrupulously well defined and expressed, and I am very hopeful that all appropriate authorities, agencies and stakeholders should have no problem of implementing them judiciously and expeditiously. Moreover, it is quite useful to appreciate that GASAT took the exceptional initiative of working out a second set of separate recommendations that is directly and specifically relevant to the Mauritian context.

At its last meeting of the Planning and Organising committee that was held at the Mauritius Institute of Education, I was requested to consider if I could continue to help in the future activities of the local GASAT Organisation. I am absolutely pleased to inform all GASAT members that I have wholeheartedly agreed to the request made.

I am confident that Mrs J Naugah as the new GASAT Chairperson with her research team will be able to contribute significantly towards the positive relationship between Gender and Science and Technology. I take this opportunity to thank everyone, who in one way or another, has helped in making the GASAT 11 International Conference an exceptionally unique and resounding success. I wish also to express my deep and sincere thanks to all the GASAT Board members for their trust which they have placed upon me as the Patron of GASAT 11 Conference which was held in Mauritius. Together with Jaya's research team, I am really looking forward to help and provide moral support in the setting-up of a well structured local GASAT organisation in Mauritius.



Lady Sarojni Jugnauth  
Patron, GASAT 11 Conference

## **Conference Chair's Report on GASAT 11 – Jayantee Naugah**

The GASAT 11 Conference was a great success. As the Chair of the Conference I would like to thank the Patron for all the support, advice and encouragement given to us in the organisation of the Conference. My special thanks to Mona Dahms who asserted herself in protecting the Rights and By Laws of the GASAT Association in difficult times during the organisation process. We have learnt a lot from her and I will always remember her power and her force of determination to stand by us firmly.

I am also grateful to the Chairman of the Mauritius Institute of Education Council for having intervened appropriately to ensure that logistic and administrative support were made available to facilitate the work of the Planning and Organising Committee whenever required.

Prior to the Conference, we received 150 abstracts from 29 countries of which 100 were approved by International reviewers. At the Conference, 55 papers were presented in parallel and round table sessions. There were two poster presentations, four keynote addresses (one delivered daily) and one country paper by Dr Arjoon Suddhoo, Executive Director, Mauritius Research Council.

The keynote addresses focused on the following:

- ❖ Recent developments in UK for women in Science and Technology by Dr Nancy Lane, University of Cambridge
- ❖ UNESCO/ANSTI activities for the promotion of networking among female scientists in Africa by Prof J Massaquoi, UNESCO, Nairobi
- ❖ Asking different questions – Strategies for Change from the Context of Canadian Education by Ann Holmes, Principal Consultant, Canada
- ❖ The Emerging Gender – ICT Agenda in Education by Prof. Lesley Parker, Senior Deputy Vice Chancellor, Curtin University, Australia

### **GASAT Meetings**

During the Conference there were three outgoing GASAT Board meetings chaired by Mona Dahms and one new Board meeting, chaired by Jaya Naugah as well as one General Meeting. Dr Yashwant Ramma from Mauritius was elected as the first male Executive Secretary of GASAT. At the last Board meeting the powers of the GASAT Board were amended and Bylaws were revised and amended and these were approved at the General Meeting.

There were two Regional GASAT Meetings where strategies pertinent to the regions were discussed.

For Africa Region, amongst other propositions, it was agreed to issue a journal on a regular basis.

### **Accountability of GASAT**

GASAT as an International Organisation is accountable to its own Board in so far as the academic, administrative, planning, financing and implementing of the conference are concerned. However, it works closely with various institutions for the furtherance of its objectives and also for seeking logistic and institutional facilities. As Chair, I have the responsibility of finding an appropriate location for GASAT 12 conference.

## **Activities**

As an initial follow up of the conference, a meeting with the Ministry of Women's Rights, Family Welfare and Child Development was held. The Permanent Secretary, the Principal Assistant Secretary, the Administrative Officer and Adviser and Ann Holmes from Canada were present. Discussions focused on gender mainstreaming, sensitization campaign to encourage more girls into Science. Various steps taken by the Ministry for mainstreaming gender in all sectors of the economy, computer and scientific literacy for women in Women's Centres and Mauritius/Canada Association were discussed. The Ministry expressed the wish to work closely with GASAT Association on gender issues.

## **Outcomes of GASAT**

GASAT as an organization appreciates the participation of the Mauritian Government, the Mauritius Institute of Education and the Mauritius Research Council, the Tertiary Education Commission and other local agencies and authorities for the success of the Conference.

The outcomes of the Conference will be implemented at international and local levels. It was the first time that special resolutions were drafted for the host country with the collaboration of international participants. As GASAT Chair, I will ensure that a Plan of Action is implemented in Mauritius.

## **Positive Outcomes of the Conference**

The Conference has provided opportunities for very interesting collaboration and forging of links among stakeholders locally, and networking at international level. There is a great deal of forward thinking and this has impressed the international participants as this will help to explore horizons in the field of gender, science and technology.

On the whole it was an exceptional conference. There was tremendous capacity building – the impact on the staff was impressive. Unthinkable and unwarranted circumstances during the planning and organisation stage of the conference have made us intellectually and professionally more pragmatic. Our country is experiencing change and through sharing of ideas and experiences we felt much enriched.

We have to look more closely on the impact and input of ICT on education and work out avenues for promoting scientific and technological literacy. We should aim at being pluralistic, gender inclusive and eclectic in our science and technology education. The various papers presented by Prof Lesley Parker, Ann Holmes, Prof J. Massaquoi, Dr Arjoon Suddhoo, Dr Ved Goel from the Commonwealth Secretariat, Dr Sheila Bunwaree and others need to be examined closely so as to bring about the necessary changes for gender inclusive science and technology. Sharing of experiences and networking will ensure that science and technology benefit all members of society. This International Conference has provided a rich source of recommendations specific to gender-inclusive science and technology.

## INTRODUCTION

The beginning of the third millennium has already witnessed unprecedented changes in the domain of science, technology and the world of work. Different kinds of world socio-economic and political forces have brought around challenging pressures on the growing issues of gender within the developed and developing world. New paradigm orders are rapidly shifting their importance with respect to the overall welfare of humankind and thus GASAT has become a well-organised association, which aims at contributing through Science and Technology, towards the promotion of greater equity and distributive justice.

GASAT international conferences are held every two/three years and have been central in establishing strong and influential networks of individuals and organisations that are engaged in research and grassroots activities with a view to promoting gender equity in science and technology.

The paper contributions and proceedings of GASAT conferences provide an important source of information on research and interventions in the field of gender, science and technology. In addition, GASAT provides an international forum for sharing research findings and strengthening global networks.

GASAT held its first International Conference in 1981 in Eindhoven, (Netherlands) in 1981. The subsequent conferences were held in: 1983 Oslo (Norway), 1985 London (UK), 1987 Ann Arbor (USA), 1989 Haifa (Israel), 1991 Melbourne (Australia), 1993 Waterloo (Canada), 1996 Ahmedabad (India), 1998 Accra (Ghana), 2001 Copenhagen (Denmark).

This is the first time that the GASAT international conference was held in a small island state.

The theme of the GASAT 11 Conference was: *Gender-Science, Technology and Economic Paradigm Shifts (G-STEPS); New Challenges for Gender – distributive justice and equity.*

*This GASAT conference was structured around the following four themes:*

- New Initiatives in Science, Technology, Mathematics Education at the Formal Level
- Meeting the Challenges of the New Technologies
- Women, Science, Technology and the Workforce
- Gender, the Environment and Sustainable Development

The following issues were highlighted in the above themes:

- Elaboration of new techniques of mastery learning based on paradigms of psychology of learning and cognitive science
- Creation of a better fluidity in the exchange of the new technologies between the developed and the developing world
- Strategic policies to protect and promote women's rights and career opportunities in the realm of corporate and global governance
- Recognising and promoting the contribution and relevance of indigenous knowledge in improving the quality of life

The following forms of presentation were used during the conference by the delegates:

1. Keynote address, 2. Country paper, 3. Workshops, 4. Round table discussions, 5. Poster presentation, 6. Interactive sessions, 7. Home Groups

Four parallel sessions were simultaneously conducted in the allocated time schedule (annex 1)

### **Home Groups**

Home Group sessions are unique to GASAT conferences. A Home Group is an intercultural and interdisciplinary group of 10-15 conference participants who meet during the conference.

The purposes of the Home are as follows:

- To help understand the variety of cultures and disciplines represented at GASAT
- To welcome new participants into GASAT
- To provide a sense of belonging and create an atmosphere of trust
- To provide opportunities for reflection on key note speeches and sessions
- To allow participants to develop a shared vision of GASAT objectives by sharing views, ideas and information
- To provide a means for participants to make contacts, develop friendship and establish networks
- To give everyone an opportunity to talk in a supportive atmosphere
- To sort out participants' problems as and when the need arises

### **How are Home Groups organised?**

Home Groups are organised by the Planning Committee according to criteria of broad representation of countries and sub-themes. One person from each Home Group is identified as the Home Group facilitator. It is the role of the facilitator to encourage and support discussion and to enable the contribution of each individual member of the Home Group. Refer to annex 2 for issues discussed during the Home groups sessions.

## **Report from Academic and Programme Chair – Pritam Parmessur**

The GASAT 11 International Conference was truly a great success from the viewpoint of academic and professional standard and also from the perspective of innovative ideas and significantly relevant experiences. Without the shadow of any doubt, I wish to add that the whole process of planning and organising the academic and professional aspects of the conference has been indeed a most exhilarating, unique and challenging exercise which will stay as a memorable event throughout my lifetime. There are in fact, two main reasons for the planning committee to be very humbly proud of: Firstly, the quality and level of excellence achieved in all the thematic paper presentations and keynote addresses were quite timely and appropriate in so far as gender plurality, inclusivity, equity and social justice were considered. Secondly, all our stakeholders and interested partners were fully engaged in hard work throughout the whole process of the GASAT 11 conference. Their engagement showed the laudable evidence of a high degree of unconditional conviviality among all the participants and staff, and also a shared vision of futurism that can shape the social reconstructionist dimension of our research activities.

I hope that all the GASAT 11 participants will share the view that all the sub-themes were considered to be necessarily important and highly worthwhile. The collaborative participation of all the selected chairpersons for the conference's plenary sessions and round table symposia were quite exemplary and most commendable. This is the true and unsolicited feedback I have obtained quite readily from almost all the GASAT participants. For the record, I feel very honoured to express my heartfelt gratitude to all our chairpersons and to the author of our country paper, Dr A. Suddhoo, for their insightful contribution to the GASAT 11 conference. I should also mention that the Convenor of GASAT 11, Mrs J. Naugah and the secretary, Dr Y. Ramma, provided me with all the necessary logistic support in so far as the planning, administrating, delivering of the conference abstracts and papers. These two close colleagues of mine remained and continue to be the most dependable and trustworthy persons I have ever met in my professional career. They were at their best when the chips were down and when we had to work against the clock in order to ensure that the GASAT 11 conference, was going to be the greatest academic and research event in the field of gender equity and educational advancement in science and technology in Mauritius.

May I also deeply thank Lady Sarojni Jugnauth, Patron of GASAT 11, Mr S. Bissoondoyal, Chairman of Mauritius Institute of Education Council for their prompt, well thought and usual guidance that was given to me throughout, and even after, the GASAT 11 International Conference.

Finally, it is with the strictness sense of the humbleness of my mind that I shall call upon your academic and professional experience to make the GASAT association the leading organization which should continue to play the key role in issues related to gender equity and social justice and to the much needed advancement of learning and new knowledge through science and technology. There are plausible reasons to believe that the paradigm of new knowledge may become the next strategic research activity for an accelerated form of cost beneficial economic, technological, social and cultural development of humanity. The world will, inevitably, require vast amount of quality new knowledge for all our people to have access to wider opportunities in the improvement of their future life chances, social upliftment and excellent utilitarian achievements.

## **Report from the Executive Secretary – Yashwant Ramma**

### **Process leading to GASAT 11**

- The proposal to hold GASAT 11 in Mauritius was submitted in GASAT 10 in Denmark in 2001 by me and Jaya Naugah, a long standing GASAT member. This was unanimously accepted by the GASAT Board Members. It was the first time that GASAT was moving to a small island state.
- The request for entrusting the hosting of GASAT 11 Conference to the Mauritius Institute of Mauritius was made by Jaya and me.
- On our return to Mauritius, we informed the then Director, Mr Prem Saddul, about the matter. He was most agreeable to host the conference under the Chair of Jaya Naugah. A formal request was then sent to him in January 2002 by Mona Dahms, the GASAT Chair.
- The Mauritius Institute of Education Council approved the decision of the Director in April 2002.
- The Ministry of Education and Scientific Research submitted a paper to the Cabinet of Ministers for Approval.
- After approval by Cabinet, the Ministry of Education and Scientific Research gave the green light for the hosting of the conference.
- Jayshree Mehta who was in Mauritius at that time shared her experience with us on how to start the organisation of the conference and setting up of various committees. Her suggestions were most valuable and preparation for the organisation was initiated in May 2002. The GASAT Planning Committee started its work soon after.
- Mr A Parsuramen, Director of UNESCO BRENDA met the Planning Committee in July 2002 and advised us on modalities for securing funds from International Organisations.
- Dissemination of information regarding the GASAT 11 International Conference was conveyed to previous GASAT participants (a list of which was sent to us by Mona Dahms). Call for papers were made through local institutions, Embassies, GASAT website, email, snail mail and personal contacts- local and abroad.
- Letters requesting sponsorship were sent to local, international institutions and organisations.
- The Mauritius Research Council was the first sponsor. Other assistance was offered by the Council before, during and after the conference.
- A number of stakeholders joined in the organisation and/or funding of the conference.
- A lot of work regarding raising of funds and the general organisation of the conference prior to February 2003 and even after, was done on a voluntary basis.
- A second call for papers was made in October 2002.
- Many of the abstracts arrived late due to the unfavourable International situations (Iraq war and SARS disease).
- The venue for the holding of the conference was selected from a number proposals received by the Planning committee. The Grand Baie International Conference Center was chosen because of its proximity to the hotel and the facilities offered.
- The Prime Minister's Office was very helpful in advising us about visa procurement for the participants and other protocol modalities.

- The Ministry of Tourism and Leisure offered free of charge brochures on Mauritius to be distributed to delegates.

The following issues should be placed on record:

- The Secretariat has done a wonderful task in meeting the deadline established by the organisers, despite the various problems that were initially encountered.
- The low participation of overseas delegates can partly be attributed to the SARS disease as well as to the Irak war. Many delegates cancelled their trips. Others decided to attend at the last moment and submitted their abstracts late. The committee did its level best to accommodate the papers which were submitted late so as to satisfy everybody. This inevitably led to changes in the programme.
- For the last three weeks prior to the conference, some members have been working till midnight to complete assigned tasks.
- During the Conference, delegates were given immediate attention whenever help was sought.
- Computer as well as internet facilities were extended to all delegates.
- Photocopying facilities were extended to delegates free of charge.
- 113 participants from 19 countries participated in GASAT 11.

No	Country	Number of Participants
1.	Afghanistan	1
2.	Australia	3
3.	Botswana	1
4.	Brazil	1
5.	Canada	9
6.	China	1
7.	Denmark	4
8.	Germany	1
9.	India	2
10.	Kenya	2
11.	Mauritius	49
12.	New Zealand	1
13.	Nigeria	12
14.	South Africa	7
15.	Sweden	6
16.	Thailand	1
17.	Uganda	1
18.	United Kingdom	9
19.	USA	2
	Total	113

- Girls students from various colleges in Mauritius attended the parallel sessions and had the opportunity to interact with delegates.
- 14 Graduate (Post Graduate Certificate in Education) and trainee (Teachers Certificate Primary) teachers as well as friends of GASAT worked as

volunteers helping the Secretariat. Besides the 113 participants, they too attended a number of sessions.

- Some of the volunteers were from the Society of Biology teachers.
- International sponsorship was limited.
- Sponsorship was made available to some participants from the developing countries, some GASAT members who helped in the organisation of the conference.
- For the Opening ceremony, the Planning Committee invited the Prime Minister, the Deputy Prime Minister, the Minister of Education and Scientific Research, the Minister of Women's Right and Child Development, other Ministers the Leader of the Opposition, Members of Parliament and other distinguished guests.

## **GASAT II International Conference Recommendations**

The participants unanimously decided that there should be two sets of recommendations; one for Mauritius and one for GASAT Association. The former is a unique event in GASAT.

The recommendations were proposed in line with the sub-themes.

### **1. New Initiatives in Science, Technology, Mathematics Education at Formal level.**

- (a) To promote within the education system the access of girls and women to scientific and technological education at all levels.
- (b) To support for networking among women in science and technology.
- (c) To support for role model and mentoring schemes.
- (d) An emphasis be placed on promoting role models and mentors for women in science and technology – in school, in post-secondary education, in the workforce, and among high-tech business owners and executives.
- (e) Mathematics, technology and science programs should be designed to accommodate the learning styles of girls and young women and to make these subjects more relevant to their lives.
- (f) Need for data that reflects the global situation collected under sub-headings that are inclusive and that represent a diversity of approaches to the field.
- (g) Incorporation into the curriculum of education systems, STEM topics in a way that encourages critical and creative scientific and technical literacy of all citizens, in particular women, because most citizens will be users of science and technology rather than producers.
- (h) Information and Communication Technology (ICT) skills development be integrated into science teacher training programmes to enable science teachers to make full advantage of ICT in science teaching.
- (i) To improve women's participation in ICT, further research must be conducted to develop teaching strategies which are based on task decomposition of capabilities offered by new technologies.
- (j) Further research be conducted on integrating indigenous science into formal science curriculum to increase students interest, participation and motivation in science and for sustainable development.
- (k) To improve scientific and technological literacy and participation of boys and girls in science and technology, curriculum must be contextual, gender inclusive and related to the daily lives of learners and societal needs.
- (l) Further research is needed to integrate social, and cultural theories of learning into gender and learning in science and technology education to create opportunities for women's empowerment and gender justice in society.
- (m) A reconstructionist and pragmatic critique of the Science Action Plan should be undertaken so that the gender gaps be addressed and appropriate action be undertaken.
- (n) The different task force and monitoring groups that have been set up as referred by Dr Suddhoo in his presentation at the GASAT 11 Conference should be equipped with gender analysis skills and tools so that the monitoring can be done with greater focus on gender issues.

- (o) An inventory of all scientific equipment that are developed using locally available materials should be made in primary schools.
- (p) An inventory of studies and research carried out on gender, science and technology in Mauritius should be made so that the findings can be pulled out and used to feed into policy making.
- (q) Gender research methodologies should form a central component of all social research methods course dealing with curriculum and Teacher Education.
- (r) More work needs to be done on how to make the curriculum become more gender sensitive, responsive and relevant to the changing needs of the society.
- (s) Publication of scholarly work in the field of gender, science and technology should be encouraged and the findings be vulgarized so that people's consciousness may become more gender sensitive. This would help to make our world a more just and equitable society.

## **2. Meeting the challenges of the New Technologies**

- (a) A review of socio-cultural and pedagogical strategies and practices in computing be made.
- (b) A review of policies, practices and training opportunities available in the formal and informal sectors of economy to train women in ICT such that they have equal access to and opportunities for career advancement in the multiple roles in the technical, marketing and business areas of ICT.
- (c) Synergies and collaboration should be developed between researchers and the different forms of media so that dissemination of information takes place.

## **3. Women, Science, Technology and the workforces**

- (a) To improve conditions for recruitment, retention and advancement in all fields of research.
- (b) To undertake research, supported by the collection and analysis of gender-disaggregated data, documenting constraints and progress in expanding the role of women in science and technology
- (c) To allow transparent and fair selection and recruitment practices
- (d) To provide fellowship and training support for women returning to the workforce after a career break
- (e) To enable change strategies be implemented so that women's way of knowing can contribute to the development of technological tools
- (f) While introducing new technologies, the peculiar needs of women should be assessed and incorporated into decision making and provisions made for providing specific training.
- (g) A review of gendered structures of science engineering and technological Institutions be made and appropriate institutional change strategies and pedagogical shift be developed to improve the participation and career advancement retention, of female into such institutions.
- (h) Human resource development policies in science and technology must identify any gender discriminatory policies and practices to ensure that

there are no gender stereotyping that there are equal opportunities at all levels.

- (i) To integrate women scientists and technologists back into work force in post-conflict societies, special refresher courses must be organized to update their skills and qualifications so that they could compete on equal terms with their male colleagues.
- (j) A greater amount of advocacy work should be done for the advancement of science and technology in general but more specifically for girls and women since they continue to be the most marginalized and discriminated on the labour market.
- (k) An inventory of studies and research carried out on gender, science and technology should be made so that the findings can be pulled out and used to feed into policy making.

#### **4. Gender, the Environment and Sustainable Development**

- (a) To undertake research, supported by the collection and analysis of gender-disaggregated data, documenting constraints and progress in expanding the role of women in science and technology
- (b) Further research be conducted on integrating indigeneous science into formal science curriculum to increase students interest, participation and motivation in science and for sustainable development.
- (c) Non-formal science and technology education programmes be developed for rural and urban poor women empowering them to contribute to development and quality of their lives.
- (d) Gender sensitive educational budgets especially as regards the science and technology sector should become a priority but for this to happen, all stakeholders working on budgets should be equipped with relevant tools, skills and knowledge.
- (e) Bridging the gap between policy makers and researchers is urgent if our society is to be transformed into a more gender equitable one.

## **Recommendations for Mauritius**

GASAT 11 participants appreciate the contribution of the Mauritian government including the Mauritius Institute of Education, the Mauritius Research Council and other local agencies and authorities to the success of the GASAT 11 Conference.

GASAT 11 recommends all considerations of Science and Technology, their development, use in education, should be based on principles of social responsibility in the context of environmental and social sustainability. This is specially urgent in the context of globalisation and continuing industrialisation.

Participants from around the world attending the GASAT 11 Conference wish to support the following recommendations relating to Genders and Science and Technology in Mauritius.

- A gender sensitive critique of the Science Action Plan should be undertaken so that gender gaps may be identified and appropriate action be undertaken to address these.
- Task forces and monitoring groups should be equipped with gender analysis skills and tools to identify and address gender issues. These should include gender-disaggregated statistics of participation and outcomes.
- The preparation of educational budgets, especially those relating to Science and Technology (including ICT) should be informed by gender sensitive knowledge, skills and tools.
- Science, technology and ICT should be compulsory for all to the age of 16.
- Greater advocacy for the advancement of Science and Technology, including the representation of women in these fields, is called for since women are the most marginalized and discriminated against groups in the labour market.
- The government should take responsibility for the Public Understanding of Science, working through agencies such as, parent-teacher groups, careers guidance officers and all aspects of media.

## **Research and Publication**

- The pursuit of and publication of scholarly work in the field of gender, science and technology should be encouraged. Gender sensitive research methodology should form a central component of all social research methods courses at the Mauritius Institute of Education, the University and in other tertiary institutions.
- Bridging the gap between policy makers and researchers is essential if use is to be made of the outcomes of research.

## **Curriculum**

- More work needs to be done on how to make the school curriculum become more gender sensitive, responsive to the needs of girls as well as boys, and relevant to the changing needs of Mauritian society.

- To improve scientific and technological literacy and participation of boys and girls in science and technology, curriculum must be contextual, gender inclusive and related to societal needs and the daily lives of learners.
- Further research should be conducted on integrating indigenous science into formal science curricula to increase students' interest in science for sustainable development, participation and motivation.

## **EVALUATION OF THE CONFERENCE**

### **(Susan Smandych, Canada, Anita Ramdinny, Mauritius) Summary of GASAT 11 Evaluations**

#### **Introduction**

The evaluation exercise for the GASAT 11 Conference was initiated by the home group facilitators from previous conferences. During a brainstorming session, the process for the collection of feedback, and the type of questions to be formulated for the questionnaire which was to be administered to the participants on the conference was discussed. (see Home Group Session summary for details of process – Annex 2) The questionnaire was finalised, and distributed to the participants the day prior to the closing of the conference. The local Secretariat provided support to prepare, distribute and compile the evaluation forms.

The questionnaires were distributed among the 113 delegates present at the conference, and 55 responses were received. There were 11 responses from Mauritius, out of 49 delegates, and 44 responses, out of 69 International delegates. The majority of evaluation forms were collected via home group sessions.

The findings of the evaluation, based on the data collected, are presented as follows:

#### **Section A: General Findings on the Conference**

#### **Section B: Specific Findings and Comments**

##### ***Section A: General Findings***

The majority of the participants were very positive in their appreciation of the conference, and expressed their satisfaction with the content of the program, and with the organisation and administration of the conference (78% and 82 % respectively) The feedback on the quality of content of presentations was seen to be satisfactory, and was rated on average as 4 out of 5. Similarly, it was found that the quality of discussion at presentations to be satisfactory and was rated on average as 4 out of 5. Some of the general comments included the following:

- *Many ideas from the conference can be integrated into people's work.*
- *The quality of presentations was very good, but discussion at presentations was frustrating due to time limitations*
- *The conference came out with excellent suggestions for future conferences.*

However, some concerns were also expressed by the participants. They felt that:

1. *not enough time was allowed for discussion and informal networking*

2. *the papers were too “scientific” with respect to content (more description of research than of outcomes/implementation of results) as well as the style of presentation (more lecture than discussion)*
3. *there were too many sub-topics., and not focussed enough*

**A summary of the main recommendations for Future GASAT Conferences included the following suggestions:**

1. *Continue to use the Home Group process to distribute and collect evaluation forms*
2. *Modify program to allow more time for informal networking and discussion*
3. *Need for broader advertising of conference & need for more frequent updates to website*
4. *Focus topic/sub-topics of conference so that outcomes are more specific. Implement suggestions offered by participants.*

**Section B: Specific Findings**

**1. Attendance to GASAT CONFERENCE**

The responses show that 38% of the participants had previously attended a GASAT Conference, whereas for 62% of the participants, GASAT 11 was their first experience.

The response reveals that 96% express their wish to attend another GASAT Conference, and some of the reasons they gave included the following:

- *“Yes, if appropriate arrangements are made and host country is accessible”*
- *“Yes, this is the start of a long journey in terms of treatment of gender/issues. I would like to know more about the happenings in the future.”*
- *“Yes, it was very helpful for my personal development and growth in my career. It has also helped me to see things around me in a very different way and I have been frankly stimulated to do things for me and the people around me. ”*
- *“Yes, GASAT is my favourite conference. I get to think with colleagues & make friends.”*

**2. Knowledge about GASAT**

The participants came to know about GASAT through the following means:

- ❖ Most people heard about the conference from their colleagues/network
- ❖ Some via direct invitations
- ❖ Some via call for papers
- ❖ via general search on internet

The data also show that 71% of the participants had visited the GASAT website.

**3. Reasons for Attending the Conference**

The reasons given by the participants for attending the conference were mainly the following:

- *To present paper*
- *For networking*
- *To learn about culture of Mauritius*
- *To see friends. To exchange ideas. To help GASAT.”*
- *“The aims are in line with my vision of women in the world, promoting her status and empowering her.”*
- *“To present my paper, to gain an international perspective to my research, to meet new people and network”*

#### **4. Satisfaction with Program and Administrative Support**

On the whole, the data obtained reveal that the participants were satisfied with the program and with the administrative support provided (78% and 82% respectively) Some of their typical responses included the following:

- *“Yes, however, I would prefer critical paper presentation instead of just literature and statement of results.”*
- *“Yes, but wished more information about empirical projects in abstracts in advance”*
- *“The program was good, perhaps needs to be more focussed, less broad in content so that outcomes are more specific.”*
- *“Yes - there was not time to breathe really with all the intensive interactions for parallel presentations, home groups, and regional groups.”*
- *“Yes - but there could have been more emphasis on the paradigm shift.”*
- *“Yes – but would have liked more opportunity for discussion within sessions and for group discussion. Would like to see GASAT use a different format from that of typical scientific conferences. Much more interactive.”*
- *“Yes - except for the fact that that my employer and even myself believed that having been invited to present my paper, the Association should assist in terms of air fares”*
- *“The program has been well organised and the quality of material & papers presented are commendable.”*
- *“Yes - but it would have been useful to have had the abstract put in alphabetical order.”*
- *“I am satisfied with the administration and facilities but not satisfied with the non provision of financial support to members especially those from the developing countries.”*
- *“Many people have been doing a dedicated and continuous work. I do appreciate all those efforts! Very nice hotel, excellent accommodations and conference centre.”*
- *“Yes - especially when I confirmed late, adjustments by Dr Ramma was swift.”*
- *“The secretariat was most efficient and helpful. Photocopies, newsletters and all achieved under crowded conditions. The facilities are very luxurious and well-equipped. The cost of the hotel may have discouraged some.”*

#### **5. Some Stimulating Ideas Emerging from the Conference**

- *The idea on Social Capital was very innovative and enriching.”*

- *“Municipal Technology Centres ‘Kits’ for introducing gender equity policies into tertiary institutions.”*
- *“All the keynote addresses were very informative. The home group sessions and regional meetings gave participants good opportunity to interact with one another.”*
- *“Education for sustainable development Dr Lotz Sisitka. No need to “fix” women; need to “fix” system. Dr Lane. Media influence on gender Dr Siqueira (Brazil).”*
- *“Gill Kirkup’s about communities of practice, Mary Anderson’s about WISE investments. Ann Holmes Keynote about yelling, strategy and other.”*
- *“Meeting Najila from Afghanistan.*
- *“The need for economic paradigm shift as a required aspect of social change to promote man in SET. A reiteration of the value of socially responsible science between social justice and science.”*
- *“Knowing that even in developed countries gender is still an issue where there is lots to be done. Having women in all sectors but still under represented. Ideas about building social capital and communities of practice.”*

#### **6. Some Suggestions for the Integration of Stimulating Ideas**

- *“Yes - in educational practice, it is possible to integrate these ideas. Concerning research - possible GASAT members need to collaborate.”*
- *“Yes - the inspiration from the theoretical ideas will be integrated into my own PhD study - and the good practices will be suggested to my colleagues.”*
- *“I will definitely use the concept of wealth alleviation in future talks and papers.”*
- *“Yes - our work parallels much other work in other countries and we can use ideas from the Athena project in Britain and from the Hypatia project in Canada.”*
- *“Yes some of them. But the most important thing is that I feel strengthened”*
- *“Yes - information obtained from the keynote addresses will be given to my students and other interested persons. Materials and papers presented at the conference will be given to my colleagues and students. Observations about the organisation will also be implemented in my country when the need arises.”*
- *“Yes, the ideas are interesting but (a) the strategies and action plans and implementation plans have not been presented (b) it would be more interesting if speakers could give experience of implementing the ideas/projects in their country.”*

#### **7. Highlights of the Conference**

When the participants were asked to describe some highlights of the conference, the following responses were obtained. “Meeting of professionals all around the world whether they are from Africa, Canada, etc. The dissipation of the invisible but yet remarkable barrier that exists between men & women.”

- “Keynote by Ann Holmes - a beautiful and informed talk about science. Heila Lotz Sisitka presentation regarding hands on education combining social context and science”
- “Meeting like minded women from all parts of the world. The warmth of welcome and interaction was greatly appreciated”
- “My first international conference has been a success and so much of evidence of gender bias was presented as previously it was only from hear-say.”

### **8. Comments/Suggestions for Future GASAT?**

- *“More students should be encouraged to do research and make presentations, specifically age 24-30. This is the future generation of policy makers. I think they would have a lot of impact. More male participants are needed. Women cannot implement these alone.”*
- *“It is to be noted that both girl and boy secondary students should be invited, since gender equality is a matter of concern for all of society, not only women.”*
- *“Shorten the first day (Monday). Many are still very tired from travelling (we were in session from 10 am to 8 pm). Save the conference dinner until after sessions!”*
- *“Some advice (prior to the conference) about presentation skills and use of overhead transparencies.”*
- *“A restructuring of the program is needed to allow more time for discussion and interaction. This can be done with some creative thinking and design.”*
- *“More promoting before the conference too widen the circle. Better time keeping in sessions, including stricter rules for presenters. Possibilities to show videos.”*
- *“(Invite) some more people like me and my colleague working in governmental agencies ...and to make it possible for more delegates from developing countries to come, next GASAT should be held in a less fancy hotel/place. Maybe at a university.”*
- *“I believe GASAT should 1: publish and market their message globally;  
2: encourage international collaboration (across counties) to secure funding/grants; 3: engage key champions from industry for co-sponsorship, marketing and opportunities to implement some of the theories presented at the conference ”*
  - *“Reflect on the role of home groups. The overall Bias is still towards ‘Western/Northern’ culture.”*
  - *“Like to have participants read at least those papers within a specific stream, before coming to the conference, then spend time discussing them in a group setting with the authors. A summary of initiatives conditions by region would be interesting and helpful.”*
  - *“More space in the program for networking and discussions. Strict on short presentation and long question/discussion period, put excursion in the middle of the program schedule, put home groups in the middle of the day.”*

### ***Conclusion***

The data obtained from the evaluation, as seen above, reveal that the majority of the participants (more than 70% in all cases), were satisfied with most aspects of the conference. – program, administrative and support facilities, level and quality of presentation, accommodation, and food. The comments made by the participants on the different features of the conference is very revealing, and show that the conference was indeed successful in attaining its objectives. It must be pointed out also that some very pertinent suggestions, as shown above, have been made by the participants to improve future GASAT conferences.

**Monday 06 July 2003**

OPENING CEREMONY

Master of Ceremony - Ann Holmes, Canada

▪ **Speech by Mona Dahms, GASAT Chair**

The Right Honourable Prime Minister, Sir Anerood Jugnauth  
Members of the Diplomatic Corps  
Lady Sarojni Jugnauth, Patron of GASAT Conference  
Jaya Naugah, GASAT 11 Convenor  
Ladies and Gentlemen:

Dear friends old as well as new

I cannot truly express how happy I am to be back in Mauritius. I was here many years ago, when I was working in Tanzania and ever since the decision was taken in the GASAT 10 conference at Copenhagen 2 years ago to host the GASAT 11 conference here in Mauritius, I have been looking forward to going back to this beautiful island a truly multicultural multiethnic haven of peace and hospitality as I remember it and so I am sure I did not remember wrong. So therefore, on behalf of the GASAT Association and on my own behalf I want to express my sincere gratitude and gratefulness to everybody here in Mauritius who worked so hard to make this international GASAT 11 conference possible. I know from experience when we were planning the GASAT 10 conference that planning an international conference requires an awful lot of hard and dedicated work from an awful lot of persons of different skills. So there are far too many people involved in the planning of the conference for me to name them all but there are a few persons who stand out and who should be named. First of all, Lady Sarojni Jugnauth, I would like to give you a special thank you very very much. I have about your commitment, your dedicated and strong support which I know is absolutely invaluable to this conference and without which there might not even have been a conference. So thank you very very much Lady for having made it possible for me to come to Mauritius. Also I would like to thank the conference convenor, Mrs Jayantee Naugah, whom I know from the GASAT 7 conference in Canada in 1993. So we have been together on a number of occasions and I know Jaya has been working very very hard to make this conference happen. So thank you very very much to you Jaya. Also Mr Yashwant Ramma, the conference Secretary who came to Copenhagen in the last conference together with Jaya to convince the GASAT board that GASAT 11 should be hosted in Mauritius and I am very happy that he succeeded in convincing us not that it was very hard because it was a very strong and dedicated proposal that he came up with. But I am very happy that we are here now and I know that an awful lot of work has been done by Yashwant. So thank you very much to you Yashwant. The last person that I want to mention by name is the person whom I have just recently come to know Mr Pritam Parmessur he is in charge of the academic program of the GASAT 11 conference. So when by the end of the conference, we all go back home inspired by challenging intellectual discussions and exchange of experiences as we used to do in the GASAT conferences, I think we owe a great debt to Mr Pritam Parmesur for his planning of this academic program. So thank you very much to you Pritam.

So the framework is in place now. The planning committee has secured us as GASAT conference delegates a proper framework for our discussions, exchange of experiences etc. So it is now up to us as conference delegates to try to take further the objectives of the GASAT Association. Now I have to divert from the manuscript because Mr Bissoondoyal said something that I would like to comment on. You mentioned about responsible use of science and technology and to me this is the most important objective of the GASAT Association and it has been my driving force for being in that association for so many years. My first GASAT conference was in 1985 in London where Jan Harding was the chair person. Ever since then my driving force has been this objective of socially responsible science and technology also environmentally sustainable science and technology. Because I think as we see science and technology being used today there is a great need for a change in the way we use our scientific and technological knowledge. We need to use it in away that will benefit humankind throughout the world. We need to use it in a way to ensure that poor nations will benefit from the world's natural resources that poor nations are given a chance to develop and improve the standard of living of their population and I have a strong belief much as unfortunately I cannot prove this by statistics that with more woman scientists, more women technologists and more woman engineers, we may eventually achieve a better world for all us and that is the reason why I am here in GASAT and I have been here for many years and still remain there. With these last words, I would like as the former GASAT 10 conference convenor to hand over the GASAT chair to Mrs Jayantee Naugah whom I am confident is very capable to take on this task and I wish all of us some very inspired and very wonderful days to experience, full of joy and laughter and full of intellectual challenges and academic discussions.

## ■ Speech by Jayantee Naugah, GASAT 11 Convenor

The Right Honourable Prime Minister, Sir Anerood Jugnauth  
Honourable Ministers  
The Chairman of District Council of the North – Mr S Ellayah  
Members of the Diplomatic Corps  
Lady Sarojni Jugnauth, Patron of GASAT Conference  
Prof Mona Dahms, GASAT Chair  
Mr Suren Bissoondoyal – Chairman MIE Council  
Prof Seewant Bhoojedhur – Chairman Mauritius Research Council  
Distinguished Participants and Guests  
Ladies and Gentlemen

It gives me great pleasure as Convenor of GASAT 11 to have brought to our small country this big gathering of men and women scientists, technologists, academics and educational administrators from all over the world so as to put our minds together and come up with strategies for improving gender equality through discussions and sharing of experiences in the field of science and technology education. Science and technology has a vital role to play in the development of humankind and we cannot ignore the contribution of the 50% of our women in the workforce in the overall national development of our country. For quite a long time, women have been given a backseat in the field of science and technology but gradually women are being increasingly recognized and respected for the quality of their work. This gathering of gender sensitive men and women in science and technology will give us the chance to highlight our achievements and say loudly “we are here, don’t forget that”. Women like Marie Curie and space astronaut Kalpana Chawla have shown that women are capable of the highest level of achievements because of their commitments to progress. Now we are claiming all the chances that we deserve and rightly so.

It is indeed a great honour for Mauritius to organise this International Conference. I thank the GASAT Board and the GASAT general meeting for having placed their trust in us through a due process of voting when we brought the proposal before them in Copenhagen in 2001.

Right Honourable Prime Minister and, the Patron of the conference, Lady Sarojni Jugnauth, I would like to say a big thank you for all the support you have given me and the members of the GASAT Planning Committee for allowing us to fulfil our tasks and duties. Lady Sarojni Jugnauth, I have got a special word for you and you remind me of the anonymous poem “Footprints on the sand”. “You carried me and the planning committee on your shoulders when we most needed you.” That has left an indelible mark in our hearts and those of my closest and dependable colleagues especially our Academic chair, Mr Pritam Parmessur and Mona Dahms, the Chair of GASAT. This conference would not have taken place had it not been for your absolute sense of determination and positive mind-set. You inspired with the fine feeling of sobriety and humbleness of mind and motivated us to continue our mission without fear or favour.

This gives me added pleasure to see the presence of so many important personalities here. The Mauritius Research Council under the chairmanship of

Prof Bhoojedhur and Directorship of Dr Arjoon Suddhoo; Director of the Tertiary Education Commission, Dr Lutcheemeah, Chairman of MIE council, Mr Suren Bissoondoyal, Dr Ved Goel from the Commonwealth Secretariat, Prof Massaquoi of UNESCO Nairobi, who is representing, Mr Parsuramen, Director of UNESCO, the Ag Director, Directorate and all my colleagues of MIE. All these wonderful personalities have provided valuable contributions in ensuring the success of our GASAT conference.

Increased focus on formal and informal education new technologies, empowerment of women, gender and sustainable development will undoubtedly bring the developing world closer to the developed world and reduce the huge economic gap. Science and technology education when they are within the reach of all girls and women will serve definitely as powerful fields of study that will drive the economy more sustainable. To achieve this, it will be necessary to focus on policies and practical implementation strategies so that our academicians, policy makers and practitioners are fully equipped to support and initiate plans of actions in any appropriate context.

The issue of gender equality equally important in both developing and developed. The momentum to the work on gender equality in science, technology and mathematics education in Mauritius started with a workshop which the commonwealth secretarial organised some seven years ago. Since then, we have made considerable progress but more has to be done not only at the education front but at the workforce level also. We look forward to the proceedings of this conference to draw practical strategies for improving gender equality.

I am happy to see here so many familiar faces that I have met several times during the last years that I have been a GASAT member, your curiosity for our country and your eagerness to share your expertise have made you come all the way to this little place and work out something big that will benefit us all.

## ■ Speech by Lady Sarojni Jugnauth, Patron GASAT 11

The Right Honourable Prime Minister, Sir Anerood Jugnauth  
Honourable Ministers  
Chairman of District Council of the North – Mr S Ellayah  
Members of the Diplomatic Corps  
Mrs Jayantee Naugah, Convenor of the GASAT Conference  
Prof Mona Dahms, GASAT Chair  
Mr Suren Bissoondoyal – Chairman of MIE Council  
Prof S Bhoojedhur – Chairman Mauritius Research Council  
Distinguished Participants and Guests  
Ladies and Gentleman

On behalf of our Planning Committee, and on my own behalf, I have the immense pleasure to welcome you all to the 11th International Conference of GASAT, which is being held for the first time in Mauritius.

I would also like to extend a very special and warm welcome to all the scientists, technologists, researchers and academics from the various tertiary bodies and International Organisations who are present here to participate actively in all the scheduled parallel sessions and in the round table symposia.

Allow me first, to share with you my pleasure to be invited to be the Patron of the GASAT 11 Conference.

When the invitation was made, I accepted it wholeheartedly because I have always campaigned for gender equity during my whole professional career. Moreover because of my close contact with people from all walks of life, I may offer some grassroots insights on **the march of women towards equality**.

I was brought up in a family where I have learnt from women elders about the true value of education for progress and emancipation. Within the family structure, the commitment to education was such that, when there was no school in my village, my family decided to put a plot of land for the building of a government primary school which, my father, late S Balla, had actually constructed with his own means. In the past recent years, my family also donated a pre-primary school which is still functioning in the village of Rivière du Poste. It is a pre-primary school, which is open to **both girls and boys**.

My commitment to education and the educative process was fully reinforced in terms of my futuristic aspirations when I embraced a teaching career in education. There is no doubt, in my mind, that education has been most instrumental in the fast and increasing development of this country since independence. At the same time, there have been great strides towards gender equity and better opportunities for overall self-development. At the primary and secondary school level, girls' education has attained unprecedented equality of educational opportunities.

Over the last few decades, there have been considerable achievements registered in Mauritius in the area of gender equality. The utilitarian approaches were adopted in the last two decades, in the development of our society. These approaches have created very wide ranging and much better opportunities for women in various

industrial, financial, public and service sectors of our national economy. Women have increasingly penetrated all the professions; our laws have been harmonised and modernised based on democratic principles and on the overall purposes of human rights. In short, women have entered all the professions and positions in our society.

Having achieved so much, we cannot afford not to devise new strategies and innovative practices in order to ensure greater distributive justice and equity as stated in the main theme of this conference. I should point out here that, as much as I am committed to gender equality, I also believe on the notion of meritocracy and I shall always be supportive of the very fair notion 'right people should occupy the right place'. Given the nature and trend of the global economies and world markets, I believe in a fair and equitable balance between women and men especially when our country has to rely almost exclusively on its human resources. Here, we do not have any deposits of diamond and gold or reserves of fossil fuel. We have no choice but to rely on the potential and strength of our workforce. And, this is why I do believe that this conference is quite appropriate and useful to us since we would all like to learn from you and, of course also share our work experiences together and thus expand our capacity building internationally.

With my experience about women in the labour market, here and elsewhere, I have plausible reason to **re-assert my belief in the need for adapting the social reconstructionist strategy to empower our women so that society, at large, can benefit from a much improved standard of living.** We need to rethink our economic model of development when there are **radical incrementalism in global market competitions**, increased level of job- degradation, greater demands for polyvalent and trained workers and more technologically literate labour force. I fully subscribe to all the four sub-themes of the conference on Gender, and Science and Technology. Through science and technology, we should be able develop strategies for greater access to education, better secured job opportunities, improved quality and standard of family life.

As you may be aware, since the 4th World Conference in Beijing in 1995, new visions and strategies of development were formulated. There have been attempts since to **explore the connections between financial criteria and the growing social crisis.** The approach of human development does not just mean to facilitate women's role and participation in the production economy, but instead the productive economy must be transformed so that due recognition is given to family and community responsibilities.

I am happy that eminent academics and researchers, mostly from the fields of science and technology, who will be participating in the conference sessions, will examine succinctly all the sub-themes of the conference and provide us with their expert knowledge, insights and findings. What we are striving in a small island state like ours, is human development where there is not only maximum efficiency but also fair equity and justice so that the road to the utilitarian vision towards the achievement of maximum happiness may be reached by each and every worker of our society in their respective jobs or positions. I am sure that your deliberations will contribute to helping us for the happier future for all our workers both nationally and international. I look forward to hearing your recommendations.

Before ending, may I thank all staff who has work collaboratively with the GASAT planning committee, the volunteers who will be providing valuable support to the secretariat.

As Patron I wish to place on record the institutional support of the Mauritius Research Council, the Tertiary Education Commission, the Mauritius Institute of Education for its logistic and administrative support, to the Ministry of Education and Scientific Research, the Ministry of Women's Rights, Child Development and Family Welfare and to all our dependable sponsors.

Last, but not the least, I am deeply grateful to Mr S Bissoondyal, Chairman of the MIE Council, to the Ag Director and all her Academic, Administrative and support staff, to Mrs J Naugah, the new Chairperson of GASAT, Mr Pritam Parmessur, the Academic Chair, Dr Y Ramma, Secretary of our planning committee, all of whom have shown a most exemplary commitment to make this conference meaningful and enjoyable

Thank you and May God bless ALL.

**■ Speech by Hon. Navarre-Marie, Minister of Women's Right, Child Development and Family Welfare**

The Right Honourable Prime Minister  
Lady Sarojni Jugnauth, Patron of GASAT 11  
Members of diplomatic corps,  
My colleagues of the National Assembly  
The Chairman of the district council North  
Professor Dahms, GASAT chairperson  
Mr Bissondoyal, chairman MIE  
Mrs Naugah GASAT Convenor  
Distinguished guests, ladies and gentlemen

I am honoured to be present on this auspicious occasion for the opening ceremony of the GASAT 11 conference.

It is indeed a matter of pride for Mauritius to host this international conference and to share experiences with participating countries. This conference will, of course, give all of us the opportunity to have a critical appreciation of our achievements and lessons learnt to date in our efforts aimed at eliminating gender discrimination in our different societies particularly in the fields of science and technology.

Gender issues have always remained high on the agenda of the Mauritian Government. We have, on numerous occasions, reiterated our commitment towards the promotion of gender equality and elimination of all forms of discrimination against women. In fact, Mauritius was among the first countries to have ratified and signed the Convention on the Elimination of all Forms of Discrimination against women in 1984 and 1985 respectively. Mauritius also signed a SADC declaration on gender and development, and the Addendum to the Declaration on Gender and Development and the prevention and elimination of violence against women and children.

I may wish to point out that at the level of the Ministry of women rights and child development and family welfare, we have initiated a series of action for gender mainstreaming in all government policies and programmes. Let me highlight a few of them:

A Task Force was set in 2000 to look into all laws that are discriminatory towards women. The Task Force submitted its report in October 2001 following which actions have been initiated for the amendment of such laws several of which fall under the purview of different ministries. We are in the process of formulating a National Gender Policy, in that respect, we will be having the services of a consultant shortly from the commonwealth secretariat.

An action plan for Gender Responsive Budgeting is being finalized by a High Level Committee set up by government, so as to ensure equitable allocations of resources between men and women.

Officers of my ministry have been trained under different programs funded by the UN agencies on gender and development. The objective of these programmes is enable such officers to acquire skills and knowledge that will enable them to act as trainers at grassroot level.

The Sex Discrimination Act has been enacted in 2002. It aims at eliminating gender discrimination with regards with gender employment, education, accommodation and access to public places.

Appropriate structures have been set up at the level of my ministry to deal with gender issues and in particular on capacity building among women. There is a Women's Unit which serves as a focal point for women issues and which function through a network of Women Centres across the island. One of the main objectives of this unit is to strengthen gender mainstreaming taking into account the reproductive, productive, and social roles of women. It works in collaboration with other government institutions and NGO's and implement the different policies and projects related to women. The National Women Council and the National Women Entrepreneur Council, which function under the aegis of my ministry, operate as executive arms in the implementation of our different policies, programs and projects all geared towards the creation of an enabling environment and enhancing the social economic development of women and enabling them to fulfill the roles as responsible agents of the society.

The theme of GASAT 11 conference is: Gender, Science, Technology and Economic EParadigm Shift, New Challenges for Gender Distributive justice and equity. We are therefore her to talk on gender equity and justice in the field of science and technology which is indeed a very challenging theme in itself.

The contribution of women in the development process of our society cannot be ignored. There is no doubt that their share in the economic and social development of the country has been on the increase. With the progress of Science and Technology, women have a still more important role to play especially with regards to our society which is poised shortly to become a cyber centre in the region. This also applies to other countries in the context of globalisation of world economy.

Education has always remained a high profile in the Mauritian society. More than 13% of the total recurrent government budget is allocated to this sector. Education is free in Mauritius. Boys and girls are equal access to school and colleges. However, there are many factors that influence the choice for boys and girls for science and technology subjects at secondary and tertiary level. Some of them are lack of facilities and equipments in some schools.

There are lesser schools which have facilities for science subjects for girls at HSC level. Specific groups such as housewives, girls who are school drop out or who have not succeeded in the school certificate exams have limited opportunity access to educational and non-educational institutions to acquire further skills and knowledge in Science and Technology. It is therefore necessary to create awareness, develop mastery of learning for science subjects and develop opportunities for access to proper institutions. This is being presently addressed by government in the education reform program.

Employers favour the employment of men in scientific and technological fields. With the progress of in Science and Technology, the women are called upon to participate more and to be in touch with new technologies on the labour market. However, it is observed that some employers in some sectors favour male candidates in jobs related to Science and Technology and which offer very attractive packages and benefits. Women are therefore limited in their choice of employment and take up

minor jobs such as clerks, nurses, typist, teacher and secretaries. This limited job prospect and opportunities discourage girls to take up science subjects. As pointed out earlier, to eliminate this discrimination, my ministry has come up with a Sex Discrimination Act in 2002. An intensive sensitisation campaign is being worked out to sensitise students and employers among others.

Influence of teachers and parents:- Teachers tend to consider that science is more appropriate to boys than girls. Girls on the other hand are influenced by stereotypes which do not promote their interest in science. Lack of guidance from teachers and parents is also another factor.

A concerted and consolidated approach is needed to address these problems and one of the means to create awareness in the population at large. My Ministry has therefore embarked on campaigns to sensitise people at different social levels and positions on gender issues. We are proposing to further strengthen this campaign. As pointed out earlier, officers are being trained at present to act as resource person on the grass root level. Training manuals are being produced for the use by trainers in that respect. Real involvement of women in science and technology starts right at school. It is high time therefore for the gender component to be included in the educational curricula and in training of teachers. This will help in changing their attitudes in the promotion of gender equality. The use of technology by womenfolk is another issue that need to be given due consideration when we are talking of economic empowerment of women. Ladies and gentlemen, be it the scientific or any other fields women need to be empowered and given access to new technologies, they must be encouraged to take advantage of the various schemes put in place so that they can set up their own businesses or upgrade their existing businesses. It is an essential tool for everyone nowadays. Internet and other technological developments such as fax and electronic mail have become prerequisites in any business today as we are living in the e-age, e-commerce, e-business and e-communication. We are connected to every part of the world. The amount of information and data through the internet is beyond our understanding as lady folk. However, it is known that access to the internet is not free from dangers. Women and children who were not properly sensitized can become easy preys of unscrupulous person who can do harm or lure the person on the other end. We as a responsible government are conscious of these dangers. We are therefore coming very soon, actually today itself, with a comprehensive program including the enactment of the appropriate legislation to address this problem. The developments of new technologies are formidable vehicles for sustainable development as they facilitate the creation of new employment leading to economic growth. The dangers associated to computer and IT should in no way act as a barrier to economy and advancement. My ministry is working on computer courses for women and girls in our women centres, thus enabling them to have a better understanding of IT. To conclude I would like to say that this conference has come at the right moment, when the country is experiencing development and progress in the technological field. It will definitely help to trigger interest among our womenfolk in understanding their role in this process of development. I wish all participants a fruitful interaction and successful deliberations. I thank you.

■ **Speech by The Right Honourable Sir Anerood Jugnauth**

Prime Minister

On the occasion of the Opening Ceremony of Gender and Science and Technology International Conference (GASAT)

At Grand Baie International conference Centre

On Monday 07 July 2003 at 10 00 hours

Hon. Ministers

Mrs Mona Dahms, Chairperson of GASAT Board

The Patron of GASAT 11

Excellencies, Members of the Diplomatic Corps

Hon. Members of the National Assembly

Distinguished Delegates

Distinguished Guests

Ladies and Gentlemen

It is indeed with great pleasure that I am in your midst this morning for the Opening Ceremony of the 11th International Conference of the Gender and Science and Technology Association (GASAT).

Allow me to extend a warm welcome to all foreign delegates and I wish you will spare some time to visit our island in spite of an agenda which will keep you busy during the five coming days.

The theme of the Conference “Gender and Science and Technology and Economic Paradigm Shifts; New Challenges for Gender - distributive Justice and Equity”, is of paramount importance and of equal relevance to many countries of the world and of Mauritius in particular.

As you are aware, Mauritius has made giant strides in its economic development since its accession to Independence in 1968. Over 35 years, womenfolk have constantly contributed their share in the economic progress of our country.

It is therefore no surprise that they are to be found in all spheres of activity, be it in the public or private sectors. From traditional social areas like education and health, they have moved in such fields as Law, Finance, Business, Textiles and ICT with equal success.

In 1983, we created a Ministry of Women’s Rights, Child Development and Family Welfare always headed by a Lady Minister. In fact this Ministry has over the past twenty years inspired Government in implementing the right policies geared towards the emancipation, empowerment and welfare of women in Mauritius.

Positive effects have also been registered in the welfare of children and of families in general over the years.

Dear Delegates

True it is that in many countries Gender equality does not seem to have made much progress. You will be pleased to learn that there is no such discrimination in Mauritius. In fact girls do consistently better than boys at school and University, and

salaries are the same for both men and women, unlike what it was up to only recently even in some more developed countries.

However, we want to improve the lot of women further. Gender equality must not remain an empty slogan. As charity always begins at home, in the public sector more and more women cadres have been appointed Permanent Secretaries, the same is true for the post of Principal Assistant Secretaries.

In the past, I have personally made an appeal to the Private Sector so that more and more women could find their way to the boardroom.

Now that Mauritius is rapidly diversifying its economic base, the service sector is fastly gaining ground. On our part, we are sparing no effort to develop our human resources in a big way. ICT will help us provide more white collars jobs to our young people, girls and boys alike.

Now coming to the theme of the Conference, certain studies conducted recently have indicated that there is no strong gender imbalance at the early stages of education here in Mauritius.

However, less and less students at the tertiary level and young women in particular do shift for other streams than Science and Technology.

We have to correct such imbalances and we have introduced several new initiatives likely to equip the child with basic knowledge and skills so that he or she finds his or her way in a world driven by science and technology.

This is why science is being taught right at the Primary level. This is why also information Technology will find its way in both primary and secondary level curriculum. IT and science laboratories will have to be provided to educational institutions because there is no other alternative to practical knowledge.

Dear Delegates

We in Mauritius have no minerals or oil or any other resources except our human resources to see us through to the next stage of our development.

Our progress will depend to a large extent on how we use science, technology and modern management to overcome such hurdles which stand in our way.

I firmly believe that it is not by sheer luck that we have been able to register such a level of socio-economic development. Education has and will always be high on our agenda. Gender equality will be one of the key factors in our strategy towards sustaining economic development and social progress in Mauritius.

Before ending, may I wish you all fruitful deliberations, to those who have travelled from distant lands. I would invite you to spend some time to discover for yourselves how religious and cultural differences can also be a factor of human progress and social upliftment in Mauritius.

I thank you for your attention.

**The Prime Minister proceeded with the opening ceremony of the 11th GASAT Conference.**

Monday 07 July 2003 [1145 – 1300 hours, Chairperson Mrs J Naugah, Chairperson GASAT 11]  
KEYNOTE ADDRESS

**Dr Nancy Lane, Department of Zoology, Cambridge University, UK**

[njl1@cam.ac.uk](mailto:njl1@cam.ac.uk)

**Should nations be concerned about their women scientists? The UK's efforts to recruit, retain and promote the undervalued half of their workforce.**

Why should UK universities bother to set up a special initiative for women in science, as they did in 1999 with the Athene Project? And why did the UK Secretary of State call for yet another set of recommendations for women in science, engineering and technology (SET) in 2002? Is there truly a 'glass ceiling' here against which women's heads constantly collide? Is there no 'level playing field' with the men, particularly for females who are scientists or engineers? Does the 'old boy network' conspire to keep women out of top positions and senior appointments except in very rare instances? Are there not equal opportunities for all in our scientific laboratories? Or are women simply inveterate complainers, who rail against a system which they have no real inclination to join, given the inordinate commitment, constant pressures, long hours and resultant stress that attend high office and top-ranking scientific activity? Should we therefore refrain from trying to persuade women to strive for something for which many of them may lack enthusiasm?

Over the last decade, there has been increasing debate over the reasons underlying the dearth of women at all levels in SET. Dearth there clearly is, since over the whole of the UK less than 10% of all Professors in SET subjects are female, with numbers particularly low in Physics, Maths, Engineering and IT; the higher the office is the fewer incumbents there are with two 'X chromosomes' (i.e. females). Battalions of women have argued that this is the result of the male chauvinist culture which exists in scientific laboratories – a system designed by men to suit their own life style, and incompatible with women's lives and their historic domestic responsibilities. But are things changing? Are the flexible 'family-friendly' policies of many employers, with their job sharing, part-time working, flexi-hours, maternity leave and child care schemes, making it easier for women to carry on in the scientific laboratory after child bearing? Is recognition of women's skilful managerial style and co-operational spirit enhancing their value in the lab and work place compared with the combative and absurd wastage of human resources if 50% of the population (the women) are underutilized in SET, (which underpins the national wealth), a sound one? And what about the loss to the economy of the cost of educating and training the women who do go into SET, only to lose them from the laboratory after the birth of their children?

Since 1993, when the UK Cabinet Office published **The Rising Tide**, the publication which emerged from a Working Party I chaired for the then Prime Minister, John Major, a special Unit for women in SET has been in place at the OST (Office of Science and Technology). This operates on the basis that there are lost opportunities both to the national economy and for women if more girls are not encouraged to become scientists or engineers. Subsequently, a group of us were persuaded to set up a Working Party that gathered together data to produce a book of advice for women in SET, entitled **Cracking IT**, and published in 1997.

In 1999, the chief Executive of HEFCE (Higher Education Funding Council for England), stirred into action by several of us women in SET, agreed to the possibility that money should be put into a fund earmarked to encourage best practice towards the greater participation, retention and promotion of women in Higher Education (HE) in SET in the UK. The result of these and other discussions was the emergence of the (now UK-wide) Athena Project, launched by Lord Sainsbury, the Minister for Science, in early 1999. Athena is now based in the EC Unit (Equality Challenge Unit) in London's Universities UK, under the leadership of a Steering Committee of which I am deputy-chair.

Finally, Cambridge, in 1999, was persuaded to set up WISETI (Women in Science, Engineering and Technology Initiative), a scheme to encourage women at Cambridge to stay on in science, for which I act as the part-time Project Director. So it would seem that I have pinned my personal colours fairly firmly to the mast over the last several years, and have diluted my time available to do scientific experiments by directing a good part of my energies to trying to improve the position for women in SET. One might argue, and people have, that I am wasting my time; that, ultimately, women will have equal opportunities in SET and will come to comprise 50% of practicing scientists and occupy a high proportion of all senior positions. If women are good enough, it is claimed, they will rise to the top without effort. It is clear from 'A' level results as well as those in University in the UK that girls are sufficiently able to be good scientists. But women have been actively involved in science for 30 to 40 years now, and yet we still have few women FRS and F.R. Eng (Fellows of the Royal Society for Royal Academy of Engineering, the ultimate accolade of success) as is the case in other nations too (nature, Nov 25 1999, 402). Of those women that are FRS (less than 4% of the total Fellowship), many are unmarried, or married but childless. The system seems stacked against women scientists leading a normal family life. Moreover it seems that if we wait, particularly for equality in numbers of women in top jobs, it may never happen, certainly not within the foreseeable future.

Another difficulty is that even if women achieve high office, as happened with the female Professors in SET at MIT (Massachusetts Institute of Technology), they may still find themselves marginalized, with less salary, space, infrastructure and support than the men in their Department. Younger women in the lab, often, as at MIT, fail to see that there is a problem for them, until, with the passage of time, they find themselves nowhere near the center of power and decision-making. Sexual harassment may also dog their heels: At a discussion with five women scientists recently, three of them admitted to leaving a post-doctoral position owing to unwanted harassment which they were unable to deal with other than by departing the lab. Condescension from male colleagues, and a lack of preparedness to take women seriously – a 'don't bother their pretty little about that' attitude, is also a crushing experience for many women.

Pro-activity or positive action (although not positive discrimination, which leads to tokenism), would therefore seem to be essential. Last year, to this end, I prepared a Code of Practice, as a guide for scientific labs to follow, to engender greater equality for all in the laboratory independent of gender, ethnic origin or bale-bodiedness, to give rise to a harassment-free lab where all students and contract research staff know "where they are", and everyone has a mentor to whom to turn for career advice. This is being piloted this year here in Cambridge, in one of our science labs. Time will tell if this Department ends up with happier, stress-free members, in comparison with a 'control' lab in which the Code is not implemented. Happily, the Royal Society also sees the virtues in a Code of Practice, and is likewise preparing a code; their clout is such that ours may well receive more serious consideration as a result of their having produced one too.

A scheme has also been devised for high-flying senior women scientists, with leadership potential, to interact with senior men by job-secondments and work-place shadowing, to provide the experiences of networking with successful and powerful decision-makers. 'Networking', the current term for making and using friendly contacts made at conferences and meetings, emerges as one of the most significant forces in forging a successful career. Networking with the 'great and the good' may be particularly valuable as one may observe with the success of the 'old boy network'. Without any such experience, women find it difficult to interact effectively with senior policy makers.

Nowadays the portfolio' career becomes perhaps the only rational choice for women and men. None of us has a 'job for life' any longer, and scientific funding is increasingly highly problematical. It is arguably better, therefore, to wear two or more part-time "hats", rather than one full-time one, so that there is some financial support to fall back on when 'times become hard' with respect to any one position. Being a Fellow of a College as well as a member of a University Department in Cambridge University might provide one example of this. Serving in a voluntary capacity on committees, as well as with paid positions in other posts, gives the opportunity to network with a variety of other strategic thinkers, and raises one's public image. These measures may help women increase their profile so as to persuade the decision makers to select them for high office. In such matters, 'head hunters' are enormously important, so it is a matter of growing concern as to whether such firms have a reasonable and fair number of women on their books and whether they put women forward as frequently as they do men. This realization has led us in Cambridge, to hire "recruitment officers" to act as head-hunters in persuading women to apply for University positions, an activity which they normally signally fail to do.

What about the unhelpful "queen-bee" behaviour of certain 'successful' women scientists? Some very high-flying women may not like others aspiring to climb up the leader after them, perhaps relishing the sense of splendid isolation and uniqueness they enjoy. It is interesting that senior men have traditionally put out a helping hand to young male scientist who fit into the category of 'bright young man', cast, often, in the same mould as they are, so "in their own image". But this seems not to occur so frequently with women.

Perhaps, then, it is the lack of female role models and mentors in science that persuade women that they should not enter a race they believe they cannot ever win by virtue of the lack of visible women 'at the top'? Some men believe that women should not feel pressured to carry on with serious science after producing a family; some women would agree with this view. But others do want to carry on in science after giving birth to their children and it seems a pity not to encourage them. They revel in the challenge and excitement of laboratory life, in the thrill of travel to international conferences, in the euphoric experience when finding an unexpected but favourable result to an important experiment whilst also, no doubt, in their off-hours, enjoying their family. I have certainly always done so. Even, perhaps, the management of their team of workers and sorting out the funding of their group's research is pleasurable. But it seems that women often lack the confidence to put themselves forward – this is borne out by the Wellcome Trust's recent 2001 investigation that served to demonstrate that fewer women than men put in for biomedical grants or awards, although they were equally successful in winning them if they did apply. Is it that we need to build up the confidence of our female student scientists, to encourage them to believe in themselves and their own abilities? The Springboard programme we have piloted and now run regularly here in Cambridge for undergraduate girls in science and engineering is proving successful in doing just that, judging from the responses of those that have experienced it. Role models, more

senior women who practice science, come to talk to these girls about their career, as part of the programme, to help the girls to recognize that most women in SET have had to overcome hurdles along the way, so that they, the students, should, on the other hand, not be deterred by tales of difficulties to come and on the other, recognize that the game is worth the candle.

Having been asked for three major recommendations for action, the Greenfield Report, SET Fair, put forward the concept of a Working Science Centre, in late November 2002, to avoid the current fragmentation of action. This would involve information sharing and support, and would provide a knowledge base for the media, head-hunters, government, industry and professional societies. It would provide a focus for organizations and assist with a business-like approach to project management. Another suggestion was the establishment of an Equality or Diversity Audit, to be required of HEIs and firms each year, reporting on their Equal Opportunities and Family-friendly policies. A third idea was to give tax advantages to those establishments who hired and trained women returning to the workforce, with an incentive programme for part-time working or job sharing and to support those who give women more opportunities for international travel, interactions, and speaking experience.

Parenthetically, a scheme to this end is just this year being established, between the UK and Canada. Exchange of senior women in SET between the two countries will raise the public understanding of science, encourage networking, permit mentoring activities, allow for international collaboration and post-doc exchange, stimulate school girls to want to study science, and involve the media in raising awareness of role model women in SET. This is being organized by the Canadian and British High Commissions, together with the Royal Society of Canada, galvanized by a cross-Canada lecture tour on 'Rosalind Franklin and DNA; Women in SET' which I was supported in giving in January 2003.

Monitoring and evaluation of those initiatives will be essential, with the continuing collection of data, year on year, the establishment of data bases and qualitative, longitudinal analyses as highlighted in SET Fair.

In order that women may be involved in policy making and strategic thinking, an advisory panel of senior women to the UK's Chief Scientific Advisor, who reports directly to government, is being called for, by SET Fair, together with the establishment of an Implementation Panel to ensure that the Report's recommendations are properly put in place. This could lead to women having a greater input into policy formulation than they previously have done, as well as being more extensively involved in strategic thinking. With this additional intellectual power bearing on SET problems, one may hope there might be a speedy transformation, allowing a greater contribution from women in SET.

Finally, the proactive stance taken by the UK Athena Project, by the WISET Initiative here in Cambridge, not to mention by Government's Set Fair and the OST Unit for Women, as well as the European Union, (where 40% representation of women on national committees and decision-making bodies in SET is being sought), worthwhile? It seems that the answer must be yes, if you believe in equal opportunities for all, and if you consider that women have something to contribute to science. Yes, too, if we want to realize the full potential of 100% of our human resource pool, not just 50% of it. And certainly yes, if women want, and are to have, the exciting and enriching life that a career in science promises, full of intellectual challenge, with global travel opportunities and a variety of different work experiences. Time alone will tell.

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Chairperson GASAT 11, Mauritius]**

**Science and Technology in a Small Island Developing State:  
The Case of Mauritius**

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*Abstract*

This paper summarises a number of studies on the status of science and technology in Mauritius while focussing on the education sector. The findings show that science as a subject is becoming increasingly less attractive to pupils, as is the case in many countries across the world. Many reasons are advanced for this state of affairs and the paper addresses some of the issues that need to be tackled in the near future. With regard to gender issues, the findings show that, while there isn't a strong gender imbalance at the early stages of education, this issue needs attention at the tertiary level education and also at the professional level.

*Introduction*

One always wonders how a small island country like ours, without any of the natural resources like oil, gas, wood, ores or precious stones, has been able to achieve such a level of socio-economic development and environmental management within the post-independence to present day period. In all, only 35 years.

By far, one of the main determining factors has been the educational investment by Government and private sector. Teaching and learning have been areas of priority from the very beginning of the emancipation period of the population of the island. Great many stories of sacrifice can be told of families who have left no stone unturned to provide the right education to their children. Culturally, education remains one of the most precious pillars of the population. Therefore, it is no wonder that even today the sector benefits from a large share of the national and family budgets. Had it not been for the human resources development, we may not have been able to take advantage of the various bilateral and multilateral conventions and protocols related to development. Times are changing and nets are being removed, while funds are getting more and more difficult to obtain. How do we cope with this situation as a small island developing state?

The Republic of Mauritius, with its multicultural population of about 1.2 million and its relative remoteness from the main global trades and markets, today faces a tremendous challenge in keeping pace with the process of technological globalization. Our ability to adapt and exploit new technologies will be key to our economic success. The country has long moved from a policy of labour intensive to that of capital intensive with a view to creating a knowledge-based society. The Government of Mauritius has already embarked upon the eventual transformation of the island into the first Cyber Island in this part of the world. The construction phase of a state-of-the-art cyber city is already a reality and will pave the way for an e-transformation of the whole country. In particular, the processes of e-government, e-education, and e-commerce have reached advanced stages of development and will soon render most services in Mauritius available at the click of a mouse. Such initiatives require enormous investments and have been possible through bilateral and international collaborations as well as public and private sector joint ventures. In order to sustain

the e-initiative and ensure the generational IT equity, Government has also finalised the School IT Project and will soon embark on its implementation.

I would like here to quote Nobel Laureate Ahmed H Zewail (TWAS Fellow): “The developing world must create new systems of education that emphasize rational thinking.”

The transformation of Mauritius into a knowledge-based society is a necessity for future economic and social growth. However, this growth must be sustainable by the availability of quality human resources, which in turn implies the necessity for an educational and training system of equal quality for every child and adult. A system that is child- and people-centred, driven by the needs of the country whilst taking into account the impact of the ongoing process of globalisation. The role and importance of the teaching and learning of science and technology has long been felt and several recent initiatives have been introduced with a view to equipping the child with basic knowledge and skills to orient itself in a world driven by technological changes.

Science as a core subject is being taught to all pupils at primary schools. Information Technology (IT) will soon be introduced to all primary schools and will also be reinforced in all secondary schools in Mauritius. However, there are fundamental issues that need to be addressed together with the introduction of science, particularly at the level of primary schools. While acknowledging the importance of science in schools, there remain three aspects, which demand careful attention:

- What kind of science should one be teaching?
- How should that science be taught?
- And finally, who should be teaching that science?

This paper highlights some of these issues within the context of small developing island states and proposes various ways to further promote the teaching and learning of relevant science in the context of sustainable development and gender equity.

### **What Kind of Science? The Science Curriculum.**

Science literacy is nowadays a must in order for one to comprehend the world and to be able to contribute positively to its development. Furthermore, with the increasing importance of Information and Communication Technology (ICT), and realizing that one cannot develop competent ICT skills without a good science foundation and particularly mathematics, the teaching and learning of science become a prime consideration for the development of human capital. Therefore some form of science should be compulsory at schools. It is generally thought that science should be compulsory up to the age of 16. In some countries science is compulsory up to the age of 18.

However, what is even more important is the curriculum aspect. In many countries, young people are put off by science because it is perceived to be difficult and it does not relate to everyday life. The challenge is to design a curriculum that satisfies some of the following requirements:

*Science should be fun and attractive to the pupils.*

*Science should not be about remembering a large body of scientific facts.*

*Science should help one to understand how things, including nature itself, work.*

*Science should be based on the analysis and interpretation of evidence.*

*Science is about doing practical things, observing processes, understanding and duplicating.*

At the age of sixteen, a carefully designed curriculum could meet the above requirement while also giving the young student enough scientific notion to

understand the functioning of the human body and the essentials of the environmental processes. In this way, at the end of the school curriculum, the student can take care of his/her body and protect his/her environment. These two objectives of the teaching of science are fundamentals of good citizenship.

In addition to making relevant science compulsory, one must not lose sight that the science to be taught at school should also provide a secure foundation for those moving to further (post sixteen) scientific studies. This could prove to be a tall order but has to be taken into consideration.

### ***Science at Primary Schools and the Importance of Practical Classes***

The primary level (5-11 years old) is a crucial phase and very often the time when the child shapes up his/her perception of science and its relevance to the world and also the time when gender imbalances in science could be introduced. This is therefore a phase when it is important to carefully think of what kind of science to deliver and also how this science is to be taught. Some people argue that science should start when the pupil has mastered basic reading and writing. Others are of the view that since science is also about observing and understanding then the age of the child is immaterial. The author is of the latter view.

Science is mostly about doing things and it should not be taught in a theoretical and abstract manner. Particularly, when it comes to the young child, it is essential to include practical work and fieldwork. This helps the pupils to develop their understanding of science, appreciate that science is based on evidence and acquire hands on skills that are essential if the pupils are to progress in science. The children must be given the opportunity to do exciting and varied experimental and investigative work.

However, the reality in many primary schools in developing countries is that resources are not available to equip every primary school with a science laboratory. Ways around this major constraint could include the following:

*Introduction of regional laboratories that could service a number of neighboring schools.*

*Introduction of mobile laboratories.*

*Use of low-cost scientific equipment that could be constructed from locally available materials.*

*Use of multi-media to create virtual laboratories.*

### ***Teacher Training***

It is unfortunate, but very often true, that the human resource element is at times neglected in the improvement of the status of science in the educational sector. Science teachers should be provided with time, relevant training and resources including assistance from trained laboratory-assistants. The teaching of science has to evoke the curiosity and inquisitive nature of the child. Only motivated science teachers will achieve this objective.

At the level of primary, a fundamental issue to address is whether the general-purpose teacher who teaches English, French and Mathematics, can also be trained to teach science. This same issue also arises with the teaching of Information Technology. The situation is more complex if most general-purpose teachers have themselves never learned science in their school days. However, this issue can be resolved if resources are available, which may not be the case in many developing countries.

More and more emphasis is being laid on learning from experience and less on teaching in the conventional manner. A more comprehensive approach has therefore to be defined regarding the role of teachers. Activities outside the classroom have to

be encouraged. As the learning environment changes, professional involvement becomes essential. Teachers need to be given the opportunity to share their experience and ideas with colleagues and benefit from the support of researchers and managers. There is no magic formula to ensure the interest of young persons in science, mathematics and technology. A lot will depend on the ability and sensitivity of the teacher to capture the attention of the young curious mind and devise new methods to encourage the young persons.

### ***Promoting Science & Technology Education***

As the world becomes increasingly driven by science & technology (S&T), Mauritius cannot stay aloof of these developments. Our ability to remain competitive in the technological race will strongly depend on the quality, the scientific know-how and technological skills of our human resources. Science education is nowadays a basic necessity for the citizen to comprehend and live in a world that is increasingly undergoing technological transformation.

The promotion of science & technology is an issue that concerns all levels of the education sector and not only the tertiary level. In fact, it is postulated that the primary and secondary levels are indeed the crucial phases in the fostering of science education. The focus at the tertiary level is therefore the consolidation of science and technology for national benefits.

It is now generally accepted that science and technology are not only there to cater for utilities, infrastructures, food security and public health, but fused with culture and economics, they become the major determinants of our life style and our future.

This section highlights some of the findings of a number of investigations and studies that have been conducted by the Mauritius Research Council with a view to assessing the status of science in Mauritius in general, and more specifically, in the education sector. A set of actions are also proposed to address some of the issues.

In short, the findings are worrying and if steps are not taken with some urgency, Mauritius could find itself lagging in what is increasingly becoming a world driven by technology, and, of course, technology is the application of science. Our current lacking in science could have serious implications on the quality of our human resource, particularly within the context of the vision of transforming the country into a Cyber island. *A fundamental realisation is that one cannot develop competent IT skills without a sound knowledge of science and mathematics.*

The major recommendation from the reports is a complete review of the teaching and learning of science in our primary and secondary schools. The findings show that the current state of affairs is already leading to many pupils and students shying away from science for many reasons varying from science being perceived as a difficult subject to the lack of career opportunities for those opting for scientific subjects.

### ***Gender***

With regard to the gender issue, the reports bring out that although girls outperform boys in lower grades of education, they shy away from science, particularly physics, at the higher levels. This eventually has led to lesser women studying subjects like engineering at the tertiary level. Many girls regard physics as traditionally unsuitable, and this view is reinforced by peer, parent and teacher pressure.

The recent surveys on learning outcomes, under the joint UNESCO/UNICEF MLA Project, show that there is a strong and significant relationship between level of mother's education and 15 year-old learning outcomes for the developed nations. Such an assumption would mean that today's young ladies of the South would need to complete the learning cycle, not only for achievements and better jobs, but also to

ensure that the next generation can cope better with the new North-South situation being created by globalisation. There is also the question of faith. Very often the child will lean on the mother's word, the mother's word being the word of truth. A mother's science and technology literacy would therefore mean that quality education might start at home.

***A study on Science , Technology and Innovation Audit "Gender Issues" proposes that other programmes should include:***

- Special programmes to be given to girls for embarking on Engineering and other Technology related fields
- Prize awards to the best female students in outstanding performances in the 'Hard Sciences' such as Physics, Engineering etc.
- Organisation of job orientation days in scientific and technical careers to provide them with information and encourage them to choose science subjects and technical ones
- Organisation of nation-wide contests for the best design and equipment made by students and teachers working within science clubs in secondary schools etc...
- Reviewing the Environmental programme at the Primary Level to make it more science oriented

***Proposed measures to be taken include:***

- Dispelling social prejudices that Science and Engineering are reserved for boys.
- Sensitising parents on the advantages of scientific education of girls in our society
- Presenting models of women in Science and Engineering by organising conferences and educational talks in which women in Science and Engineering play a major role.
- Adopting appropriate teaching aids which will make the study of Science and Engineering-related subjects more attractive to girls.

***At the State level:***

- The syllabus of mathematics and sciences should be modified so as to make the teaching of these subjects more relevant to the everyday experiences of girls (trading, measurement, farming, cooking, etc.)
- Encouragement should be given to girls when performing well in the sciences (prizes, medals etc.)
- Through seminars, conferences, workshop, roundtable etc..., the State should give the girls the opportunity to see and interact with role models (women in science and engineering)

The survey of teachers indicated that the government policy had improved the teaching of S & T in Mauritius, but not adequately. For further improvements in the teaching of S & T, a follow-up survey of teachers' views on the subject could be useful. Some of the issues requiring further elaboration are as follows:

- some believe that the facilities for continuous professional development are inadequate.

- One form of support for science teachers at all levels is the development of partnerships with working scientists.
- More scientists should be encouraged to visit schools as the teachers feel isolated from leading-edge research and what is best practice in industry.
- They would also like to be involved in developing science teaching materials and curriculum.

It was felt that these measures would help them tackle their science lessons in a positive frame of mind hence increasing the science literacy index.

The deteriorating status of science in Mauritius is not an isolated finding, since many other countries in the world are facing more or less the same problem. In a recent report commissioned by the House of Commons in the U.K, Dr Ian Gibson, Chairman of the Science and Technology Committee, commenting on GCSE Science, quoted the following:

*“Science should be the most exciting subject on the school curriculum: scientific controversies and breakthroughs hit the headlines every day. But school science can be so boring it puts young people off science for life. GCSE science students have to cram in so many facts that they have no time to explore interesting ideas, and slog through practical exercises, which are completely pointless. This is a disaster: we need to encourage a new generation of young scientists and to ensure that the rest of the population has a sound understanding of scientific principles.”*

The above quote applies equally to the status of science in our schools, as we tend to follow closely the British model. Other countries have and are already taking bold steps to reverse the negative trend. In most countries science is compulsory to the age of 16 and in some to the age of eighteen. These countries realise that, nowadays, science literacy is a must to become a productive citizen. Mauritius cannot afford to stay aloof or else we stand to miss the boat!

**In order to redress the situation, the following issues need to be addressed:**

*For the Primary Sector:*

- At what age group should science be introduced?
- Science curriculum to be reviewed to be locally relevant.
- Science being taught in an abstract form.
- Are teachers adequately qualified, trained and motivated to teach science?
- Total lack of practical classes.
- Introduction of group learning (for practicals).
- Use of multimedia to teach practical (Virtual Laboratories).
- Use of local low-cost equipment for practicals.
- Introduction of Mobile Science Laboratories.
- Science should be fun and attractive.

*For the Secondary sector:*

- Science perceived as difficult.
- Lack of career opportunities.
- Less than 25% of pupils opt for science at O level.
- About 10% of pupils take computer studies at O level.
- Less than 3% of pupils take computer studies at A level.
- Extremely few girls are attracted to physics.
- Lack of infrastructure for practicals.
- Review of practical and field work.

Training and recruitment of Laboratory Assistants.  
Science not an option in some schools.  
Science curriculum to be locally relevant.  
Curriculum should not be a “Puzzle”  
Recommend some form of integrated science to be compulsory up to Form V.  
Phase out and eventually ban “Alternative to Practical Exams”

*For the Tertiary sector:*

Limited access to engineering and IT courses.  
Limited scientific infra-structure in some institutions.  
Maintenance of scientific equipments to be improved.  
Limited career opportunities for those pursuing science studies.  
Perceived imbalance in the teaching of pure v/s applied science.  
Lack of interest by the private sector in scientific activities and scientists.  
Lack of commercial application of science.  
Lack of scientific multidisciplinary teams and team-spirit.  
Provision of science by private tertiary institutions virtually inexistent.  
Inadequate science priorities.  
Science curriculum to be more relevant to national needs.  
Lack of supervisors for postgraduate science studies.  
Training of teachers for science subjects to be revisited.  
Migration of IT academics to the better paid private sector.  
National brain drain of Mauritian scientists.  
Inability to attract scientists from abroad.

All the issues raised above should be addressed through the development of a holistic plan that would take on board the national needs as well as regional requirements. It is high time to reconcile with the fact that the delivering of higher education can also be a profitable business. Mauritius should capitalise on its geographical hub position in the Indian Ocean as well as its bilingualism to exploit on the educational needs of neighbouring countries. However, whatever be the strategy, a high degree of quality should be in-built in order to ensure local, regional and universal accreditation, wherever possible.

***Science for National Priorities and Capacity Building***

The tertiary education sector is at the forefront of our human resource development system. It needs to contribute to the provision of a trained and qualified workforce. The vision and priorities of Mauritius are already set to a large extent and universities and institutions of higher learning should conceive the design of their courses within national objectives.

The country is on its way to transform itself onto a cyber island. Biotechnology will be called upon to improve and increase the productivity of the agricultural sector. The health sector will need more medical and paramedical staff. Diabetes, cardio-vascular diseases and obesity are still highly prevalent in the country. Biomedical and bio-informatics studies of these killer diseases will become increasingly a must. Our ability to sustain development on the island will largely depend on our capacity to manage our waste generation and the extent we prevent and control pollution of our environment. The immense potential of our 1.7 million square kilometres of maritime space (EEZ) is still to be exploited.

None of the above aspirations and concerns can be addressed without science and technology and without people with the relevant scientific know-how. Institutions of

higher learning will be called upon to provide the knowledge and skills requirements to improve today's workforce and prepare that of to-morrow.

### ***Support for Scientific Infra-structure***

The teaching and learning of science and technology is mostly about observing, understanding and duplicating. It requires a hands-on approach and practical sessions are mandatory. An irreproachable mistake is to teach science, particularly to young ones, 'theoretical science' which bears no relationship with every day life. A major constraint to many providers of higher education, mostly private, is access to science laboratories and technological workshops. This is currently hampering the delivery of science courses, particularly those delivered by the distance mode.

A national effort is urgently needed to address this issue. One solution could be to provide on a rental basis regional science and technology laboratories. Other solutions could be through the networking of existing laboratories and their use after normal working hours. The issue of maintenance of scientific equipment should also be a concern and a plan of action is needed.

Finally, the effectiveness of the teaching and learning of practical science very often rests on the ability, skills and motivation of the laboratory assistant. Any plan developed to improve the quality of science at the tertiary level should also include an important section on the training and upgrading of scientific and technical laboratory assistants.

### ***Collaborative Science***

Applied sciences which are problem solving are, by their very nature, multidisciplinary, calling for a number of different expertises that may not be possessed by one individual. Increasingly, scientists have to associate themselves into multidisciplinary teams to tackle 'real world' problems. This demands certain qualities, such as developing habits of working together and developing an attitude of team spirit. Above all, working in a team calls for sharing of information and knowledge. Without these qualities no scientist is complete.

Regretfully these qualities are not always present in our institutions of learning and this issue needs urgent attention for it is undermining 'camaraderies'. An Association of Science Teachers may help to foster a sense of belonging to the scientific academic community. One of its functions would be the sharing of scientific know-how, including pedagogical aspects, as well as keeping the teachers abreast of latest scientific knowledge.

### **The Need for a Concerted Effort to Foster Science Education**

The issues raised above pertaining to Science Education are common to many countries, including developing countries. Science and technology education will play a vital role in the transition from the present economic system to a knowledge-based economy. This perspective is even clearer for Small Island States like Mauritius, which depend largely on their human resources capacities to adapt quickly to new situations in order to ensure their survival and competitiveness. We need a vision that is consistent with our priority: that of achieving sustainable development without harming our cultural and environmental heritage.

Government is fully conscious of the importance of the "new economy" and has devised a national Information and Communication Technology strategic plan to accelerate the country's transformation into a nation where Information Technology and Communication are fully engaged for business competitiveness, civil service efficiency and effectiveness as well as encourage ICT diffusion so as to help achieve an information-based economy. This vision is an integral part of the social and

economic development plan for the country and e-Education will contribute largely to achieving these objectives.

We are bound to adopt the adaptive mode if we want success. As a small island state we need to behave globally as an intelligent system, which will allow creation of more wealth. Science, technology and innovation will continue to play pivotal roles in our development process. But, we need to persist in our endeavours to ensure equity at all levels and within all spheres of life.

### ***Conclusions***

Many of the issues raised above are common to many countries. However, in the context of a small developing island state, these issues, if not dealt with at an early stage, could hamper developmental growth in the country not being able to develop its human capital. In Mauritius, several initiatives have already been taken to redress the situation. A science education plan has been developed and Task Forces have been set up to implement and monitor the actions.

KEYNOTE ADDRESS [Tuesday 08 July 2003, 0900-1000, Chairperson Dr Ved GOEL, Deputy Director Commonwealth, UK]

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## UNESCO/ANSTI ACTIVITIES FOR CAPACITY BUILDING IN SCIENCE AND TECHNOLOGY AMONG AFRICAN WOMEN

### *Abstract*

This paper elaborates the UNESCO programme activities in Science and Technology that are of relevance to the promotion of women in this area of study. It shows how UNESCO is collaborating with The African Network of Scientific and Technological Institutions (ANSTI) to build human resource capacity in Science and Technology. It presents activities of ANSTI which women scientists in Africa can use for their professional development.

### **1. Introduction**

Issues relating to gender are handled in UNESCO by various sectors. Those affecting the general socio-economic well being of women and the role of women in development are usually implemented through programmes developed in the social and human science sector. The promotion of the education of girl child is handled by the education sector. The promotion of women in science and technology fall within the domain of the science sector programmes. In UNESCO, science is considered to be university-level affair and so the science sector operates at that level. The teaching of science in secondary or non-tertiary institutions is considered to be “education” and falls within the mandate of the education sector. These distinctions and definitions, though not universally acceptable enable the organization to allocate responsibilities to the various units within its management structure. Some gender actions however require multi-disciplinary approach involving all the sectors mentioned above. Furthermore, the implementation of a programme can take place at the global level which is handled by the UNESCO Head Office in Paris or from the regional and country offices.

In Africa, the programme on women in science are mainly the responsibility of the UNESCO regional office in Nairobi. The office uses several strategies and partners for the implementation of its programme. One of the strategies is the use of institutional networking to pool together the region’s resources for training and research in relevant areas of science and technology. In line with this strategy UNESCO supports a pan-African institutional network - The African Network of Scientific and Technological Institutions (ANSTI) - which facilitates and coordinates networking among faculties/schools of science and engineering in sub-Saharan African universities. ANSTI plays the double role of a partner and a project of UNESCO. This paper highlights the activities of this network and shows how these activities are used to promote women in science and technology in Africa.

### **2. UNESCO and Women in Science and Technology**

In 1999 UNESCO convened the World Science Conference in Budapest. The meeting recognized the historical imbalance on the participation of men and women in all science related activities and adopted a science Agenda that affirms that all human beings have the right to participate in the scientific enterprise.

Furthermore, the science Agenda which was adopted by the conference, recognizes that only through full participation of women can the full intellectual potential of humankind as a whole be ensured. The meeting put forward several recommendations for follow-up actions. Among the recommendations was that requesting governments, educational institutions, scientific communities, and bilateral and international agencies to ensure the full participation of women and girls in all aspects of science and technology.

In response to this recommendation, UNESCO in all its programmes in the natural science sector, has emphasized the need for the full participation of women. Gender mainstreaming is evident in most of the organization's science programme. A main line of action comprising several activities has been set aside under the name "women, science and technologies". Activities under this a main line of action include:

Support for UNESCO chairs on women; science and technologies; Support for networks of women scientists and engineers; Science education of young girls; women and science policy. In the case of Africa there is an additional activity called "Scientific and technological Education of women". All these activities are intended to promote or strengthen women in science and technology.

In addition to the above specific activities for women, there is also gender mainstreaming in all the other activities in the natural science sector in UNESCO. In one particular programme, Science and Technology - Capacity building and management, the activities are implemented so as to ensure the full involvement of women and young girls. In this regard it can be stated that UNESCO supports capacity building programme for networking among female scientists.

Some of the programme activities highlighted above are implemented from the UNESCO headquarters. However the decentralization policy of the organization now means that a substantial amount of the implementation is carried out from the regional offices. Each office will identify its own priorities within the UNESCO programme usually in response to the situation in the home region. Thus, for the promotion of women in science and technology, the UNESCO Nairobi Office has a class of activities that can be grouped into two main categories: Human resources capacity building and support for Networking among women scientists. The UNESCO Nairobi Office undertakes the human resource capacity building programme through ANSTI which is a regional cooperation project dedicated to capacity building in science and technology. This paper therefore presents the rationale for regional cooperation in human resource capacity building in science and technology in Africa and justifies UNESCO's use of ANSTI as a medium for the implementation of some of its activities. . The paper will also discuss the activities of the Network and show how they are used to develop women scientists in the region.

### ***3. Why Ansti/UNESCO Partnership - The Regional Cooperation Strategy for Capacity Building***

The building of high-level resource capacity requires large investments in laboratory equipment, library, good information systems, and academic and technical staff. Establishing such training facilities in every field of science and technology is a task, which is difficult for most countries in the region. Thus, a situation exists where there is a wide range of endowments for training resources across the region with some countries considerably better resourced for training, in particular subject discipline than others. Under such a situation, the best strategy is the pooling together of training resources. Such a strategy will ensure that institutions and countries which lack certain resources are able to share from the pool. It will also optimize the use of all available resources in the region.

Indeed the issue of regional cooperation for capacity building in Africa goes as far back as 1974 when it was first proposed at the first conference of African Ministers of Science and Technology (CASTAFRICA I ) held in Dakar, Senegal. It was at that meeting that the African Ministers present urged UNESCO to help African universities and research organizations engaged in training and research in science and technology to establish such linkages among themselves to enable them to pool their human and material resources and thereby contribute more effectively to the application of science and technology. In 1980, after consultations with several universities in the region, UNESCO with the financial support of UNDP and the Federal Republic of Germany established the African Network of Scientific and Technological Institutions (ANSTI). The Network was given the mandate to foster collaboration among high-level training institutions in the region with the view of building human resource capacity in science and technology. UNESCO and many other international and donor agencies have since then, looked up to the ANSTI model as the only viable strategy for sustainable high level human resource capacity building in S&T. This is because an important feature of the Network is that it intervenes at the highest level of training and thereby generates trainers who return to their respective countries and continue with the human resource development process. Thus, the ANSTI model follows a sustainable human resource capacity building process. It is a cost-effective way of training a large pool of scientists and it also minimizes brain drain since most of the training is done in the region.

This strategy of regional cooperation and the ANSTI model in particular, have been endorsed several times by African leaders. The most recent one was at the UNESCO-sponsored meeting in 1995 entitled AUDIENCE AFRICA. The meeting brought together African Heads of State or their representatives to deliberate on strategies for socio-economic development. The participants, while addressing the issue of scarce resources, recommended, the pooling of facilities, the stepping up of exchanges, scientific cooperation at regional and sub-regional levels and the establishment of Networks.

#### ***4. Institutional Framework for Capacity Building for Women in S&T in Africa***

UNESCO already has an established institutional framework for capacity building in science and technology in Africa. Over the last two decades UNESCO has used ANSTI as a medium for capacity building in science and technology. The network has in the past attracted and administered donor funds for its numerous activities which include award of fellowships for postgraduate training and staff exchange.

Using ANSTI's network nodes, it is possible to provide training facilities and produce high level human resource in science and technology in Africa. ANSTI currently has

98 members in thirty-three (33) countries in the region. Its membership includes faculties of science and engineering and scientific research institutes. The activities of the Network are coordinated from the UNESCO Nairobi Office. A small Secretariat of four (4) staff members administers fellowships programmes, a capacity building programme in learning/teaching materials production, plans and organizes conferences and also maintains contacts with all member institutions. The network promotes collaboration by regularly disseminating information on S&T activities in the region.

The building and strengthening of women's capacity in science and technology in Africa is being carried out under the umbrella of ANSTI. In order to correct the historical disadvantage of women in science and technology, the network mainstreams in all its activities. Because ANSTI is an institutional Network, it has advantage over the organizations/associations, which promote networking among individuals in science and technology. Its main advantage is its network members, which are institutions with training facilities. Thus, it can put at the disposal of the region a large pool of training facilities. Hence, institutional networks like ANSTI are in a better position for large-scale human resource capacity building across all disciplines.

## **5. Programme and Activities**

### *5.1 Rationale*

Regional Network for Capacity building must develop and implement programmes that will ensure that its members "pool and share" the available resources for the purpose of post-graduate training. Thus, opportunities must be offered to potential trainees to travel to other institutions where resources (staff and equipment) for the training they desire, are available. The network must also facilitate the movement of staff so that institutions, which are not well endowed with scientists in a particular discipline, can benefit from visits by professors from other institutions. Similarly, in order to share knowledge, information or research results and experiences, the networks must have programmes that facilitate dissemination of scientific information. Indeed information sharing is very crucial in networking for capacity building.

Based on the above-mentioned rationale, ANSTI has developed and is implementing several activities which can be grouped into six (6) programme areas: *Training, Staff Exchange, Seminar/Workshops, Information Dissemination, Research Promotion and Capacity building in production of learning/training materials*. These are core programmes. However, a major new initiative is the *promotion of the use of ICT in Science and Engineering Education*. Another activity is *facilitating networking among women scientists in Africa*.

### *5.2 Training*

The Network awards fellowships to qualified candidates for study in the basic and engineering science at member institutions outside the fellow's home country. This activity has the dual objectives of developing the human resources as well as developing the research capacity of the fellow's home and host institutions. The Network facilitates training at the highest level (i.e postgraduate studies and research). There are several reasons for this. First of all, the previously-mentioned problems

associated with training of scientists are more acute at this level; secondly, the impact from the intervention at this level is far greater because one will in actual fact be training future trainers who will go back to their home institutions to train others. Thus, one candidate who qualifies with a Ph.D or MSc. will over a period of several years be involved with the training of hundreds of scientists at the undergraduate level in his/her home country. So, whether one's objective is to produce scientists at the undergraduate level or at the postgraduate level it is cost effective for regional organizations to intervene at the highest level in order to train potential trainers who will then do the large-scale training in their respective countries. The other reason for intervening at the higher level is that nearly all countries in the region now have training facilities for undergraduate level training of scientists and the major problems associated with these facilities (i.e. infrastructure, finance) are more appropriately handled at the national level. However, in the case of high-level training (i.e. postgraduate) the training institutions are fewer, and therefore requiring some regional cooperation for exchange of students and staff.

Other training activities include awards of short-term training fellowships and the organization of training workshops.

### *5.3 Scientific Seminars and Conferences*

ANSTI promotes communication among scientists through the organization of workshops, scientific seminars and conferences on various subjects. The Network also awards conference grants to enable scientists in the region attend international conferences and subject their research findings to peer review.

### *5.4 Staff Exchange Programme*

The network awards fellowships which covers travel costs and honorarium to facilitate the travel of senior academic staff from one member institution to another in order to undertake research and/or teaching. This activity ensures that the training resources in the region are "pooled together" in order to train high-level scientists.

### *5.5 Promotion of Research*

Research is essential for the individual/personal development. Through research the individuals knowledge is increased and this may have a trickle down effect if the researcher is a university staff member. When funds are available the network supports applied research activities in member institutions.

### *5.6 Dissemination of Scientific Information*

One of the most important programme activities of ANSTI is that of the dissemination of scientific information. There are two categories of S&T information disseminated by the network. In the first category are general information on S&T activities. This class of information includes the following:

- (i) description of the scientific activities (i.e. research and training) that are carried out in the various institutions.
- (ii) information on available scientific manpower resources in the region,
- (iii) announcements on meetings, conferences, workshops and seminars

- (iv) reports on important issues affecting science and technology in the region
- (v) information on strategic issues for training in emerging areas of science and technology.

Although such information may appear to be less important than those on the actual scientific research knowledge, the experience at ANSTI indicates that the non-availability of these ancillary types of information gravely affects the success of scientific research and teaching. Access to such information enables the scientists to overcome their isolation and collaborate meaningfully on important research activities. Table 1 gives the different types of information in this group and also shows how the network collects and disseminates them. The main forms of dissemination of this class of information is the publication and distribution (in print and electronic form) of Directories, occasional reports and manuals and circular letters.

The second category of scientific information disseminated by the Network is that of research results emanating from member institutions. The network publishes the African Journal of Science and Technology (AJST) which is used as a medium to disseminate research results.

Table 1: *Collection and Dissemination of Ancillary information to enhance S&T Activities*

<i>Type of Information</i>	<i>Method of Collection</i>	<i>Method of Dissemination</i>
S&T manpower resources for training and research in the region	Questionnaires to ANSTI member institutions by e-mail	Publication of Directories in print and on the internet
S&T Research and Training Activities in the region	Questionnaires to ANSTI member institutions	Publication of Directories (also put on the internet)
Conferences, seminars and other scientific meetings	Direct communication with the organizers	Circular letters to member institutions (by e-mail)
Important issues affecting S&T in the region	Meetings of expert groups	Occasional reports (in print and electronic form)
Strategic issues in emerging technology problems	Commissioning of consultants	Books, training

### 5.7 Capacity Building for preparation of Learning/Teaching materials

The availability of affordable learning materials in science and technology is a constraint on human resource capacity building. One way of overcoming this is to develop local capabilities for the preparation of learning/teaching materials. ANSTI has a textbook production programme which utilizes staff of its member institutions to develop textbooks that utilise African examples to illustrate theoretical principles. Through a series of workshops, the materials are harmonized, tested and edited collectively. The programme has led to the production of several undergraduate

textbooks in basic and engineering sciences using over thirty (30) trained authors from member institutions.

#### *5.8 Promotion of the use of information and communication technology in science And engineering education in Africa.*

Several African universities are gradually building their ICT infrastructure. Unfortunately, most of these resources are used mainly for communication. The investments in the infrastructure are usually considerable and for most universities the maintenance costs represent a significant portion of their budget. It is therefore prudent to use the facilities in as many ways as possible. The use of the ICT as an educational technology offers a cost-effective application of the infrastructure.

ICT offers new ways in which the quality, effectiveness and the flexibility of higher education can be improved. It will certainly enable African universities overcome some of the chronic problems such as shortage of learning materials, staff and journals in the libraries. It could facilitate the delivery of higher education both within and outside the university campuses.

The goal of the UNESCO programme for the use of ICT in science and engineering education is to enhance teaching and research through access to information and learning materials and the adoption of flexible learning modes that can take place at any time and from any location. The specific objectives of the ANSTI/UNESCO project are:

- To facilitate electronic content development for subjects in the basic and engineering sciences
- Support training programmes for academic staff to enable them develop and disseminate electronic course materials.

The use of ICT in S&T education obviously has many advantages. However, we should not be carried away and adopt this educational/learning technology wholesale without examining the possible consequences. One of the implications of the use of ICT in learning in science and technology is its possible effect on marginalised groups such as women and poor students. ICT use in learning in S&T may create problems of gender equity because of (i) its demand for technical and operational skills (ii) the possible gender insensitivity of the contents and (iii) the absence of role models. In this regard ANSTI/UNESCO will support studies on the gender implications of ICT in learning in S&T in Africa. In particular, the study will examine and try to answer the following research questions:

- Is there gender inequity in access to ICT - learning facilities? And is there differential access due to cost of the technology economic status of women or the level of computer literacy of the students.
- Does ICT based learning materials favour male students?
- Do female students have the same level of technical and operational skills as their male counterparts for use of ICT in learning?
- Do female students at the entry point in College have the same level of computer literacy as their male counterparts?
- Is the frequency of use of ICT-based learning facilities in S&T the same for both sexes? The rate at which students use the facilities may influence their performance in the courses.

### *5.9 Support for women networking*

ANSTI/UNESCO undertakes this activity through support for meetings of women scientists, which are held in the region. Furthermore the Network gives grants to individuals to attend meetings outside the region which can facilitate networking.

Another activity is the compilation of database on female scientists in Africa to enable them to contact each other - A directory of women engineers in Africa was recently published by the Network.

## **6. Conclusion**

The UNESCO/ANSTI programmes are in general open to both sexes. However, in order to correct the historical imbalance against women in the field of S&T, the Network favors female scientists in all its programme activities. Thus, as a concluding remark, ANSTI invites all African scientists and those engaged in activities that will promote African women in S&T to participate in any of the activities that have been elaborated in this paper.

**KEY NOTE ADDRESS [Wednesday 09 July 2003 , 0900 – 1000]**

**Dr Ann HOLMES, Principal Consultant, Ann Holmes & Associates, Toronto, CANADA**

Asking Different Questions: Strategies for change from the context of Canadian education

I will begin by thanking my Mauritanian friends for the honour of the invitation to bring my ideas to a plenary session of this conference. I must acknowledge my friends both in Canada, the United States and here who have supported me in gathering my thoughts together. I take responsibility for the content – it is to them you owe thanks for its coherence.

As you may have gathered from my introduction by Mr S. Bissoondoyal, I am not an academic. I recently came across Antonio Gramsci's term – the organic intellectual - one who has knowledge of, or is experiencing, a situation that must be attended to. That is how I have been describing myself since. Just to say a bit more about that, - as I understand Gramsci's belief – all people have the capacity to think and therefore they have the innate capacity to understand their world and change it. I believe that such folk are crucial allies in the work for social change because they are thoroughly rooted in community, and in developing and maintaining relationships with those with whom they live and work. To be an organic intellectual is to come from and network with and be one of us with a shared commitment to those things that need to be attended to for the betterment of all.

My local network starts with Toronto, the city where I live, and moves out to Ontario, one of the ten provinces – a large area with a population of about nine million. My best skills are as a facilitator and networker because I hate to think that there are resources, materials, ideas that you could use but that you haven't been connected to them. I plan to give you some examples, from the context of Canadian education, of strategies that have been used to better the encouragement, access and experience of women in science and technology. I will be interjecting my own ideas and those of others about the degree and quality of change and what is sufficient for change to occur. I might equally have called this talk “from the context of Ontario education” or “from the context of North American education.” What I am presenting is probably best termed a hybrid. Most of us work locally and look to our neighbours and network for helpful models. You, my listeners, have the knowledge filter of your own situation – you will know best whether any of what I describe can be transferred and would make sense in your context. In that sense, whether you are an academic or not, while listening you will be an organic intellectual. I encourage your active listening to let your thoughts soar, to dream about what you would really like to see happen and how it could.

I put it to you that “gender mainstreaming” is a goal we have been moving toward for some time. As defined by the federal government agency, Status of Women Canada [1], gender mainstreaming is “a dual approach that implies the reorganization, improvement, development and evaluation of all policy processes for the purpose of incorporating a gender equality perspective into all policies, at all levels and at all stages. By bringing gender equality issues into the mainstream, we can make sure that the gender component is considered in the widest possible variety of sectors, including education...” An important question to start with — is the outcome of gender mainstreaming a sufficient condition for change??

Sue Rosser, currently Dean of Ivan Allen College, at Georgia Tech, and a professor of History, Technology, and Society, in her influential book, *Female Friendly Science* [2], first published in 1990, argues that the final step - final phase of the transformation, is science that is “redefined and reconstructed to include us all”. This phase has yet to be realized, but my vision of what it will look like includes a gender- and diversity-inclusive curricular content and a perspective that crosses as many boundaries as we can imagine to exist.

I chose this title for my talk because a friend of mine made a film for the National Film Board of Canada called *Asking Different Questions: Women in Science* [3]. As a networker, I helped her connect with three of the five women she interviewed and she made the most of those connections - -to draw out their stories and their angle of difference on the questions they ask.

Any Canadian talking to a group about gender and science and technology would be remiss if she did not mention someone I admire deeply and count as a friend — Ursula Franklin, professor emerita of metallurgy at the University of Toronto. It is around her commentary that the film is structured and, since imitation is a sincere form of flattery, I plan to refer to Ursula’s thoughts as I go along. It is no coincidence that Ursula, an engineer with a Ph. D. from Berlin has dedicated herself to the issue of peace. She was interned by the Nazis because her mother was Jewish, and her life has been focussed on the goal of the best science, which for her is the practice of science ‘as if people mattered’ not just measuring the number of jobs created or goods sold.

A series of Ursula’s public Massey lectures was first published in 1990, as *The New World of Technology*, which she revised in 1999 [4]. In her introduction to the first edition, Ursula speaks of one of her “images of a peaceful world: a society that might work somewhat like [what we call] a pot luck supper, where everyone contributes and everyone receives, and where a diversity of offerings is essential. In such a world there would be no one who could not contribute their work and care – and no one who could not count on receiving nourishment and fellowship.” I offer you this talk in the spirit of providing nourishment in the context of the intense experience that is a GASAT conference.

My talk is seasonally linked to what I just left in Canada. I am a big fan of solar power especially when it can be used to dry laundry. When telling a friend about what I planned to say, I realized that Ursula’s role in the film is that of the clothesline, for she is the strong thread upon which the stories of the other women hang. I realized that my metaphor could expand because I want to give you some examples of strategies from the Canadian context - - to rummage around in the basket of washing pulling out the bit to tell you and shaking it out for display. As I was revising this talk, I realized that for this audience I might need to note that, in Canada, it is usual for us to do our own laundry.

I have been thinking about what GASAT has achieved in 22 years, what I have observed as the necessary conditions to change and the questions that have been asked like - what are the strategies? Who are the allies? What is the rationale to use? Do we run a risk in using the economic imperative as a rationale – that when the economy is healthy again, or when all the jobs have been filled, women’s possible contribution will be ignored?

I want to be clear that the underlying subject of GASAT work is social transformation – that without structural change, our goals will not be achieved. I will hang my thoughts about this up here on the washing line and you will brush against them. I hope they will smell clean and fresh and that you can take some of them down and use them. As you play with what you are hearing, please do not take any generalizations personally, and do think locally – what does this have to do with me? To quote Vanaja Dhruvarajan [5], Professor and Senior Scholar in the Department of Sociology at the University of Winnipeg and co-author of *Gender, Race, and Nation: A Global Perspective*, “Women’s perspective rounds out how the world works. We share commonalities and differences. Systems of oppression interlock, intersect and interact.”

At GASAT 10 in Copenhagen, Nicole Dewandre, Head of the Women and Science Unit of the European Commission suggested making women’s representation in science a political issue. I believe that there is really no other way; leadership in the political and administrative arena must be engaged before any real change will occur. One of the recommendations from the GASAT 10 conference was “to get women and STEM onto the agenda of national policy organizations.”

From the Proceedings of that conference [6], “In GASAT we believe that sharing and discussing are better means of developing our understanding of the problems we are addressing, of finding new ways to solve them, and of creating visions for more responsible ways of implementing science and technology. We don’t want to end up with everyone agreeing on the best way to understand the problem, or what is the best solution.” I want to encourage you to come up with your own best solution, because your laundry line hangs in your own community, planted in your own organic possibilities.

In the GASAT objectives, you will find – “To provide a forum for the dissemination of experiences of those working in the field, and to provide a support network for those working toward the GASAT objectives.” What are your experiences and what have you come to expect? The first item to go up on my laundry line is a significant Canadian project instigated by the Canadian Teachers’ Federation in the late 80s. [7] It started with girls – with facilitated discussion groups around the country that focussed on issues of importance to the participants. It was called *A Cappella* because, like the musical term that refers to voices unaccompanied by instruments, the project director observed that the young women were living their lives without the benefit of instruments reflecting back to them the themes of importance in their lives. As the discussion group phase of the project was drawing to a close, all the participants did not want it to end. They had noticed the lack of structured opportunities to discuss these themes, the hidden curriculum, in their educational experiences – and they had learned to value them.

So we start with the subjects, and look at the context that shapes them. Thank goodness we have moved from the deficit model – that there is something wrong with girls and women that needs fixing. As Peggy Tripp-Knowles, a forestry professor at Lakehead University on Ontario, notes in the film, *Asking Different Questions*, about her subjects –trees, “Trees are fine the way they are. Over the eons they have learned the most important lesson, green side up.” Girls are fine they way they are, and we have moved the science curriculum to emphasis on the social relevance themes and community service components to engage them.

I would like to propose that we could further improve the situation of women in science and technology if we ask different questions. What has the system lost because of the relative absence of girls and women in science and technology? A lot of energy, creativity. How can the practice of science, which includes the notion of scientific objectivity, distancing and isolating problems from their context, be opened up to make sense to those who construct their world based on relationships? How can this so-called “hard” discipline become an interest for those who are more likely to have a lower self-confidence ratio? Or those who think that even when they get a high grade, that they didn’t earn it, it was luck? Even more critical, how can the politicians and the administrators be engaged to support and facilitate the implementation of the many successful strategies we already know about.

There is no such thing as a bias free classroom, workplace (or talk, for that matter). There are contexts where more people can flourish than only the privileged few for whom the system works. There is no such thing as gender neutral. Practices that are “seemingly neutral” only serve to perpetuate the status quo.

Others, notably Carol Gilligan, have explored the notion of difference, and have described current education practices as ignoring the lived experience of girls and women – those issues of particular significance for them that are seldom discussed in school – or anywhere other than women-only groups. I put it to you that, in North America at least, more and more boys are noting this absence of the connection between what they think is important and the STEM curriculum and therefore careers. This is not to suggest that the questions are new but to note that, if science is about asking questions, then changing the questions asked will change the answers. How can the content of the science problem connect with the experience and interests of the majority of my students? It means that you have to know something about their experience and interests.

In the film, Ursula tells the story that you may have heard. That of Alice Hamilton, a doctor working in the midst of a typhoid epidemic in Chicago. Alice asked not ‘is the kid sick’, but ‘why is the kid sick’? She looked at why so many poor families were getting sick and plotted their homes on a map of sewer repairs to identify the cause as unclean water. As Ursula says, “the tools of science in the hands of women are used to answer different questions.”

I am not the scientist, I am the person who supports the scientists in thinking about their context. I will share with you some of the projects I have worked on and some of the people I have heard. Canadians often feel like the mouse beside the elephant that is the USA. This is not always a negative experience as the trumpeting represents ten times as great a population as ours, and often reflects issues and presents work that we can use to our advantage. The next bit of laundry I will air is based on my recent experience at a conference in Chicago. [8] The incoming president of Women in Engineering Program Advocates Network (WEPAN) reminded us “If you keep doing what you have been doing, you will keep getting what you have been getting.” What I took from that was reinforced by others there who noted the lack of change. Debra Rolinson, Head of Advanced Electrochemical Materials Section, Naval Research Laboratory spoke about her field of chemistry. Graduate enrolment of women broke 20% in the USA in 1985. That was three tenure cycles ago. She looked at who was on the tenure track at the top 10 universities in America. It was 10% women in 2000, and 12% in 2002. Very few universities were over 15%. So what do we need to do differently? Ilene Busch-Vishniac is Dean of the Whiting School of Engineering,

Johns Hopkins University, Baltimore, Maryland, USA. Her questions were, after all the work we have done since the 80's, why haven't we come further? What is wrong with the model? Fixing the women is not fixing the problem. Ilene concludes that we have to change the culture and that the leadership does not care enough. We need to demand and be confrontational because anything less than total commitment on the part of leadership is unacceptable.

The context of the work and biases built in to the system are the conditions that necessitate asking different questions. These questions can be as direct as – how do things get done? The important act is to uncover the processes and bring them to light. Another subject in the film, Karen Messing works in Montreal and looks at workers in the workplace. At the Centre for the Study of the Interaction of Health and the Environment, Karen and her colleagues ensure that women's questions are included in the research. Her impetus was reinforced when, as a subject in a study of pregnant women, she was asked many questions including what her husband did for a living. She was never asked what her occupation was. According to Karen, most paid occupational health research does not acknowledge that 50% of the workers are women. Occupations where women dominate have not been studied. Cleaners and hairdressers are not thought of as chemical workers; the work doesn't look dangerous. There is a parallel here (about the position of importance of activities) with gardening. This traditional practice of women used scientific processes of observing, collecting and analyzing data about plants – once institutionalized it was no longer gardening, but agricultural science, the important territory of men.

Women are absent from all but 14% of the major USA occupational cancer studies. Karen's goal is to synthesize the special knowledge of the workers with the special knowledge of scientists together to make collaborative science, organic science. She has been told that the Centre does "bad science" because they are not "objective". She says women are brought up to listen to people. Both the employer and the employee may be biased. Karen asserts that we should put our biases on the table and deal with them.

In the film, Ursula speaks about "Franklin's earthworm theory of social change." She describes it like this: "things grow organically. Particularly women prepare the ground for better ways of doing science. If people aren't participating, there will be no change. It is only when we have good use of a well-prepared soil, that a better science will come."

In the USA, what first drove the openings for change in science curriculum and attracting more students was the Russians being first with Sputnik. According to Debra Rolinson, [9] because the USA depends on immigration for 40% of its S&T workers, post September 11, 2001 'fear of foreigners' has lead the administration to want to train more of its citizens for S&T. This makes it even more crucial, to ensure that the new ones coming in connect with the need for the practice of S&T as if people mattered. Be ready with action plans when such a moment of disruption occurs.

As Dewandre suggested, politics is key – to connect with leadership in that arena. An ally in political or administrative leadership can help you 'get it right' being in the right position at the right time. After many years of preparing the ground in Ontario, developing excellent resources and hanging then out to dry in the education community, a key ally in a position of leadership came forward to support work in

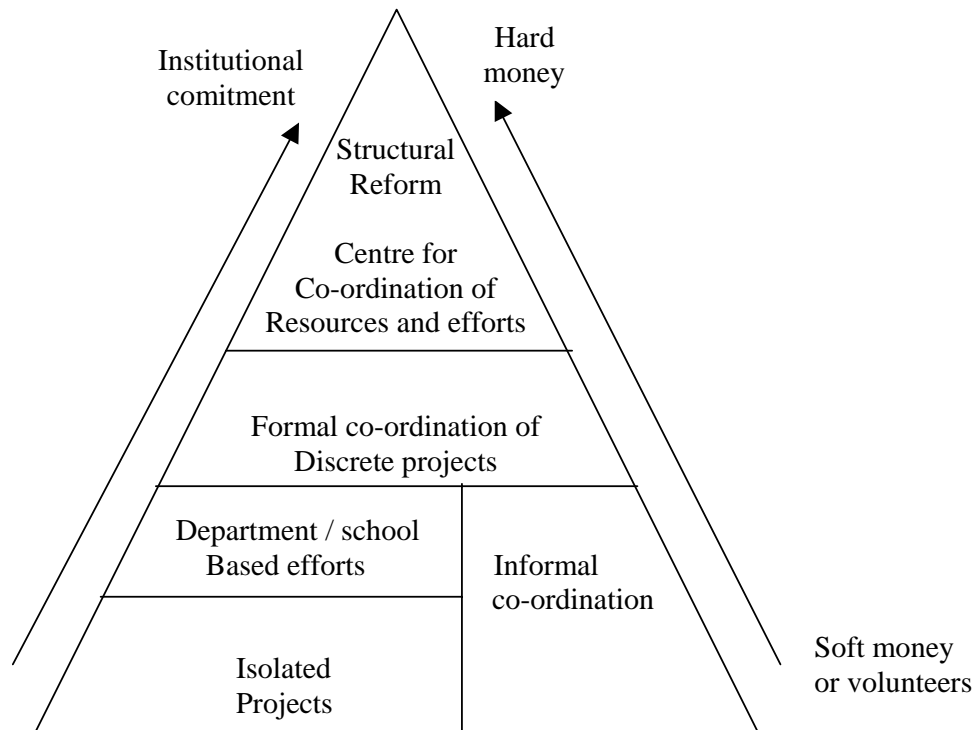
changing the way students were taught in faculties of education - he was the head of the body representing the Deans of Education in Ontario and was sensitive to equity issues and interested in taking action about gender. The Ontario government entered into a partnership with the Ontario Association of Deans of Education and with three faculties of education. *Teaching/Learning Gender Equity* [10] is a project that was the culmination of years of preparation and took a few years to achieve. The first stage created three partnership projects that each developed resources for use in faculties of education.

This work did not have a particular focus on science and technology. However, it is the process and the key enablers that are the point of my description. It is worth noting that colleagues in women's studies and education can be valuable allies to those interested in change in science and technology. This is the overlap that GASAT can represent. In this Canadian project, each set of resources developed was based in research and applied different methods and approaches to teaching gender equity. They achieved this by:

- teaching pre-service students how to analyze the gendered structure of all aspects of education;
- helping pre-service students understand the need to improve the educational experiences of females in elementary and secondary schools; and
- introducing appropriate strategies to meet this goal; and ensuring that gender equity becomes a core component of the teaching courses and processes of faculties of education.

The steps of change and the different questions were not, as we say, rocket science. However, the process did proceed further along the model for the evolution of intervention programs developed by Chubin and Malcom in "Policies to Promote Women in Science." [11] Briefly put, this model is a triangle – at the base are the large number of isolated projects that rely on individual commitment, and soft money and volunteers. The *Teaching/Learning Gender Equity* project, with the involvement of the Deans, moved further along toward institutional commitment and formal coordination of the work at three faculties, although it did not reach the peak of their triangle where institutional commitment is combined with hard money to produce structural reform.

## Model for the Evolution of Intervention Programs



The researchers and professors who were involved aired these comments on the public washing line at the end of the *Teaching/Learning Gender Equity* project – “The project teams are aware that while short-term response is measurable, the more long-term effects of the resources and how they might accomplish change are not yet evident. To bring about a more definite change will require long-term commitment on the part of faculties of education. A more immediate response, however, is the awakening of gender equity awareness among teacher candidates and their educators - an awareness that can lead to action, involvement and the building of links. These links, in turn, build a learning network that supports the implementation of policies and practices that encourage the understanding and discussion of gender equity issues in education. *The Teaching/Learning Gender Equity* project teams are confident that this goal can be achieved.”

I think they were overly optimistic. The final goal “ensuring that gender equity becomes a core component of the teaching courses and processes of faculties of education.” cannot yet be demonstrated. The resources are excellent and, where they are used, they are the earthworms preparing the soil. However, the seeds of leadership commitment and systemic transformation have yet to germinate.

On a smaller scale, Nancy Hopkins at the Massachusetts Institute of Technology tells the story of a Department Chair realizing with horror the implications of a senior faculty member saying she had never been invited to sit on a PhD committee. He knows that the committee meetings are a site for the exchange of valuable career information. Finally, he was “getting it,” understanding that there were issues that needed to be addressed. Nancy said that the process must be institutionalized, that you need a stable administration. I encourage you to tell the stories, ask the questions: in my experience, if a man has daughters, he is able to engage with descriptions of “poisoned climate” because he can envisage his daughter in it, and he does not want

anything but the best for her. If the female leader is not a feminist, you will need to develop creative ways to engage her in the work. When we act, we model different ways of acting.

Rosalind Cairncross has played an instrumental part in advancing the role of women in science. Although based in Toronto, in the film *Asking Different Questions*, Rosalind is shown modelling another way of practising science in her work in South Africa. In her searching for a new approach, Rosalind uses environmental models that break down the silos of air, water and soil in response to the difficulty women had answering questions she posed for a pre-Rio conference study. Her establishing principle is interconnectedness and an understanding of the interconnectedness that will improve science — “will stitch things together so we know how the whole thing works.” Rosalind says we “need new structures because the planet has forever to recover. It is us that are in trouble – we have been provided with the means of our survival. We did nothing to grow an apple and we are destroying the apple tree.”

In the film, Rina MacKillop, an engineering student at the University of Toronto, describes her classroom culture as “cold, not friendly”. Clearly 20% women students are not enough of a mass to shift the focus of the masculine history and traditions of the climate. Rina observes her female colleagues as subdued, and says that they “do engineering in a male way”. We in GASAT know the strategies to make the studies more inclusive, for there are many papers written and action research done to guide us in that path.

Here I offer a large item from the laundry basket, one with several pockets of activity. A multi-phase project in Ontario aimed to address some of these issues by asking particular questions that parallel the methodology developed by Status of Women Canada for its Gender Based Analysis model. The model is based on the value that “Constructive partnerships are needed between women and men.” It also assumes that “Every action, policy, program, project and socio-economic trend affects women and men differently.”

The goal of the project focused on actions that universities can take to improve the attraction and retention of undergraduate female students in engineering and applied science. It was conceived as a parallel to the work done in faculties of education, and in response to various points including the enrolment statistics. In Ontario at the start of the project in 1998, less than 22% of the full-time engineering and applied science students were women. This when, in Canada 1999, 52% of all undergraduates were women.

In March of 2000 a partnership was formed of concerned representatives from the engineering profession, engineering educators and government. As with the work in faculties of education, the relatively small amount of government funds supported those interested in the issues and unleashed a much larger commitment of volunteer and in-kind support.

The first step of Gender Based Analysis is to collect information that is sex-disaggregated: to count the number of women and men involved in any activity. The Women in Engineering project started with hiring a consultant to define the scope of the problem and collect the current knowledge. We were lucky to be able to hire Etta Wharton, an engineer and a founding member of Women in Science and Engineering. Through a review of the literature and current resources and through visits to 12 of the then 13 faculties of engineering in Ontario, Etta described the situation and made

recommendations. Her report was published as *Where We Are And Where We Need To Go*. [12] Briefly, the findings were no surprise. I have chosen a few to note. In any local situation, you need to start with this kind of data to support the leaders as you push them for change.

Commitment to change is needed. This requires social change and commitment to it by all levels of education policy makers, all levels of school, teachers, professional associations, advocates, parents, media and the students themselves. Structural reform is essential.

Where is it that we ask the questions in order to move up the evolution of the triangle?

Most initiatives are at the bottom of the pyramid, receiving small amounts of money, requiring lots of volunteer effort and commitment of individuals. Most trying to inform students about what engineering is and how it could be an attractive career. However, positive influences have been shown by science outreach. Women students report that they were encouraged by outreach activities and also by physics teachers, esp. women teachers, and meeting women engineers. We have made an impact on enrolment but this impact waxes and wanes because activities are done by volunteers. Leadership on these actions comes from an individual's personal values. If their position changes, there is no continuity or moving forward/progress.

Universities think the answer lies elsewhere in society at large and at lower levels of education. In my experience and reported by many others, those at any given level of an institution or system think they are doing a fine job; they are not the "problem". If only the ones before or after them would ... One question I heard recently puts the onus back where it belongs: what is the institutional responsibility about how their product is seen by their clients?

Equality of access in Canada is not the issue. This is a concept most familiar to equity-seeking Canadians. Judge Rosalie Abella was the sole Commissioner and author of the 1984 Canadian Report of the Royal Commission on Equality in Employment. In her report she introduced the concept that "equal access is not sufficient" the only true measure is equality of outcome. [13]

According to Beatriz Clewell and Patricia Campbell in the recent "Taking Stock: Where We've Been, Where We Are, Where We're Going," [14] "high quality courses are necessary but not sufficient ... to increase women's representation in STEM majors." Resources, outreach programs and all the other wonderful initiatives are necessary, but are not sufficient to transform any system.

The issues pointed to in Etta's report are specific to the Ontario context. Here you have to ask your own questions – to see where a generalization might be useful to apply to your context. I offer a few.

There are misconceptions about the pool of women students who have passed physics in secondary school. "Women not available and qualified." This is not true. The number of women with the prerequisites is more than ALL the spaces in first year engineering.

What is the right time to intervene? Early had been thought best, but late has been shown to be very effective. (I would say that multiple points of entry are appropriate.)

Women's image of engineering is not clear how engineering contributes to society, or how and how much engineering means working with people. It is no surprise that in Ontario chemical, biological, environmental engineering studies that articulate the relationship to society and people have higher percentages of women.

More inclusive engineering education is needed. As Sue Rosser observed in the teaching of science, – there is systemic bias in the teaching methods, instructor behaviours, course content and organization.

In Etta's research, undergraduate women in engineering reported that they 'go along to get along'. They don't want to stand out – it's a survival strategy. Diving back into the film references to hang another story on the laundry line, Peggy Tripp-Knowles is the only women professor in the Departments of Biology and Forestry at Lakehead. She wanted to know more about trees; her colleagues wanted to do applied research. As the town's biggest industry, lumbering was an obvious client to be served. The emphasis was in designing better trees. In the film, she asks "is it any wonder that thinking people stay away from that research culture?"

Peggy says she often felt that she had a different opinion, a different approach. It wasn't a comfortable place to be. Not being one to "go along to get along", she was not silent about her belief that we should not try to manage and control nature. There was no money for any other type of research so she closed her laboratory and gave the money back. She decided to look for another way to express her love of science to nature. Peggy wants to use her credibility as a scientist to show that "even scientists can see some problems. It is not 'just' emotional environmentalists." Peggy says that just getting women in to science will not make a difference. What will make a difference are feminists in science. We need to attract those who are aware of gender issues.

A list I have developed based on my experience and learning from many others includes the following necessary conditions for change. The question still remains, are they sufficient? I propose as necessary conditions -

- Commitment from leadership.
- Access to "local knowledge".
- A responsibility centre with time & power.
- Identification and engagement of key allies.

Once you have the local data, have collected relevant models of best practices and have found out who is already involved or doing similar work, then the steps of action planning are to

- Involve those affected.
- Draw on experience.
- Draw out their desire and capacity for change.
- Encourage and challenge them to make alliances and to blow their own horn. Tell everyone what they are doing because you never know where an ally might be found – perhaps in the Prime Minister's residence.

Similar steps are used by Rosalind Cairncross as she does environmental work in South Africa and works with the people who fish. In *Asking Different Questions*, she talks about the current practice as science that is “far away from the people”. In addressing the problem of depletion in fish stocks, Rosalind first listens to local experience. She says the people who fish are not biologists, but they know a lot more about fish in their waters than the biologists do. In this case the government said the depletion was due to over-fishing. While listening to the workers, Rosalind learned that there had been an increase in the presence of mining boats in the waters. The boats not only created constant noise that disturbed the fish, but there had also been an increase in the number of seals and they were eating more fish. In incorporating all sides of the story, Rosalind hopes to show that science can be useful, and relevant rather than being the cause of the problem.

What resources do we need? How to test them? After the report to the Ontario project on women in engineering was released, an action plan was developed. The report concluded that current activity is ad hoc, low on the Chubin and Malcom pyramid. Tinkering around the edges is important. It builds community, identifies allies and raises awareness. It is necessary but structural reform is essential.

The project designed a series of activities. First was to publicize the report to the key stakeholders, especially the Council of Ontario Deans of Engineering, and establish dialogue and consultation to get “buy in”. A second activity was the development of a model workshop for academic staff *Communication and Gender Differences in the Classroom: A Workshop Kit with Facilitation Notes and Videos for use in Faculties of Engineering*. [15]

Another pocket of action in the larger project is focusing on improving engineering pedagogy. How to look at a particular system’s bias? Again, the funding levered a significant in-kind contribution and encouraged researchers to focus on identifying the component parts of the system’s bias, and hanging them out on the laundry line for all to see – air the issues. How might the process of investigation be started, who needs to be involved? Four teams of Ontario researchers are developing proposals to go to major funding bodies. The project itself is encouraging our Natural Sciences and Engineering Research Council to ask different questions about their role in funding research to improve engineering education.

Any change project needs to have an analytical process. An in-depth analysis would pose key questions to get at the power issues in the structure:

Do women and men have the same experiences in science and technology?

Do women and men have equal access to the resources needed to benefit?

Who controls the decision-making processes related to this issue?

Who controls/owns the resources related to this issue?

With respect to the last two, if the answer is a corporation, institution or agency, then who heads up or controls the same?

No doubt you have your own list of good questions and steps to promote change in your own laundry baskets, and some of you will no doubt be talking about that work during this conference. I am interested in the right clothes pegs — how to get the answers hung on the public washing line to flap in the breeze and be used, not just looked at. How to get the information used and the system transformed.

“Just trying to do their job”. In my current work with engineers, it is clear that for many of them thinking about the process of how things get done is seen as an add-on, not ‘real work’. At the conferences they attend like those of the Canadian Medical and Biological Society or the Canadian Society for Engineering Management, engineers discuss their disciplines. When they are at a conference such as the recent WEPAN, the delegates revel in the overlaps, the chance to talk about their particular experiences and note how different the event is. There is an opportunity to talk and learn about projects that work on values, that address issues of climate, and systemic practices that serve to limit women and girls because “we’ve always done it that way”. An important question that comes out of this work that leadership must be asked is –what is the outcome? If, for example, a faculty of engineering has 20% graduate students who are women but 8% of the faculty, what needs to change? Why are our tax dollars supporting an institution that can’t hold on to its graduates in equal measure? What are the pressure points to push leaders into action? Media pressure? Moral suasion? Need for workers? What are the examples that will demonstrate the imperative for change?

Christopher Scholes’ QWERTY keyboard design earned him the title of ‘father of the typewriter’ not because it particularly helped typists, but because it prevented keys from jamming in the carriage. It put machine efficiency over human efficiency. A later design, the Dvorak design, was shown to improve typists’ speed and reduce typing errors. —The practice of technology taking people into account. But by then, I have read, an infrastructure of factories tooled to make the Scholes model, typing schools dedicated to teaching it and millions of typists trained on that keyboard prevented the other choice path from flourishing. No longer does society follow such blatantly ridiculous paths, one hopes.

It is now time for a large finely woven piece of fabric to be hung on the clothesline. Sue Rosser is the author of much interesting work. Sue attended the ICWES 12 conference last year in Ottawa and spoke about various forms of feminism. [16] I have chosen two to bring to this talk-

From her material: Psychoanalytic Feminism is based on Freud’s idea that “anatomy is destiny”. Women are seen as caregivers; men as leaders. These differences may alter their approaches to certain problem solving. For example, computer science studies have shown that women approach a problem with empathy and a holistic view while men tend to focus on the formulas themselves.

Essentialist Feminism proclaims sexual equality as well as celebrating the differences, and uniting all women through biology. This theory claims that women are closer to the environment because of their hormones and that this leads them to develop technology that is socially conscious. Because of their biological makeup, men tend to develop technologies to conquer and develop the modern world and to give death and destruction to the natural world.

I do not subscribe to the conclusions of either of these theories — not all women are caregivers and not all men are leaders. Nor do they necessarily want to be. However, there may be some truth in every generalization we make about gendered behaviour. Therein lies a lot of the pressure that is put on men and women. My “different” question would be – what unites us as people? How can we connect with all students in their diversity of outlooks? Many researchers have corroborated the difference in outlook of women and men, and the film *Asking Different Questions* is based on the notion that women do bring something essentially different to the table. The question

is – who cares that they might? Does anyone care to listen to their different questions? Or care to offer different answers?

Projects that utilize these theories described by Rosser ensure that the problems in the curriculum, the projects and special assignments are all designed to engage the thinker who is empathetic, thinks holistically and is socially conscious- whether the thinker is male or female. In Canada there are many programs that use the strategy of mentoring and role modeling. The focus is on career education when this is done in secondary or tertiary education. Adults in the workforce have their awareness raised and use examples and experiences that will connect with empathic students – in Ontario this focus has been used in several ways since the late 80s. For example, a series of posters was printed – each one featured a woman in a “non-traditional” occupation and the text included a quote from her about the personal aspects of her job. These quotes showed how her values were expressed through her work and life and, thereby, made a personal connection to the information.

The caution here - we cannot set up our precious subjects for an ideal life and then turn them out into a workplace that is unfriendly and unequal, that focuses on competition against all other goals. It would be like taking a piece of fine lace, crafted by hand, and putting it through the wringer washer or beating it on the rocks. Again quoting Clewell and Campbell, we must look forward to the improvement of “working conditions in both industry and academe for female scientists and engineers ... [for those] who are prepared to enter S&E fields but do not do so ... may have ... not liked what they have seen.” Industry and academe must look inward and take responsibility for improving their cultural climate to attract and keep women and the diversity of the population.

I will be interested to know if the next question is being asked much outside North America. Advocates for equality need to be prepared for it once a certain amount of ground has been tilled and the laundry is flapping – what about the boys? Most often this question is a strategically posed red herring: it deflects from the root causes of the problems for men.

Another noted Canadian feminist Michelle Landsberg, writing in June 2003 in her column in *The Toronto Star*, names this red herring:

“For all their academic accomplishment, women still hold only 14 per cent of the full professorships. They are 21 per cent of Canada’s senior managers. And their incomes lag behind men’s at every stage of their career, even when they work full-time in identical jobs. Women, especially women of colour and aboriginal women, are more than twice as likely to be poor as men are.”

“So, the patriarchy is safe, thank you very much. Men have little to fear from women, but a great deal to fear from globalization, economic restructuring, downsizing and the loss of well-paid industrialized jobs, melting away to the subsistence-wage world with a giant sucking sound. Hence the panic and the woman blaming, no matter how illogical.

If boys are to catch up with girls in literacy, an entire heritage of gender-conditioning will have to be jettisoned. All that energy, affection, curiosity and life force we see in little boys is channelled, not into free play, but into violent corporate sports with their sick emphasis on competition, emotional inexpressiveness, cruelty, unearned wealth and male dominance. Both boys and girls can and should excel in all subjects; the

fault is in us, not in them.” It is the system that has to change. To date we have not seen much evidence of long term, fixed budget item hard money allocated to this end. Political and administrative leaders must show they mean business and move beyond the individual activities at the bottom of the triangle.

I will end on a more personal level, and invite you to consider Adrienne Rich’s observation: “The most important thing a woman can do for another is to illuminate and expand her sense of possibilities.” The questions I most want answered are, what can we do for the best to ensure that all girls and women have a chance to expand their sense of possibilities for the betterment of all? (I want the ones who have the desire, to be in the fields of science and technology, so that we have a better chance to see it practiced as if people mattered.) and what can we do for the best to engage with key politicians and policy makers to institutionalize the strategies for change – with hard money attached?

Thank you for the opportunity to air my laundry, my issues on the public clothesline of this conference. Now, go out and hang up your laundry.

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The Quality of Education and School Life  
Dangers, Pleasures and Teenage Girls: A Report on Young Women and Sexuality  
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**KEYNOTE ADDRESS [Thursday 10 July 2003, 0900-1030, Chairperson – Dr Jayshree Mehta, Director, SATWAC, India]**

**By**

**Professor Lesley PARKER, Senior Deputy Vice Chancellor and Vice President,  
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### **THE EVOLVING GENDER-ICT AGENDA IN EDUCATION**

#### ***Abstract***

In this keynote address, I examine the evolution of understandings and practices associated with ICT in education, and the ways in which these understandings and practices interact with gender. I focus initially on the extent to which papers presented at GASAT conferences over the past twenty-two years have contributed to the gender/ICT debate. I frame my analysis along the lines proposed by Sutton (1991) and elaborated subsequently by Volman and van Eck (2001), in terms of “access”, “processes” and “outcomes”. Through my analysis, I provide a view of “where we were” (in 1981 at the first GASAT conference), and “where we are” (in 2003, at this 11th GASAT conference). I trace the progression of “how we got there” and go on to identify some issues to be faced in the immediate and longer-term futures, and the role GASAT is well-positioned to play in addressing these issues.

#### ***Acknowledgement***

I wish to acknowledge the valuable assistance of Susan Dunn, Curtin University of Technology, with the analysis of the GASAT Conference Proceedings and Contributions reported in this paper.

#### ***Introduction***

The theme of this conference – Gender, Science and Technology and Economic Paradigm Shifts – conjures up a host of tempting ideas to pursue in a Keynote Address, and the four sub-themes: New Initiatives in Science, Technology and Mathematics Education at the Formal Level; Meeting the Challenges of New Technologies; Women, Science, Technology and the Workforce; and, Gender, The Environment and Sustainable Development, suggest even more possibilities. I have chosen in this paper to focus on a topic – information and communications technology – which I believe impacts on all of the four conference sub-themes. My perspective is that an examination of the special case of information and communications technology (ICT) in education over the past two decades or so will tell us a lot in relation to our work towards achieving the aims of the whole international Gender and Science and Technology (GASAT) Association (see Appendix I) and in relation to the theme and sub-themes of this conference.

I need to point out that I have chosen ICT as the focus of this paper for two major reasons, in addition to its relevance to the theme and sub-themes of this Conference. First and foremost, there is little doubt that ICT will dominate in workplace, educational and social contexts by 2010. In this sense, as le Cornu (2003) has pointed out, ICT literacy is a core generic and transferable skill. Second, unlike science and mathematics education, which are traditional, established, disciplinary areas in most

education systems, going back several centuries, the place and expression of ICT in education have evolved within the lifetimes of many of us here at this Conference, as part of our everyday, taken-for-granted experiences, and they continue to evolve at a rapid and sometimes daunting pace. The social construction of ICT in education is an on-going process, in ways similar to those recognised by Gil Kirkup (1992), in her work on the social construction of computing.

A few years ago, a friend of mine said to me: you know we can't stand by and watch ICT education become gendered before our very eyes. I believe that this is a challenge which GASAT still needs to take up. My argument today is that GASAT

needs to explicitly recognise the dominance of ICT in education, and to ensure its inclusivity. This is crucial in many contexts, not the least of which is the role ICT plays in flexible learning solutions – solutions which are so important to the ways in which many women acquire or update their qualifications. I argue, further, that, as one of the few international organisations committed, for more than two decades, to equity and social justice in science and technology education, we know enough to ensure equitable outcomes in the area of ICT in education, and to advise others accordingly. In a sense, then, I would like GASAT to see itself as the custodian of the process of social construction of ICT in education.

### *Aims of this Paper*

#### **My aims in this paper are to**

- present an analysis of the extent to which papers presented at GASAT conferences over the past 22 years have contributed to the gender/ICT debate;
- highlight the gaps in knowledge and research in relation to the interaction of gender with ICT education; and
- suggest ways in which GASAT might contribute to filling these gaps, and might play a custodial role with respect to the process of social construction of ICT in education.

### *The Structure of the Analysis*

As indicated earlier, my analysis of GASAT papers on ICT is structured in terms of the pioneering work of Sutton (1991), who provided a review of a decade of research on equity and computers in schools, focusing on three themes: access to computers, processes of computer-related learning, and outcomes. Volman and van Eck (2001) followed up the work of Sutton with an analysis of what they called “the second decade”, focused in particular on gender equity. As indicated above, my analysis spans the twenty-two years of GASAT conferences, and essentially traces the role which GASAT has played in this area of education.

In my analysis, I have interpreted the themes of access, processes and outcomes in the following ways. The “access” theme covers opportunities available both informally (e.g. in the home or the community) and through formal educational settings such as schools, technical colleges and universities (including both accredited courses and special optional or targeted opportunities, such as camps or seminars organised under the auspices of a formal educational body). The “processes” theme covers all aspects of the content, pedagogy and assessment of computer or ICT-related learning. As in the case of the two reviews referred to above, this includes type of use of computers, teacher attitudes and behaviour, the curriculum (including software), assessment,

student interactions and student approaches to learning. The “outcomes” theme covers student learning outcomes in terms of knowledge, skills, attitudes, values and behaviours (including choice of subsequent careers or areas of study). In the latter sense, there can be conflation of outcomes and access, since, in some cases, the outcome of interest or attitude is a behaviour related to future choices.

At the outset of this analysis, it is important to acknowledge a striking feature of the evolutionary journey, namely the transition, in both definitional and practical terms, from a narrow focus on “computers in learning” to the current much broader focus on ICT in education. As we all now recognise, the use and study of ICT in education is not just about computers – it involves many different facets of the whole educational/IT prism, including the ways in which students engage with learning, both formally and informally, in both local and global contexts, the ways in which the outcomes of that learning are affected and measured, the creation of learning environments which ensure that ICT adds value to students’ learning, and the role of teachers in such environments. Not surprisingly, this transition is reflected in contrasts between papers presented at earlier and later GASAT conferences.

Table 1 (see Appendix II) provides an analysis of the proceedings at the following 11 GASAT conferences, with papers categorised in terms of content related to “access”, “processes”, “outcomes”, and/or “other” (if outside the previous three categories.)

- 1981 GASAT 1, for which I used the Contributions edited by Raat, Harding and Mottier (1981). These included a total of 21 papers, none of which focused on computers or ICT.
- 1983 GASAT 2, for which Lie’s (1983) Conference Report indicated a total of 32 papers, with no specific mention of any focused on computers or ICT.
- 1985 GASAT 3, with Contributions edited by Craig and Harding (1985) including 71 papers, four with a computer focus.
- 1987 GASAT 4, with Contributions (A Celebration of Diversity) edited by Daniels and Kahle (1987). These included 123 papers, 13 of which covered a computer-related topic.
- 1990 The European and Third World GASAT, the Contributions of 31 papers edited by Granstam and Frostfeld (1990), and including four related to computers.
- 1991 GASAT 6, with Contributions (Action for Equity: The second decade) edited by Rennie, Parker and Hildebrand (1991). These embraced 99 papers, with nine focused on computers.
- 1993 GASAT 7, with Contributions (Transforming Science and Technology: Our future depends on it) edited by Haggerty & Holmes (1993), and including 101 papers, 14 of which were relevant to computers or ICT.
- 1996 GASAT 8, with Contributions (Towards Sustainable Development: Achieving the 4E’s) edited by the SATWAC Foundation, and including 99 papers, nine of which focused on computers or ICT.
- 1996 The Australian, New Zealand and South Pacific Regional GASAT, the Proceedings of which were edited by Godfrey (1996). These showed 25 papers, included three on computers.
- 1997 The Australasian Joint Regional Conference of GASAT and IOSTE, with Proceedings edited by Goodell (1998). The GASAT section of these Proceedings included 30 papers, four of which were relevant to computers or ICT.

2001 GASAT 10, for which Conference Contributions (World Wide Wisdom – Socially responsible and gender inclusive Science and Technology) were distributed by conference organisers. These included 111 papers, with 14 focused on computers or ICT.

Two points need to be noted here: first, some conference proceedings are missing from my list, because I did not have access to the publications. I will return to this point later in the paper. Second, in some cases, the categorisation into Sutton’s three areas was not clear-cut, while in others, papers covered more than one area. Hence, the categorisation is not in any sense pure or absolute – it involves quite subjective judgments which could well be made quite differently by another reader. In this sense, although the outcome of the analysis is a notional indication only, it is nevertheless sufficient to tell us a “story” in relation to GASAT’s contribution to the ICT/gender debate.

Table 2 presents a summary of the numbers of computer or ICT-related papers at the various GASAT conferences between 1981 and 2001, showing the percentage of ICT-related papers at each conference.

**Table 2: Summary of Computer or ICT-Related Papers at GASAT Conferences, 1981-2001**

<b>Conference</b>	<b>Year</b>	<b>Total papers</b>	<b>Total ICT- Related papers</b>	<b>ICT as % of Total</b>
GASAT 1	1981	21	0	0.0%
GASAT 2	1983	32	0	0.0%
GASAT 3	1985	71	4	5.6%
GASAT 4 E&TW	1987	123	13	10.6%
GASAT	1990	31	4	12.9%
GASAT 6	1991	99	9	9.1%
GASAT 7	1993	10	114	13.9%
GASAT 8	1996	99	9	9.1%
GASAT (ASPRC)	1996	25	3	12.0%
GASAT & IOSTE	1997	30	4	13.3%
GASAT 10	2001	111	14	12.6%
<b>TOTAL</b>		<b>743</b>	<b>74</b>	<b>10.0%</b>

As indicated in Table 2, of the total of 743 papers available to me, around 10% were relevant to computers or ICT. There were, however, very few such papers at the early conferences (1981, 1983, 1985). It was only from 1987 onwards that the proportion of total papers began to hover between 9% and 14%.

Further, my analysis revealed that the majority of the papers presented focused on various dimension of the “access” of females to computers or ICT. Approximately half of this number addressed issues associated with the “processes” of learning, but a much smaller number documented the “outcomes” of learning, other than those associated with subsequent progression to more advanced courses or to careers in

computer science or ICT. It is of interest that papers at the most recent conference (GASAT 10) demonstrated an increased focus on some of the more socio-political aspects of the use of computers and ICT, linked to issues of empowerment of women, as foreshadowed by Nancy Kreinberg at GASAT 4 in 1987.

Overall, what has been revealed in many cases repeats what is already known in relation to the interaction of gender with science and mathematics. I am moved to question whether this is enough. Does the work on “access”, “processes” and “outcomes” tell us anything more than what Alison Kelly (1985) described as the issues for gender and science in terms of “numbers” (the disproportionately large numbers of males who study, teach and are identified as legitimate practitioners in the area); “packaging” (the masculine bias of the presentation and packaging of curriculum materials); “practices” (the male-oriented patterns of classroom processes) and “world view of the discipline” (the intrinsically masculine world view embodied in the type of thinking commonly associated with the discipline)? We would have expected, from that and subsequent work, that gender-inclusive ICT:

- (a) would have content which is sex-equitable in its use of language and would include illustrations and examples which have meaning in the lives of both females and males;
- (b) would have content which emphasises social and environmental issues;
- (c) would have pedagogy emphasising interpersonal negotiation, human interaction, language, active participation by students and real-life contexts;
- (d) would have school-based informal assessment procedures with relatively open-ended tasks drawing on contexts which are familiar to both males and females; and
- (e) would pay attention to students’ self-awareness of the extent to which their education-related decisions and experiences are socially constructed, and are products of hegemonic influences on themselves and their teachers.

The GASAT papers (and indeed much of the other research reviewed by Sutton (1991) and Volman and van Eck (2001)), have largely confirmed this situation for ICT in education, with perhaps less confirmatory evidence in relation to (d) and (e) above. I really feel there must be something more. Perhaps looking at the gaps in research will tell us.

### ***The Gaps in Research***

This overview of the GASAT contributions over two decades, together with the review conducted by Volman and van Eck (2001) has revealed a number of major gaps in research, and possibly also in the translation of that research into practice – gaps which GASAT members are well-placed to address.

The first of these concerns Sutton’s (1991) plea for research to include not only gender, but simultaneous consideration of the major status variables of gender, race and class. Overall, there is little evidence of this more comprehensive approach in GASAT papers, other than some of the more recent papers. For example, Kirkup and Li (2001) report both cross-cultural and gender differences found in their research on use of the Internet, carried out with higher education students in China and the UK. That there is not more research by GASAT members on the interaction of gender,

race, and class is somewhat surprising, given the diversity of our membership – spanning over 30 different countries and, even within the same country, many different cultural backgrounds. I note that, in terms of the many different disciplinary backgrounds from which we draw our membership, GASAT is also positioned well to conceptualise and carry out cross-disciplinary studies

The second gap relates to a need for more precision in the research on ICT in education. As Volman and van Eck (2001, p.626) remarked in their summary of research on ICT-related attitudes, the answers to research questions depend on “what sorts of attitudes are being measured, the skills in question, what computers are being used for, and the ages of the students.” They emphasised also the importance of specifying the computer or ICT application in the research context. The terms computer and ICT are used to refer to such a wide range of applications, that confusion can arise and valuable information about differential patterns of use can be masked if the application(s) are not specified precisely. Many GASAT papers do not exhibit the degree of precision considered desirable by Volman and van Eck. Especially in the early years, the term “computer” is used very generically, although there are some outstanding exceptions. These include the precision in the papers by Siann (1987) and Bernhard (1991), both of which were specific about the computer application (LOGO) and age of participants in their studies. The pioneering work of Sanders (1987, 1993) also made a significant contribution in this regard, providing details of ages and background characteristics of groups targeted by a range of strategies aimed at improving outcomes for females in computers, and evaluative information on the outcomes of initiatives. In the latter sense (of evaluation of outcomes), as noted earlier, there is a dearth of papers, not only on the outcomes of initiatives (did they work? how do we know?) but also on the outcomes for students of their engagement with computers or ICT (what did they learn?).

A third gap concerns software. Although, as Volman and van Eck (2001, p.619) commented, “empirical research on the effect of software on the attitudes and performance of students scarcely exists”, it is in this area that the translation of the principles of gender-inclusivity into practice is important. Some limited use has been made by commercial operators of assumptions (largely un-tested) about gender differences in relation to software and websites. There is also some evidence that the basic tenets established for gender-inclusivity are being followed in the development of some educational software. Close to home, I am pleased to observe that the two areas of science and ICT have come together in a major science education software development project being undertaken currently in Australia (The Le@rning Federation project). For this project, as indicated in the “educational soundness” specifications (, 2002) a focus on inclusivity (including gender inclusivity) is mandated. Developers are required to design learning objects, sequences and materials that provide learning through a range of activities known to support diverse learning needs, and to engage learners in active learning processes, reflecting and providing for a variety of learning modes and preferences. The four principles underpinning the development of the software (and its evaluation) – (i) a learner focus, (ii) integrity, (iii) useability, and (iv) accessibility – are described in ways which, in theory at least, should ensure gender inclusiveness. Only time and astute evaluation will tell whether such inclusivity is realised in practice.

Returning to the gaps in research, however, a fourth gap concerns research on pedagogy and the role of teachers in conveying hidden messages and expectations. In several cases, this aspect of pedagogy is included in papers (e.g. in Holm’s (1987)

research on the “hidden curriculum” of teaching and technology in technical schools in Denmark, and Clarke’s (1991) analysis of female-friendly computing environments). Overall, however, and perhaps surprisingly, there is not a major focus on this area in the GASAT papers.

A fifth gap concerns assessment. Increasingly, in recent years, it has been recognised, including at GASAT conferences (e.g. Murphy, 1993), that decisions about the form and organisation of assessment in any education system are not neutral decisions. They are now seen as reflecting strongly what is valued by the system, and as defining what is taught, what is meant by “achievement” and which students succeed. In this climate, there has been considerable interest in the interaction of gender with different formats, contexts and modes of assessment, with some agreement emerging that “gender-fair” assessment should include relatively open-ended tasks, drawing on a variety of contexts relevant to both females and males. Given the pioneering work of several GASAT presenters in this area, it is of interest that no GASAT papers have extended any of this work to include assessment of the outcomes of computer or ICT education.

A sixth, and perhaps the major, gap, concerns the need for research to be more theoretically informed, and analytical and explanatory in nature. Sutton commented in 1991 that the research she had reviewed then was largely atheoretical, and descriptive. She went on to say that “this is not unexpected in a new field” (1991, p.477). However, 22 years on, this is no longer a “new field”, and more progress in terms of theory-building might have been expected.

The reality is that much of the current research on gender and ICT is itself riddled with assumptions about computers/ICT as a male domain and is anchored in dualisms and dichotomies about “masculine” and “feminine”. Indeed, it is possible that research on computers and ICT in education suffers from a “double whammy” in this regard. As pointed out by Frantz and Warren (1993),

“Because the language of the computer is based on a binary system, one’s interaction with it can be either right or wrong, verified or unverified, supported or unsupported. It inherently supports a dualistic concept” (p.241).

Thinking dualistically also puts a particular bias on the kinds of research questions asked, as evidenced in the prevailing focus on differences between males and females. As Schofield (1995) has noted, however, evidence of the nature and extent of interaction between gender and computers is inconsistent. This suggests that research should go beyond a focus on dichotomies and (frequently unexplained) differences, to explore alternative paradigms. As emphasised by Ann Holmes in an earlier Keynote Address at this conference, “if you keep doing what you’ve been doing, you’ll keep getting what you’ve been getting”. There is a strong message here for us, in terms of research paradigms.

With respect to alternative paradigms, previously (Parker, 1997) I have suggested a model of gender inclusivity which sees dualisms as complementary rather than oppositional. I have argued that, although dualisms may have helped some feminist scholars to expose the inherently masculinist bias of some disciplines, we are now at a point where they have actually served their purpose. What is needed now is a vision of inclusivity which is pluralistic and eclectic. Dualisms which have, in the past, been

presented as oppositional, need to be seen as complementary. This approach is supported by the work of Thorne (1993, 2001), who argues also that

“the contrastive framework has outlived its usefulness, as has the gender ideology that it builds on and perpetuates. The view of gender as difference and binary opposition has been used to buttress male domination and to perpetuate related ideologies like the division between public and private” (p.108).

Thorne argues further that a focus on separate-but-different cultures and on dualisms associated with these leads to a loss of a sense of the whole. She emphasises the need to “start with a sense of the whole rather than as assumption of gender as separation and difference” (1993, p.108, italics in original), noting that

“If we begin by assuming different [male and female] cultures, separate spheres, or contrastive differences, we will also end up with a sharp sense of dichotomy rather than attending to multiple differences and sources of commonality.” (p 108)

She points out that the dynamics of gender are very complex – different dynamics are observable in different situations and contexts, in some cases “intertwined with other lines of difference and inequality, such as sexuality, social class, ethnicity and age” (2001, p.6). I have noted recently that Cervoni (2003) proposes to build on this through an investigation of “when, where and in what circumstances” boys and girls engage with education in ways which are perceived and defined culturally as “gendered”. This approach would appear to hold great promise for moving us forward.

### ***Summary and conclusions***

The analysis presented in this paper has revealed six major areas of concern, all of which have implications for GASAT.

First, since 1987, an average of 10 percent of the papers presented at GASAT conferences have focused on the interaction of gender with computers and/or ICT in education. Given that, as argued earlier in this paper, this area is critical to women’s advancement in workplace, educational and social contexts, one could question whether this is sufficient emphasis. This is a question which only GASAT members can answer, and which needs to be addressed at this conference. In this context, it is of interest to note that my preliminary analysis of papers at this conference indicates that ICT-related papers make up around 16 percent of the total papers – a considerable increase on previous years. Can this be taken as a portent for the future?

Second, of the papers which do focus on computers or ICT, the majority address issues associated with “access”. They are still very much at the level of “numbers of males and females”, in a sense the least sophisticated level of Kelly’s (1985) model referred to earlier. As noted by a previous Keynote Speaker, to focus on “access” is not enough. Given the maturity of GASAT as an organisation, there is a case for a shift in emphasis to the “packaging”, “practices” and “world view” dimensions of Kelly’s model – for a focus more on the outcomes of student learning, the outcomes of initiatives taken to enhance females’ experience with ICT, and the broader issues of empowerment of females.

Third, there is a need for much more precision in our reports of research and our descriptions of practice in the areas of ICT/computers. To me, the Objectives of

GASAT carry with them a message that we want to be influential in bringing about change which will benefit females engaging with science and technology. Again, as Ann Holmes emphasised yesterday, “social transformation is the ultimate aim of GASAT”. However, if we want to be influential, we need to be able to provide policy-makers and practitioners with much more precise information: which ICT applications? which girls? which attitudes? which skills? what context? And so on.

Fourth, we need to recognise the major gaps in research on the interaction of gender with ICT/computers. These show up, from both this and other reviews of research, as predominantly in the areas of pedagogy and assessment. In both of these areas, there has been much valuable work presented at previous GASAT conferences, which can be built on to explore issues associated with ICT and computers.

Fifth, the area is beginning to suffer from the lack of sound theoretical frameworks which move the dialogue beyond simplistic and counterproductive dualisms. As some other speakers at this conference (e.g. Gil Kirkup) have indicated, it is time for us to take stock – to review what we have been doing. I have suggested some promising directions for research, building on some of my own work and that of Thorne (1993, 2001). I would see such approaches as helping to move us on in many different ways, especially if we can capture the “multiple differences and sources of commonality” alluded to earlier. The evidence is that GASAT papers in the area of computers/ICT have included only very few which consider, simultaneously, other major status variables of gender, race, class, sexuality and socio-economic status. Just as real meanings associated with multi-textured and dynamic interaction can become lost when, as Thorne puts it, they are “collapsed into dualisms”, so too, it is necessary to recognise and include the “larger cultural fields in which gender relations, and the dynamics of power are constructed” (Thorne, 1993, p. 108). As I pointed out earlier, the tremendous diversity amongst GASAT members positions us well to conduct such multidimensional research. I suggest that members could plan and conduct more collaborative, cross-cultural research, utilising these opportunities at GASAT conferences for both planning and reporting.

Sixth and finally, how compete and accessible is the archive of GASAT contributions? As I indicated at the outset of this paper, some conference records were not available to me, and the fact that I had access to others was in some cases quite fortuitous. The establishment of the web-site for GASAT in the early 1990s, and its more recent consolidation, has been a major breakthrough, but we need to move now to ensure that a complete record of all of our conferences can be accessed through that web-site. I suggest we need a protocol for our publications. Even a cursory glance at what is available demonstrates inconsistencies: some have ISBN numbers, some do not; some have titles, some do not; some are officially attributed to Editors, some are not; and so on. If we want our work to be part of the academic canon, we must ensure that it is as professionally presented as possible. This, of course, has resource implications, and will need considerable discussion and dedication. It is not too much to expect, however, of an organisation which is now 22 years old.

In conclusion, then, I have argued that our vision for the future must embrace ICT explicitly. We are an international community of researchers, practitioners and facilitators committed to a specific set of Objectives encapsulating our concerns about the interaction of gender with science and technology. We have 22 years of

experience, in a wide variety of cultures, in relation to the achievement of these Objectives. Let's put it to good use!

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The Objectives of the GASAT Association are:

1. To encourage research into all aspects of gender differentiation in science and technology education and employment.
2. To foster gender equality in science and technology education.
3. To facilitate the entry of women into employment in the fields of science and technology and their progress within such employment.
4. To foster socially responsible and gender inclusive science and technology.
5. To provide a forum for dissemination and discussion of research findings and experiences of those in the field.
6. To provide a support network for those working towards the objectives outlined above.

**CLOSING CEREMONY (Master of Ceremony - Anita N Ramdinny)  
Friday 11 July 2003**

The Closing Ceremony was performed by Mr Suren Bissoondoyal, Chairman MIE Council.

Interventions were made by:

- Jaya Naugah
- Mona Dahms
- Sheila Thancanamootoo
- Prof S Bhoojedhur
- Pritam Parmessur
- Suren Bissoondoyal