MEETING THE CHALLENGES OF THE NEW TECHNOLOGIES IN SCIENCE EDUCATION IN SOUTHERN NIGERIA: THE GENDER SENSITIVE APPROACH

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ABSTRACT

Nigeria is under the compelling forces of two developments namely: globalization and democracy. In the last decade of the 20th century, it has grappled with challenges in science education delivery which has evoked efforts towards meeting the challenges of the new technologies from a gender sensitive perspective. The problem of gender stereotyping in science education in Nigeria still affects female participation in science, technology and mathematics (STM) education. This problem is evident in the teaching methods adopted in science, technology and mathematics classes, where teachers have unconsciously divided classes along gender lines. This development emphasizes gender equity issues which have continued to favour boys for science education at the expense of the girls. In this paper, six equity issues as highlighted by Brewton (2001) form the basis for discussion. The issues include (a). Mathematics, science and technology as male domain (b) peers', teachers' and society's' cultural expectations (c) biased and inappropriate curriculum materials (d) classroom interactions and atmosphere (e) anti-intellectualism and attributional style and (f) testing and assessment. These equity issues affect southern Nigeria in (a) low number of females participating in STM and (b) higher dropout rates for women in STM. Scholars agree that the problem of female participation in Southern Nigeria is essentially cultural. Based on The discussion, an action plan is summarized as follows: conscious effort at promoting equity in STM education; power stabilization programme for capacity utilization of power equipment; regular workshops for STM teachers; repositioning STM education in line with emerging new technologies and expanded science teacher education for women in STM. This will form the framework for meeting the new challenges of the new technologies in STM education in Southern Nigeria.

Introduction

Traditional and modern societies in most parts of the world are yet to be free from gender stereotyping even as globalization and democracy are taking centre stage in world affairs. Gender stereotyping has also permeated the entire school system especially in the study of science, technology and mathematics. For instance, there are 'masculine' subjects such as science, technology and mathematics; and the so called 'feminine' subjects such as Home economics, literature and secretarial studies.

In Nigeria, gender imbalance in pupil enrolment has heightened the problem of stereotyping because in many states female enrolment were as low as 23% (UNESCO 1998). Some socio-cultural factors have been identified as being responsible for low female enrolment in some parts of Nigeria. Such factors may include early marriage of girls; teenage pregnancy; engagement in some income-generating activities (UNESCO, 1998). Tsado (1998) noted that the socio-cultural dimension of the problem has become a myth to the extent that girls have consciously or unconsciously accepted STM education as a male domain. However, attention has been drawn worldwide to the dangers inherent in the continued deprivation of a large number of women from access to education especially in STM. Mogbo (2001)

notes that in the last two decades there have been sustained efforts to address the factors that constitute gender disparities in women education the world over. The decade 1975-1985 was tagged the United Nations Women Decade. From Mexico (1975), Copenhagen (1980), Nairobi (1985) to Beijing (1995), the focus has been on the status of women in education and development. The global trend was not lost on Nigeria hence the 2001 Annual Conference of the Science Teachers' Association of Nigeria had its theme as "Women in science, Technology and Mathematics Education in Nigeria". Gender equity issues featured notably in the conference. Brewton (2001) brought to fore six equity issues in a workshop to enhance learning environments in STM.

These include

- Mathematics, science and Technology as male domains.
- Peers', teachers and society's cultural expectations.
- Biased and inappropriate curriculum materials
- Classroom interactions and Atmosphere;
- Anti-intectualism and Attributional styles; and
- Testing and Assessment (Brewton, 2001.)

The six equity issues were based on a synopsis of six equity issues from Gender Equity Right from start as published by Sanders, Koch and Urso (1997). The issues were with reference to gender equity biases to watch out for and general teaching ideas to address the biases.

The equity issues identified above are discussed in this paper with the aim of meeting the challenges of the new technologies in science education. The paper discusses the six equity issues as relevant to Southern Nigeria and proposes new thrusts for achieving equity in STM education in Southern Nigeria.

The challenges of female participation in STM education in Southern Nigeria. The major challenges of women participation in STM in southern Nigeria can be expressed as follows;

- Low number of females opting for major STM Subjects.
- Higher dropout rate increasing steadily for girls from the lower primary classes (Okebukola, 1993).
- Retention rate for women in STM is highly affected by marital, family and other cultural considerations. There is a consensus among scholars in Nigeria that nearly all problems of female participation in STM are cultural (Okebukola, 1993;

UNESCO, 1998; Okeke; 2001; Okafor, 2001; Ezenwa, 2001). Even with a steady increase in women enrollment generally (in Anambra state there is already Gender Disparity Reversal where female enrolment is about 83.74%. UNESCO, 1998), there is still gender disparity in favour of boys in STM. Some modern challenges to development that are gender based as identified by Baiyelo (2001) show that;

- The contributions to development by men and women is lopsided in favour of men due largely to the worlds long history of patriarchy system.
- Inequalities between men and women abound which deny women access to education, credit, power and control in society.
- Resistance to development also abound which tend to limit the extent to which oppression and domination of women as well as violence against them may be redressed while access to quality education is widened for them.

The above challenges define in practical terms the persistent declining access to STM education by women in Southern Nigeria. The emerging new technologies and globalization tend to widen the existing gap.

The Six Equity Issues In Southern Nigeria

1. Science, Mathematics and Technology as Male domain Women and girls seem to be discouraged from STM education since inventors and contributors in texts and other curriculum materials are commonly males. Statistics obtained from many researches also reveal a much higher proportion of male STM teachers than females (see table 1). Students of STM often perceive the characteristic STM teacher from a male perspective, and therefore a female STM teacher looks abnormal. The study by Ibole (2001) corroborates this perception of students of STM subjects. Unconsciously, the average female in Southern Nigeria is intimidated by the large number of males in STM and quickly resigns to this overwhelming

feeling that STM is a male domain.

2. Peers' Teacher, Parents' and Society's Cultural expectations. Females in schools, homes and even in places of worship are expected to be ready to 'help' both their male counterparts and parents in domestic matters. If a female is the first child in a family, she is often stampeded or given out in marriage soon enough so that the dowry can be used to take care of the younger (who in most cases are males in the family) in school. The female child is saddled with the job of carrying the baby of the house and is not expected to play with the boys. Further more, the teacher gets angry with a male for poor performance in STM, only to show 'understanding' with another female for the same 'offence'. The result is that while a female proudly

informs the parents that she failed , an STM subject, the male counterpart is expected to hide his face in shame for the same problem. Such a situation provides a subtle encouragement to girls not to take failure in STM as a challenge that needs remedy.

3. Biased and Inappropriate curriculum materials.

Curriculum materials (text books, posters advertisement jingles etc) present boys as leaders, active and those whose ambitions have bearing with STM subjects. Illustrations show boys as engineers, architects, medial doctors, surveyors, sailors and pilots, while girls are shown as secretaries, messengers, nannies. This tends to restrict the females' aspirations to the traditional occupations which often don't require much of STM subjects.

4. Classroom Interaction and Atmosphere

The STM teachers unconsciously feel more committed to ensure male achievement, but feel less so even where the girls are not performing well. Boys are usually assigned to lead group assignments. The result is such that boys feel more challenged and achieve better. More assistance is given to the boys by the teachers to ensure success in STM subjects.

5. Anti-Intellectualism and attrributional style

It is a male trait to achieve and so a male student attributes success to his intelligence and failure to insufficient efforts, while the girls are said to be lucky to achieve and naturally fail due to inability. The failure of a female in STM is taken as normal and so does not require plans to remedy, but for a boy all efforts are made to ensure that remedy is found. This encourages retention in school among males and frustration among females.

6. Testing and Assessment

Testing formats and assignment procedures tend to favour boys more than girls. Girls tend to perform better with real life application problems and with process skill questions than straight content questions which require memorization, guessing and highly competitive. The common problem in most parts of Southern Nigeria is that testing and assessment methods emphasize cognitive essay and multiple choice question patterns that are mere recall assessment, leaving the performance or manipulative aspects of learning hardly assessed.

Table 1

Secondary School STM Teachers By Subject/Gender In Imo State By Zones

Subjects	Zone	Male	Female	Total	%Female

Agric science	Okigwe	24	9	33	27.3
	Orlu	38	31	69	41.9
	Owerri	42	26	68	38.2
Chemistry	Okigwe	27	5	32	15.6
	Orlu	46	22	68	32.4
	Owerri	65	38	103	36.9
Biology	Okigwe	17	20	37	54.1
	Orlu	21	30	51	58.8
	Owerri	49	80	129	62.0
Mathematics	Okigwe	27	08	35	22.9
	Orlu	41	24	65	36.9
	Owerri	75	57	132	43.2
Physics	Okigwe	24	04	30	13.3
	Orlu	29	09	38	23.7
	Owerri	58	09	67	13.4
Introductory technology					
	Okigwe	09	-	09	0.0
	Orlu	23	-	23	0.0
	Owerri	40	04	44	9.1

Table 2 Summary Of Women In STM Per Subject

Subject	TOTAL	FEMALE	%
Agric science	211	66	31.3
Chemistry	203	65	32.0
Biology	217	130	59.9
Mathematics	232	89	38.4
Physics	135	22	16.3
Introductory. Technology	76	04	5.3

Source: Ibole (2001)

TABLE 3: University Undergraduate Enrolment In Nigeria 1980-1999.

Tables

Period Region Male Female Total

1980/81 North South Total 15813(22.2%)40.421

(56.9%)56,234 2559(3.6%)12,302(17.3%)14,861

18372(25.8%)52723(74.2) 71095

1991/92 North South Total

33,242(18.7%)93,242(18.7%)126563 9,371 (5.3%)

41,788(23.5%)51159 42,613(24.0%)135109(76.0)177722

1998/99 North South Total

45370(18.2%)129878(52.1%)175248 14459 (5.8%)

59580(23.9%)74039 59829(24.0%)189453(76.0)249287

Source: Annual Reports 1982-1999, National Universities Commission, Abuja.

Basic Assumptions

Some basic assumptions are stated here for proposing the action plan for meeting the challenges of the new technologies in science education in Southern Nigeria. These assumptions are critical and will guarantee success of the new action plan. The following are the assumptions.

1. There will be continuity in government policy and implementation.
2. The Federal government spends a minimum of 26% of its annual budget on education as prescribed by UNESCO.
3. There will be political stability to ensure that programmes are executed.
4. Policy implementation must be executed with high level of fidelity on the part of government and devoid of political considerations.

Action Plan For A Gender Sensitive STM Education

Probably, the successful enthronement of democracy in Nigeria is the biggest boost required to propagate a new action plan for a gender sensitive STM education in Southern Nigeria. Earlier discussions have shown that the problem of inequity in STM education in Southern Nigeria is essentially cultural. It is also important to note that globalization has stimulated a new thrust in our vision and action as it brings us into active competition with other nations of the global village (Okebukola, 2000). STM education is an area with high impact of globalization. STM is unaguably the major pillar of the economic enterprise of nations such as Nigeria. The new thrusts proposed by this paper to meet the new challenges of the New technologies in STM from a gender sensitive perspective are as follows:

- Conscious Effort at Promoting Equity

Access to computer aided learning should be encouraged for STM subjects to compliment the normal teacher delivered lectures. The aim here should be to diversify both the learning outlets as well as evaluation devices. Since learning involves the cognitive, affective and psychomotor aspects, all categories of students should be given equal opportunities to achieve at their pace and disposition.

Achieving equity in access to STM in Southern Nigeria must include a conscious effort to re-capture intending dropouts (mainly females) or those who have withdrawn for marriage and financial problems. Females should be supported

financially and given sex education to reduce unwanted pregnancies so as to retain them long enough to complete their studies.

- Power stabilization programme.

A major challenge to the use of new technologies in STM education in Southern Nigeria is the near absence of stable power supply in the rural and urban areas. Okebukola (2000) noted that the massive purchase of power equipment for schools in remote locations where public power supply was non existent only resulted in the non-installation of such equipment. It also exposed such equipment to thieves since they were not being used. Power supply remains the most important criticism of the present Nigerian Federal government. The new thrust here for an effective STM education is to ensure through appropriate policy pronouncement and implementation a power stabilization programme to assist in STM education delivery. In this era of information Technology (IT) such a policy can only be regarded as a national priority in Nigeria.

Regular workshops for STM teachers on broad based evaluation techniques. There is an urgent need to organize workshops for serving STM Teachers on the broad-based nature of evaluation. Teachers tend to rely on the old cognitive assessment techniques which limit the scope of assessment to mental abilities. Observational and performance tests need to be well understood so as to afford every student a fair opportunity to achieve.

Remedial Adult classes for Teenage mothers. Many teenage mothers who dropout of school often become abandoned by their parents to fend for themselves and children. Special government funds should be used to sponsor remedial classes in STM to recapture those that are still eager to go to school. The social stigma brought on them by society is also a factor for which effort should be made to encourage them. The sponsorship should also include provision of incentives to cater for their young babies and other basic needs.

Expanded Science Teacher Education Programme for women.

Training of women STM teachers should be pursued through deliberate scholarship programmes by government agencies. This will ultimately increase female teachers of STM in schools.

Repositioning of STM Education in Line with Emerging New Technologies in Southern Nigeria. One of Nigeria's vision 2010 goals on education is to revitalize the educational system to reflect recent developments in knowledge and skills (Okebukola 2000).

Modern laboratory equipment are grossly lacking in secondary schools and the tertiary levels. Budgetary provisions must be made by the Nigerian government to provide needed equipment to brace up to new challenges of the new technologies in STM education.

Conclusion

This paper reviewed the six equity issues in Brewton (2001) as relevant in southern Nigeria. The special challenges facing STM education in the area are highlighted. On the basis of the challenges and some basic assumptions, an action plan for a gender sensitive STM was proposed..

In conclusion, it is important to remark that the Nigerian Policy on Science and technology is clear on the aims. The curriculum has been well articulated with functionality and integration of theory and practical as paramount aims. Gender equality in access to education was also provided for. However, what is pertinent to do now is for us as a country to be more sensitive, creative and responsive to the new challenges created by globalization, new technologies and our quest to democratize government. This provides the framework for meeting the new challenges of the new Technologies in STM education in Southern Nigeria.

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THE NOMFUNDO STORY. A STORYTELLING METHOD TO KEEP THE LEARNER IN FOCUS.

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Project background

NEEP-GET (National Environmental Educational Project – General Education and Training band) is a part of the South African educational system. It thus works to support teachers to implement environmental learning within South African schools and particularly within the new South African Curriculum. NEEP – GET supports the Government of South Africa in the promotion of sustainable living though the implementation of Environmental education in all learning areas.

The main target group is curriculum staff in the educational department and teachers in all provinces in South Africa working on a cluster model. The NEEP – GET project is founded by DANIDA and implemented by IBIS, a Danish NGO.

We, Technical Advisor Presha Ramsarup and Technical Advisor Helle Gudmandsen, have been working on the project in the province KwaZulu Natal and it is in this work we have developed the storytelling method keeping the learner in the focus.

We hereby share the idea and are very interested to get feedback from anyone who tries out the methods with educators. Any suggestions can be mailed to helle@gudmandsen.dk or presha@isdial.net

The educational background of South Africa

South African education is emerging from a history of socially unjust, prescriptive education practices that endeavoured to model South African children through a curriculum and education system that would reflect and entrench the Apartheid government's ideology. Under Apartheid, South Africa had nineteen different education departments separated by race, geography and ideology, thus South Africa's democratic government inherited a divided and unequal system of education. Curriculum change in post-apartheid South Africa started immediately after the election in 1994 with a process of syllabus revision and subject rationalisation. The purpose being mainly to lay the foundations for a single, national core curriculum.

Curriculum 2005 is the uniting vision for transforming apartheid education. The vehicle by which this will be attained would be an Outcomes Based Approach (OBE) to education.

In OBE clear statements are made about what skills, values and attitudes learners should acquire as a result of learning. These statements are called outcomes because they say what the results (or outcome) of learning should be.

The focus on outcomes encouraged the development of flexible, relevant programmes of learning that have a long-term focus/vision.

The kind of learner envisaged is one who will be imbued with the values to act in the interests of a society based on respect for democracy, equality, human dignity, life and social justice.

The curriculum aims to develop the full potential of each learner as a citizen of a democratic South Africa. It seeks to create a lifelong learner who is confident, and independent, literate, numerate, and multi-skilled, compassionate, with a respect for the environment and the ability to participate in society as a critical and active citizen.

When South Africa's new constitution was adopted it linked environmental injustices to human rights and social responsibilities. The constitution signalled a national commitment to environmental action by recognising citizens' rights to an environment that is not detrimental to their health or well-being.

To ensure this one of the foundational principles of the new curriculum, which is integral to all 8 learning areas is creating an awareness of the relationship between human rights, a healthy environment, social justice and inclusivity. This means that EACH learning area needs to make its unique contribution in building an environmentally literate and responsible population.

In late 1999, Mr Asmal (Education Minister) established a National Environmental Education Programme (NEEP). This programme aims to support the implementation of environmental education in all levels and all phases of the education and training system, in accordance with the principle of the White Paper on Education and Training (1995) which states that environmental education should be a vital element of all levels and programmes of the education and training system. The *National Environmental Education Programme for General Education and Training (NEEP-GET)* is one of the projects that will fall under NEEP. The project is aimed at enabling the inclusion of environmental learning in the OBE system at policy, professional development and school-based curriculum implementation levels for the General Education and Training band (Gr 1-9).

It thus works to support teachers to implement environmental education within South African schools and particularly within the new South African Curriculum. NEEP – GET supports the Government of South Africa in the promotion of sustainable living though the implementation of Environmental education in all learning areas.

The main target group is curriculum staff and teachers in all provinces in South Africa working on a cluster model. A cluster model is an approach to working with teachers in a long time process.

Working on the cluster model we have developed different facilitation methods implementing environmental understanding for sustainable development. The holistic view we have on environmental learning is build on a strong social constructivist approach.

Human rights, social justice, economical issues and a healthy environment are all interlink to each other and parts in sustainable development.

To keep the learner in focus when we deal with environmental education we are using a storytelling method.

The Nonfundo story – environmental learning in schools.

(Reflecting on our goal as educators: Keeping Nonfundo – the learner as a focus?)

- How can a South African learner develop a sustainable living and become a critical citizen if we as teachers do not keep the learner in focus, understanding the learner's needs, prior knowledge (indigenous knowledge) and cultural background?
- What must we as teachers understand and reflect on to be able to help learners to develop skills, knowledge, attitudes and values?
- How do we as educators deal with issues as gender and inclusivity?
- How can environmental learning improve the quality of life?
- How can environmental learning integrate different learning areas?

Reflecting on our goal as educators: Keeping Nomfundo – the learner as a focus?

The idea is to build a story that gets teachers to reflect on the goal. To start the story they asked to create their vision of their perfect environmental learner. They create Nomfundo, who has finished grade 9 and is a very environmentally literate learner. She has had 10 years of education focused on environmental learning. The questions are:

- What has this learner gained from the education? What does she know? How does she feel and think about her environment?
- What can she do? How does she feel and think about her environment?
- What environmental skills, values, knowledge, and attitudes would Nomfundo have?

TASK: The teachers individually write down all the knowledge, skills and values they can think off individually by filling in a "spider map" around Nomfundo.

They discuss in their groups, pool their ideas and in groups write their ideas on strips of paper and paste on the board around Nomfundo, this will help to develop a better visual picture of Nomfundo as created.

A discussion on what are environmental skills, knowledge, values and attitudes will come out of all the ideas. (See the example from a cluster meeting with South African teachers.)

When everybody has agreed that this is all the good environmental learning Nomfundo has gained from her time in school we can now conclude that this is all the tools/life skills that she has developed.

The questions that remain are:

- How is Nomfundo going to use these tools in her live?
- Having the tools does not mean we can use them critically. How does that happen?
- Compare all environmental tools Nomfundo has gained with the 12 critical outcomes in the curriculum.

Building a story of Nomfundo's life

Build the life of a young woman in SA. Lead discussion and prompt with relevant questions:

- Nomfundo has a life – tell us about her life
- Where does she live?
- How is her family situation?
- What background does she have – what does she value in life?
- Describe the environment she lives in.

Out of the question comes a story of a woman. If the learners create her with a very glamorous life, the facilitator has to come up with a boy (Sipho) who comes from a very different environment to see how he lives.

- Where does he live?

- How is his family situation? Background
- Education, employment

How does Nomfundo use her "tools"?

What happens if Nomfundo and Sipho get married? They come from very different backgrounds. How does Nomfundo use the environmental learning she has gained to make a better life?

- How does Nomfundo use her tools (SKVAs) – critical thinking, decision making, how she uses her rights and assume responsibility to making a better environment for her and Sipho.

Did you think of any "tools" that she needs that she did not have? Take teachers continually back to brainstorm; they can keep adding strips of paper with "new" SKVAs. They can also remove those SKVAs that Nomfundo is using as the story develops, which can be pasted around another picture of Nomfundo.

Our vision of Nomfundo and the Critical Outcomes

Comparing our vision of our "perfect" learner to the vision in the critical outcomes.

Group Task: Reflecting on our role.

How do we teach to help develop Nomfundo's in our classroom?

Our goal is to use Nomfundo and her story as a "hook" to keep the educators focused on the learner in their development of learning programs – planning their teaching.

Theoretical framework

Working with teachers in South Africa trying to implement environmental learning in the new curriculum 2005 it is important that the process becomes a transformation process.

The approach to learning in curriculum 2005 is learner-centered. Therefore the approach places emphases on constructivism. "Each of us constructs our own meaning and learning about issues, problems and topics. Because none of us has had exactly the same experiences as any other person, our understanding, our interpretations, and our schemata becomes unique." (Marlow and Page, 1998:10)

Another way of saying it, meaning is created in the mind of learners as a result of the learner's sensory interaction with her or his world. Because it is created in the mind of the learners, it cannot simply be told to the learners by the teacher. Learners construct schema from many previous experiences. (W.L.Saunders, 1992)

The first point to note is that what children learn in the classroom will depend to a large extent on what they already know. Children do not come to any lesson empty-headed, they come with partial schemata.

But how do their schemata change in school? Teachers offer knowledge in the form of telling, demonstrating and explaining and pupils work on different kinds of tasks or activities designed to allow the practice, development or generation of a wide range of knowledge and understanding. Most importantly, it is the child who makes sense of these inputs, by constructing links with their prior knowledge.

Therefore new knowledge has to link up to prior knowledge to make meaning for the learner. From the previous school system in South Africa, it was never consider that the schemata children come to school with had influence on the learning. It was the teaching it self that gave the knowledge and skills.

When teachers in South Africa today have to acknowledge learner's prior knowledge, we see it as very important to understand the local environment learners come from. Understanding the learner's local environment and the impact it has on the child will help the teacher to acknowledge the schemata the child comes with. It will help teachers to link up the learning in the classroom to prior knowledge.

We often felt working with teachers and subject advisors in the department of education, that the learner-centered approach was understood in theory but not in practice. It is difficult for teachers to keep the learner in focus.

We therefore thought the idea of creating a learner in the learner's local environment together with the teachers would help the teachers to keep the learner in focus.

A learner-centered approach must start by getting to know the learners and the background they come from concerning their culture, religion and family life.

12 critical outcomes as they are phrased in Curriculum 2005

- Communicate effectively using visual, mathematical and /or language skills in the modes of oral and /or written presentation
- Identify and solve problems by using creative and critical thinking
- Organise and manage yourself and your activities responsibly and effectively
- Work effectively with others in a group
- Collect/analyse, organise and critically evaluate information
- Use science and technology effectively and critically, showing responsibility towards the environment and health of others
- Understanding the world is a set of related systems;

- This means that problem solving context do not exist in isolation
- Reflecting on and exploring a variety of strategies to learn more efficiently
- Participating as responsible citizens in life of local, national and global communities
- Being culturally and aesthetically sensitive across a range of social contexts
- Exploring education and career opportunities
- Developing entrepreneurial opportunities

A work sheet used in the NEEP cluster meetings in KwaZulu Natal, South Africa.
The artist is an 11 year old girl.

Nomfundo as a critical environmental learner

(Example from a cluster meeting with teachers in Umbubulu, KwaZulu Natal, South Africa)

Skills

Dependency, sharing information illiterate people, strategist, problem identification, prioritise, research, negotiation, recycling, measure, analyse, collect and interpret data, communication amongst animals, drawing attention to issues, decision maker, purification, problem solver, distinguish between alien and indigenous.

Knowledge

Pollution, different diseases, land issues, recycle, diseases, open-space management system, human rights, recycling, waste management, healthy habits, harmful products non environmental friendly, managing and utilising natural resources, littering, flora and fauna, zoology, anatomy, animal rights, organic and inorganic products, various natural phenomena conservation.

Values

Accountability, awareness, respect yourself and other people appreciation, tolerance, able to motivate others, faithfulness, assertive, confidence, strong values – stand by what they believe.

BEYOND THE PATRIARCHAL PARADIGM

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The story of Mala, Rose, Shehnaaz, Louisa. It is also the story of Dereck, Zameer, Chan and Babu. This is a story of how these women impact upon their men and children and vice versa. This study tries to understand women's quest for greater freedom, equity, and access while playing the multiple roles of wife, mother, homemaker, bread-earner, community helper and much more. This drama of women's evolution is not seen in a vacuum or background of unrealistic dreams utopian visions of "happily ever after" scenarios but against the rough seas of socio-economic forces, buffeted by the turbulent waves of local and global politics and diplomacy. There were strategies of compromise and acceptance vying with promises of change and betterment.

Against this larger macro-economic, demographic picture of national development it is undoubtedly also the story of human rights and human development where the nightmare of poverty, ignorance, discrimination, unemployment, shrouds all peoples in its darkness. Every where there are some who are even less equal to others than the rest as George Orwell states in his "Animal Farm".

Women's rights, we learn painfully and slowly are human rights after all and 'unless the slaves themselves protest, unite and join hands,' even Abraham Lincoln the champion of the rights of slaves alone could not do much?'

It is a slow but steady march through the independence decade in Mauritius towards finding a voice, which could be heard through the cries for democracy and freedom cries against colonisation, cries for emigration, cries for affiliation with Britain. In that decade women were seen as part of the crowd – their needs were not different, their thoughts were with their husbands, with their fathers and with their sons. They all walked together from the gloomy humiliations and suppressions of the 'crowded baracoon' of the colonists to the horizons where the word 'independence', and " self-governance" was lighting up the different corners of an island ready to be reborn.

There was no doubt that without an overt rebellion women had begun to find a more purposeful destiny. Titmus and Meade had almost rung the death knell for the island, what with overpopulation, unemployment, skyrocketing aspirations of the young, thwarted dreams of the not so old, all of it became a cauldron of strange vapours almost suffocating the passionate nation builders of the sixties.

The family planning slogan mongers and advocates of the late 50's and early sixties won the day and awakened the consciousness of the people and men and women moved to change their country's destiny by greater awareness of their individual roles and positive responses to the need of the hour. Women leadership though scarce brought changes dramatically by understanding the call for greater education, health-care, birth control and giving unstinted support for the family. Individuals, governments, non-governmental organisations (NGOs), corporations, policy-makers, multilateral organisations have a role in transforming the potential of national resources and the promise of technology–know-how and networking into social arrangements that truly promote fundamental freedoms everywhere rather than just pay just lip service to them. Women in their own right played their own part in the national developmental scenes. Women in Mauritius had begun by the late sixties to be more visible in the socio- economic life of their country. Most women however stay away from the political echelons of power by not joining the exacting hysterical electioneering campaigns either for the party or for themselves. They moved into the practical down to earth, areas of building their lives through sane forays into work and education, home making, child caring, employment in farming and agriculture.

More and more choices and opportunities opened so that each person could lead a life of respect and value. Home was still the forefront of the women's dream – to marry, to settle and have children. The dream was a continuation of her mother and grandmother's reveries. However, education opened new frontiers - free education, birth control, better health, industrialisation all provided new challenges. When human development and human rights advance together, they reinforce one another – expanding people's capabilities and protecting their rights and fundamental freedoms. From parallel pathways both in concept and action followed in the earlier decades – development and rights through the arduous work of economists and social scientists, through political activists and lawyers promoted a final convergence where concepts and action now meet in the same arena of new partnerships and alliances through the spirit of democracy, social justice and human welfare. In this build up the UN system, the commonwealth machinery, all gave the gender movement moral legitimacy and a legal framework. Although the civil and political rights were integral parts of the development process --- questions had to be asked and women spearheaded the answers and changes so that anomalies in the constitution could be addressed and the discrimination issues against women workers, women employees revisited.

The attitudinal barriers within the hardened entrenched patriarchal world had still to be hacked away. That was not easy since the patriarchal concrete had hardened into the cells and marrow of our womenfolk themselves. Of course, said some of the women in the rural areas, "he must be consulted in all matters … and he can do no wrong". The sense of inferiority despite legal empowerments and the sheer vulnerability of her position in the home as mother and wife allowed for many injustices to continue and triumph in the home front and work-front. In the political arena the few brave ones who stuck out wore labels which the "macho men" tacked on. Derogatory terms like 'Orangina' and "Bond girl" were littered on newspapers and consumed by a public ready to be amused and entertained. Further, the women were given importance only as long as they followed obediently the dictates of the majority. And the majority were clearly men.

There was need to bring a dynamic long-term perspective to the fulfilment of rights. Rights of women could only be realized in a socio-economic context and a close look at the economic institutional constraints made a closer look at ways to overcome them obligatory.

The law, the constitution and the social mechanisms helped to bring gender equality on a more realistic level giving the rhetoric and advocacy its teeth brought in its train an amazing empowerment to women who worked outside the homes. They were now empowered through the law to denounce violence within the homes and ask for redress and social support. The connectedness and the links of these domestic issues to children's rights and child abuse also surfaced automatically. When the gender issues were being mainstreamed all social-cultural and economic issues had to be looked at afresh. Environment, social security, productivity issues, childcare and nurture and other interests began to surface and called for particular attention since the state's accountability and commitments were called to question. The convention on the elimination of all forms of discrimination against women (CEDAW) was agreed to in 1979 and the convention on the Rights of the child 10 years later. In 1990, 10% of all the world's countries had ratified all six major human rights instruments, but by February 2000 in 10 years this increased spectacularly to nearly half of all countries.

As the 20th century ends and the 21st century emerges globalisation with its information highways and communication technologies, new global rules and institutions is accelerating the need for a new developmental paradigm of political and economic integration. As corruption escalates within the private and public sectors, a

new ethic of governance is mandatory if anarchy and chaos is to be eschewed. The end of cold war has not meant the end of war itself. On the end other hand new threats of terrorism armed conflicts, ethnic cleansing and religious bigotry continue to smear the front pages and headlines of the multimedia press, Internet, T.V. and cable leaving the ordinary citizen with a sense of futility and deep powerlessness. It has brought new threats to human security and human freedom. The results of globalisation despite its obvious gains in technology and trade have resulted in violations in human rights, growing inequality and social strain. "The distance between the incomes of the richest and poorest country about 3 to 1 in 1820, 35 to 1 in 1950, 44 to 1 in 1973 and 72 to 1 in 1992.

A recent study of world income distribution among households shows a sharp rise in inequality - with the Gini coefficient deteriorating from 0.63 in 1988 to 0.66 in 1993 (a value of 0 signifies perfect equality, a value of 1 perfect inequality) Gaps between rich and poor are widening in many countries - in the Russian Federation the Gini coefficient rose from 0.24 to 0.48 between 1987 - 88 and 1993-95. In Sweden, the United Kingdom and the United States it rose by more than 16% in the 1980s and early 1990s. It remains very high in much of Latin America - 0.57 in Ecuador, 0.59 in Brazil and Paraguay. Meanwhile, economic growth has stagnated in many developing countries. The average annual growth of income per capita in 1990-98 was negative in 50 countries, only one of them an OECD country".

Human Development Report 2000.

Entrenched economic and political interests clearly evident in the WTO rules and its applications will further accentuate the divisive values of the neo-colonial hierarchy of interests. It is important for the south -south dialogue to balance the see-sawing power base and use today's technologies to build new regional networks and build alliances to fight the poverty, exploitations, the dictatorships, and assert human rights on all frontiers.

Unless the Human Right Covenant is respected in global agreements and all stakeholders are consulted, the state and the global actors like the WTO and the NGOs may all have separate developmental agendas of interests. Communication in the super highways of technology may consequently turn into a nightmare of cacophonous sounds not different from the famed Tower of Babel. Trade rules, gender rules, workers rules all will have to have a common human rights basis of action to be coherent and equitable. From the hierarchy of power when we talk of international agreements, it must be consonant with the state and individual rights

simultaneously respecting the ethics of governance, responsibility and empowerment at all levels of international and national systems. Where is the binding glue in this noble vision of common goals?

The global figures are strangely frightening. The global on-line community is growing exponentially; reaching 26% of all people in the United States but fewer that 1 - % in all developing regions. What communication are we talking about? The media gap and the digital gap are already creating abysmal rifts between countries. Undoubtedly, the gender issues are deeply and inextricably tied with the historical notions of patriarchy and the results of industrialisation. In time it nurtured a social system in which individualism figured strongly through sobered by democratic and parliamentary procedures and sometimes by an impartial judiciary. This individualism if it is again not governed by ethical rules of growth and empowerment it can lead to an *impasse* within the systems of co-operation and development.

By allowing newer entrepreneurial routes to wealth, industrialisation allowed corporations to become standard form of organisation for business activities. Private sector business meant 'shareholders interests reign supreme'. Business ethics thus gives way automatically to ruthless competition as enterprises vie for the highest returns and growth rates. Worse even, ethics came to be derided by leading economists like Milton Friedman in his oft quoted statement "*The social responsibility of business is to make profits."*

"Business ethics is still regarded by many well-intended people as an oxymoron or a contradiction in terms. There is a firm belief that the corporation's ethical obligations do not extend beyond those of their shareholders. As a result of this new creed of business, pollution, depletion of natural resources, child labour, fraud, corruption, employee and consumer abuse, all go undeterred as private enterprises thrive in a market-place that fails to provide the signals to keep in balance the conflicting interests of shareholders and other stakeholders."[1] Against this backdrop gender issues just like child protection or the protection of minority interests all receive a backlash in the absence of social responsibility. "Might is still right" as Nelson Mandela reluctantly conceded but the struggle "to reverse this questionable ethical order is constant, consistent and committed."

The need for ethical principles is an integral part of economic engines. They serve the same kind of functions as fuel and timing systems do in engines: 'impetus and co-ordination'.

[1] Deva Armoogum in l'Express of 24 October 2000

When the fuel and timing systems fail the engine stalls, Similarly when ethical principles are violated the economic engine fails. Women all over the world are debating over the true meaning of development. They are acutely aware of the power of multinationals in the globalisation process and its impact on real issues of poverty, unemployment and stagnation. The example of *Monsanto* in India is a case in point. This is an example where "corporations are manipulating science and promoting scientific fraud to silence and censor the moral and safety debate, which they see as interference in their profits. Corporate protectionism is the order of the day but increasingly though, the countries of the South are teaching the world lessons in ethics and morality and in sustainable development."[2]

Researchers are questioning whether the indices selected by the UNDP itself to measure social development are conceptually well defined and whether the criteria chosen adequately measure it. It is argued that the Human Development Index (HDI) and the Gender Development Index (GDI) ignore completely the role of land reforms in enhancing capabilities. What is being proposed under the indices is "within the framework of the existing developmental paradigm" which is white, male and market dominated?

Coming back to the story of Mala, Rose, Shehnaaz and Louisa we can clearly see that the gender battles fought in 1970s' were critically important. Women gained access to jobs, education and credit. But as they dressed for success in their business suits, the world tended to forget that 90% of women chose to have children and that women would remain seriously handicapped in the workplace unless the state and the civil society established a system of family supports and subsidized child care.

There is also no question that women in the 21st century have awakened to new roles and challenges. Mala's children have greater choices open to them and Rose's children have gone into professions denied to their mothers and grand-mothers thanks to the privileges and opportunities opened by free

education and free health services. With greater equality of opportunity at different levels, social mobility becomes easier diminishing the intergenerational transmission of poverty. With globalization and technology led changes, the determinants of social mobility will undoubtedly change. Will Mauritian women be able to accept these new changes and re-work the new paradigm with wisdom and strength. With the new

[2] Organic Consumers' Association – a world-wide consumer protection organisation

vistas open to them and the experiences they have gained from history crowded with patriarchal archetypes and masculine posturing the task before them is formidable and daunting.

Tara Hazareesingh one of our 'indepth' interviewees summed up our work in terms of the period chosen by the researchers succinctly. "I came to Mauritius in 1951 where essential services like electricity and water were meagre commodities and both men and women had many obstacles to overcome whether political, economic, social or cultural. Mauritius has developed by leaps and bounds and both men and women find themselves freely enjoying the benefits of post-industrial Mauritius of 1990's and beyond but I hope they will be able to reconcile the benefits of material progress with the preservation of spirituality and a strong sense of community service."

CHANGING THE SUBJECT AND TEACHING TO GET MORE STUDENTS TO SCIENCE AND TECHNOLOGY?

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Abstract: In Sweden, as in many other western countries, too few young people choose science for their career. My study is about the relationships between pupils' attitudes, understanding and ability and what may affect their choices for upper secondary school. I have followed the same group of pupils from grade 5 (12 years) to grade 9 (16 years). The basis of my study is how they experience school and the science teaching. On the whole the 80 teenagers are very positive to school. Their interest in learning different school subjects and their feeling of success in these are very high but not as high in hard science as in other subjects, especially not the girls'. When asking them to explain some everyday phenomena it is not the pupils with the highest marks who have the best answers. The most gifted pupils according to logical ability and/or marks are not so interested in science and very few of them, not even the boys, can think of a career in science. From the interviews it is obvious that they are interested in science but not as it is presented in school. They want to learn more about science in the society, not about "dead things". To be interested in learning science the subject matter has to have a more personal value to them. They also want to discuss, work together in groups, and to pose and work with questions from their own area of interest.

Background and aims

There are few studies about interest and attitude toward science among young children in Sweden. In the "Second International Science Study" Swedish pupils at the age of ten think that science is both fun and interesting. Amongst older pupils the boys still think it is interesting but not so much fun and the girls definitely do not think it is fun and their interest varies. The result for the oldest pupils corresponds with later results in the "Third International Mathematics and Science Study" in both Sweden and other European countries (Beaton et al., 1996). In the article "Mission impossible? Can anything be done about attitudes to science?" Ramsden (1998) summarizes some conclusions in earlier research:

> …… the widely held perception of science being difficult and not relevant to the lives of most people, of science causing social and environmental problems; that science is more attractive to males than females; that interest in science decreases over the years of secondary schooling; that these more negative views are associated with the physical sciences rather than the biological sciences (Ramsden, 1998 s 125).

The aim of the study is to follow a group of pupils from the age of twelve until they leave lower secondary school at the age of sixteen to describe and analyse how their attitudes towards and interest in science and technology develop and change but also how this and other factors influence their choice for upper secondary school.

Framework

Many studies on attitudes towards and interest in science and technology have been completed but it is difficult to extract a coherent view from them as the question is very complex. In the study I summarise my review of earlier research in four points:

- Attitude or interest is judged in the literature by a range of quite different measures, from whether the pupils "like" such things as the teaching, the teachers, the content, and the different subjects to their choice or intention to choose a course or an education in science.
- There are relationships between attitudes/interest and cognitive variables such as ability, achievement and marks but not as strong as might be expected.
- Sex and personality are important for attitudes/interest as well as pupils' background.
- "Everything" in school may influence attitudes/interest but it is difficult to assess the relative strengths of different factors.

On the other hand it is difficult to find any study about either the relationships between the many different variables, or reasons for individual pupils' change of attitudes. Nor have I found any studies about the relationship between scientific concept understanding and attitudes towards science.

According to the theory of planned behaviour (Ajzen, 1985) a person's intention to perform a behaviour depends on different determinants which are *attitudes toward the behaviour, subjective norm* and *perceived behavioural control*. The third determinant is very close to Bandura's (1997) concept *self-efficacy*. The strength of the determinants is different from one person to another but also from one action to another. The determinants are in turn built up as the sum of different variables with different strength. These can be age, sex, values, and so on. The theory says that the intention to behave in a certain way is strengthened if the person

- has a positive attitude towards the behaviour
- believes near people have a favourable attitude towards the behaviour
- believes she has the resources and opportunity to engage in the behaviour

In figure 1 I have outlined a model of how I understand the action of choosing for upper secondary school.

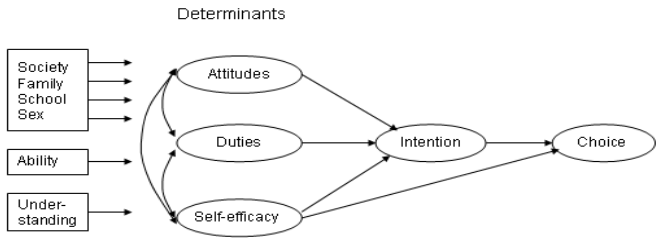

Figure 1. **My model of the action of choosing for upper secondary school based on the theory of planned behavior.**

Methods and samples

The basis of my study is how the pupils experience school, and science teaching, and the feelings that will influence them when choosing a programme for upper secondary school. The data is collected using observations, interviews and questionnaires, as by combining different methods and contrasting them the understanding of a complex situation can be deeper (Cohen, Manion, & Morrison, 2000). The study is carried out in a school with pupils from different home backgrounds. About 25 % are from immigrant families. The sample consists of 80 pupils, the whole age group in this school. The group changes over time as pupils move out and in, some pupils do not want to be interviewed and so on but more than 50 pupils have complete all the questionnaires and interviews during the five years.

Results on group level

When I leave them in Grade 9 they have just chosen for upper secondary school. Perhaps they will be accepted to study in the chosen programme, perhaps not. Some will have to choose a new programme before autumn; others will perhaps change their choice after some weeks if they do not find the programme suitable for them. But many of them will follow their intentions and realise their dreams. Perhaps their dreams would have been different if school and teaching had been different. It is difficult to speculate but I am sure that their view of science could have been more positive. It is not easy to summarise all these pupils' experiences and feelings as they are so different but from each research question I will discuss some aspects repeated by many of them.

How do pupils' attitudes towards and interest in science change during compulsory school?

A sententious answer would be "it was mucked up" at least for physics and chemistry but I shall try to give a more balanced answer. In the attitude questionnaire the pupils have answered the questions: *"How good do you think you are at the following subjects?"* and *"How interested are you to learn more in the following subjects?"* in grades 5, 6, 7, 8 and 9. They did this for all their school subjects. On average they feel most interested and best in Grade 5. During the following years their mean rating falls but rises again in Grade 9 but not to the same level as in Grade 5. Looking at the sexes I can see that the girls think they are nearly as good in Grade 9 as in Grade 5 but not as interested to learn any more. The boys on the other hand think they are as

interested in Grade 9 as in Grade 5 but not as good as before. Looking at different subjects I can see that interest in learning more in the social sciences is increasing for both girls and boys as well as their feeling of success. The same applies to biology. The initial experience of the girls with physics, chemistry and technology in Grade 7 makes them feel uninterested but also that they are not so good either in these subjects. During the years their interests stay on a very low level but also they feel a little more competent. That girls are uninterested in physics, chemistry and technology is nothing new but what is more interesting is that the boys are also negative. Compared with the girls they are more positive but compared with other subjects, physics and chemistry are at the bottom.

So my conclusion will be that pupils' interest in physics and chemistry is low and decreases during the years. It has little to do with age as interest in other subjects is higher and increases. It has little to do with sexes as both girls and boys put these subjects at the bottom of their ranking lists.

What in school affects attitudes and interest?

A short answer is "everything" but a real answer; the situation is complicated. Some pupils can say that they love to do labwork in science but not calculating and others say the reverse. It is the same with most activities. The following summary of about 60 interviews every year is a description of the most important factors to quite a lot of the pupils.

The pupils have very little experience of science from upper primary school and the one they have is mostly from some "days with experiments" and expect science to be like that. They are very disappointed when they meet science teaching where they are supposed to sit still and listen, copy the blackboard and fill in stencils. When they start with labwork in the next grade they really like it but probably it was too late to change their image of science. As they have little experiences of physics and chemistry from lower grades they say they perceive it is so new, so strange, so difficult and so serious all at once. They compare with other subjects such as English and geography which started like a game and the difficulties have come gradually. As they experience science as difficult, they also think they are not good in the subject, and then it becomes much more difficult and so on. This can be the beginning of a negative spiral between attitudes and behaviour which can be difficult to break (Shrigley, 1990).

They perceive both physics and chemistry as authoritarian subjects with the message *"it is like this, learn it because it is right, here is nothing to discuss"*. They also perceive all lessons are so predictable; first the teacher talks, then the pupils work. When analysing all the interviews it is so obvious to me that science teaching has to be more varied. Some pupils like one way of working, others like other ways, but all dislike doing it the same way all the time. Sometimes they all want to discuss, work together in groups, and to pose and work with questions from their own area of interest. In other words, they want to have more influence on their learning like they have in other subjects. Another important thing is what is taught in science. Not even biology is interesting if it is about algae and mosses. Much rather they want to learn about human beings precisely like the pupils in Reiss' (2000) study. Answers in the SAS-study also show that they are interested in everything that is odd, fantastic and spectacular for instance dinosaurs and life in space. I can understand one girl's frustration if she had expected such content and had to learn about how a hammer works. I can hear the same disappointment from many pupils who like to watch TV-programmes about science and read such magazines. Some pupils who during lessons and interviews showed "scientific attitudes"[1] also choose a non-science programme for upper secondary school saying they are not interested in "school science".

The last area, which can be more important than I would ever have thought, is the "hidden messages" in science or its semiotics (Shapiro & Kirby, 1998). Many pupils have told me, it is so depressing to go to the classrooms with black desks, black blackboard, curtains cocked to one side, dirty walls with old pictures and worst of all bad smelling. Together with this they meet textbooks with only facts and facts, terrible to read, and very serious teachers. There are pupils who ask *"Is it not allowed for science teacher to laugh?"*

What decides the choice for upper secondary school?

As early as in Grade 5 we talk about their dreams for the future and quite a lot of the pupils have ideas about their working life. Many have predictable dreams such as being a police officer, hairdresser, lawyer, vocalist and doctor. Other pupils are not so precise but could imagine working with computers or the economy. There are of course quite a lot who have no idea yet. I posed this question every year. Before the

[1] Scientific attitudes means good characteristics for scientific work such as logic, open-mindedness, honesty, scepticism, curiosity and consideration of consequences (Gardner, 1975; Simpson, Koballa Jr., Oliver, & Crawley III, 1994).

interviews in Grade 9, I read all transcriptions and the pupils were also allowed listen to this part of earlier interviews. Both I and also the pupils were very astonished that their dreams from Grade 5 or 6 have been more or less repeated every year. If so many decide their future so early and science is so unfamiliar to them, perhaps it is not strange that they do not choose science. Another problem is that they do not know very much about different professions within science. When talking about chemistry most of pupils can only give me two reasons for learning it. The first is to get good marks and the second is to become a chemistry teacher. The last one is none of their future dreams and as they cannot image any more professions for which chemistry is relevant, they cannot see the meaning with learning chemistry.

What significance has attitude/interest?

According to the pupils interest is the most important factor for their choice for upper secondary school. Nearly all pupils who have not chosen science explain their choice with the subjects in the programme had to be interesting. If I look at the attitude questionnaires there are only 6 of the 80 pupils who say they are more interested in natural science than social science. 44 say the contrary. When I ask the pupils who have chosen science, why they have done so, and the most common answer is that they have to because of their future careers. If I look at the attitude questionnaires they are not more interested in science than their schoolmates. There are also pupils who have dreams for their future which involves choosing science for upper secondary but as they think that science is so boring they have given it up. Already in the SAS-questionnaire in Grade 5 they answered a question about important factors for their future career and the most important was to get an interesting work. Every year I have also asked about important factors for their future career and the answer had been the same all the time and pupils all over the world say exactly the same (Sjøberg, 2002).

What significance has ability?

Of course, ability and achievement are important but not as important as expected, just as Gardner (1975) concluded. Many of pupils who choose science are good but on the other hand only one quarter of the gifted pupils with high marks choose science. As there is much more mathematics in the science programme you could expect pupils with the highest mark in mathematics to choose it but not even half of the pupils do so. On the other hand one third of the pupils who have chosen science have barely passed in mathematics. Many gifted pupils' reason for not choosing

science is their sense of self-efficacy (Bandura, 1997). According to their own opinion they are not good in science and mathematics even if their marks are good. It is especially the girls who do not trust their marks and say that they must be wrong as they do not understand. They seem to feel that to be good they also have to be interested and get encouragement from the teacher. According to Aikenhead's (1996) terminology, they have not got enough help to cross the borders into the subculture of science.

What significance has understanding?

In nearly all grades I have asked the pupils to explain some everyday phenomena and categorised their answers according to research on conceptual understanding. In year 9 there are a small group (about 30 % of the pupils) who are categorised to have good understanding across a range of conceptual areas. In this group it is only 25 % who choose science. In the interviews it was obvious that the pupils are not used to discussing and answering questions like this. For example when I ask them about the seasons, many answer, it is because the inclination of the earth. When I continue with questions about how that can explain why it is colder and darker in winter, they look very surprised as they feel they have already given me the "correct", complete answer. They seem to have a view that the task is simple, and a superficial answer is sufficient. They are not interested in pursuing such ideas to any depth. I conclude that they do not understand that they have not understood the whole range of the question. If this is the case they cannot improve their understanding. There is another aspect of not understanding. Often teachers do not make clear to the pupils what they are supposed to learn from the labwork or what is said in the textbook. When they do not understand such things they doubt their own capability and lose interest.

What significance has sex, social and cultural background?

In this group there are as many girls as boys who choose science. Compared with the nation it is the boys in this group who do not choose. The most important reason for those who choose science is that they already have decided on their future career. The reasons for gifted pupils not to choose differ between the sexes. More girls say they do not think they are able but more boys say that it because they find science boring. The pupils who choose science tend to be immigrants or have well educated parents. In the interviews these pupils say that they can choose what they want to but I can also hear between the lines that many parents think that they shall choose a

programme preparing for further education. But if it is an education within natural or social sciences does not seem to matter.

Summary

If I interpret the pupils' choice for upper secondary school from my model in figure 1, I can see that many pupils have a positive attitude to science but often a more positive attitude to other subjects. They have duties to their parents but these are not strongly expressed. There are parents who wish their children to choose a theoretical programme but only one of the 80 subjects "have to" take science. The last determinant, self-efficacy, follows the same pattern as the attitude. Many pupils think they are good in science but not as good as in other subjects. For most pupils it seems as if attitude is the strongest determinant for the choice. The determinants are influenced by different factors. Girls and boys perceive science teaching differently but it seems as if the boys are on their way to developing the same critical attitude as the girls have had since long ago. The social background is important as many of the pupils who choose science are from well educated homes but even this group is loosing interest. There are many pupils from cultures with a strong patriarchal tradition who choose science; perhaps it is easier for them to accept the authoritarian nature of the science teaching. Good ability is a necessary factor but does not guarantee science will be chosen. Neither has good conceptual understanding a crucial importance but on the other hand there are many pupils who say that they would not choose science as they do not understand science in the way it is taught. So my conclusion is that to most pupils, attitude is the most important determinant but also self-efficacy as they influence each other.

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A GENDER INCLUSIVE MULTIDIMENSIONAL APPROACH TO THE EMPOWERMENT OF LEARNERS (BOYS AND GIRLS) IN SCIENCE EDUCATION

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Abstract Boys as well as girls in primary and secondary schools need to be motivated and empowered to choose science subjects and to achieve high quality performance.
The main challenge is to prepare students - boys and girls - to cope with factual data while acquiring and using skills to succeed at all levels.
Such a broad all round profile requires an approach that addresses multiple intelligences of all learners; uses the multiple facets of all media and resources; and is adaptable to a wide range of learning contexts. It promotes gender equity, distributive justice and sustainable citizenship.
A multidimensional approach as a gender inclusive strategy to science education uses a supportive framework in classroom interactions. The use of practical, verbal, visual, cognitive and group processes is an enabling factor in empowering the teacher and the learner to select, develop and sustain a repertoire of effective strategies suited to their specific contexts.
The model offers a prospective view and aims at shifting the focus of learning from memorization of factual data to developing competencies for critical thinking and problem solving.
The proposed multidisciplinary processes can be tailored to both formal and non-formal sectors. The processes empower the learner by using the prior competencies to build new skills, through interactions with available and accessible resources.
Evidence of the use of the model in teacher education at the MIE is also presented.

Preamble

Coping with the demands of formal education is a big challenge for all stakeholders. The educational reforms in Mauritius (2002), aiming to provide greater access and equity, have also increased some of the inherent complexities.

One factor that makes education progressively more challenging is the rapid proliferation of knowledge. Rote learning and its short term gratifications lure teachers and learners into cycles of ever diminishing returns. Hence quality of achievement suffers.
Developing confident citizenship in a scientific world needs adaptability to changing global socio economic realities. One tool in ensuring this is to enable learners to develop a range of skills for sustaining their learning in schools and beyond.
Such an approach comprises long term benefits. A shift to reflective skills based teaching and learning needs gradual exploration of all basic competencies. Skills provide the basis for action. Learning how to learn skills develop students into independent learners.
A holistic approach leads to sustainable actions that allow learning to become life long**:** an essential criterion for adaptability in a changing world.

A. REFLECTIONS ON SOME VIEWS FROM CURRENT RESEARCH

♦ PRACTICAL SCIENCE IS EXPERIENTIAL

Practical science is a valuable tool for scientific understanding and developing skills. Wrongly done, it may have negative effects. To be successful, practical science needs to rest on a firm foundation of basic prerequisites. *"Good science investigations often start with a stage of exploring the materials of an experiment"* (Crismond D, 2001). Such an approach continues with the exploration of each step. Students engage in observations, recording and drawing, prior to analysis and interpretation of data.
This sequence fits the theory or abstract concepts into the *'hands on'* methodological framework of science. The mental creation of their own ideas by students from past

and current experiences makes the learning of science become constructivist and *'minds on'*. Practical science involves inquiry into scientific concepts. *"Studies of inquiry oriented programmes show substantial effects in favour of such an approach, including cognitive achievement, process skills and attitude to science"* (Anderson R, 2002).

Practicals involve the student as active partner and activate brain processes. Costa D A (2002) cites Taba and lists, among the conditions that facilitate meaning:

- stimulation of all senses
- fitting information into already stored patterns
- finding patterns in information
- challenges to stimulate thought
- social interactions
- positive emotional support
- development of a broad range of skills: mental, physical, social and emotional.

Practical sessions in science are opportunities to develop and practice all types of skills. Thus learning science becomes active**:** both hands-on and minds-on.

♦ LANGUAGE AND SCIENCE: COMMUNICATION SKILLS EMPOWER LEARNERS

Science students need language skills to cope with the *"medium of instruction"*. Further, the specific words and terms of scientific writing require much practice to develop proficiency. Understanding science texts, or examination questions and the use of clear expression defeat many science students.

"Non-mainstream students do not have enough opportunities to acquire formal discourse as they move from the personalised oral context of the home to the depersonalised written knowledge of the science classroom" (Heath, 1983).

Oral interactions in the science classroom need to be supported by written tasks. This facilitates the mental mapping of science concepts.

The needs of auditory students are met by *"walking them through the science lessons verbally"* (Robinson S, 2002). Classroom talk in science lessons develops competence and performance skills. *"The use of narrative features in students' conversations is one way to expand science discourse"* (Kurth LA et al, 2002).

"Critical language awareness affects curriculum planning by ***valuing forms of discourse, participatory and experience based creative oral and written practice, collaborative problem solving and using visual learning"*** (Corson D, 2000).

Science activities and practicals provide opportunities for students to practice a range of verbal skills. Language interactions become an empowering tool and develop communication competencies.

Language skills need much practice as a prerequisite to and a tool in the study of science. Science teachers need to create a discourse space that allows induction to the study of science. Using student talk as starting point acknowledges the learner's prior competencies. Language skills enable science process skills to be practiced, first orally, then in writing. Learning becomes *"minds-on"*.

B	SCIENCE AND SKILLS FOR SCIENCE EDUCATION: SKILLS AS TRADITIONAL TOOLS

SCIENCE is a field of inquiry with specific attributes:

BOX A SCIENCE	A conceptually structured field of inductivo-deductivist reasoning based on systematic investigations to search for verifiable truths.

SCIENCE EDUCATION USES A CUMULATIVE BODY OF CONCRETE PERSONAL EXPERIENCES to initiate students into scientific thinking. It follows a SPIRAL CURRICULUM. Science education places high demands on all dimensions of skills. The dimensions of skills link to age long traditions in all formal or informal educational undertakings: from learning to pick berries (hunter-gatherer) to today's specialized vocational education.

Why skills? Skills enable students to become learners, using learning opportunities systematically to acquire competencies. Skills have always figured prominently in all educational traditions. (Table 1)

♦ A MULTIDIMENSIONAL FRAMEWORK OF SKILLS

table 1: The dimensions of skills

TRADITIONS	DIMENSIONS
	1. PRACTICAL / PROCEDURAL
1. Experience • farming • hunter gatherer	• "tactile knowledge" • hands on • discovery learning • inquiry learning • learning by doing • sensorimotor (extension of senses by scientific tools & "Instrumentation") • experiential • life applications • crafts / music / art
2. 3R^{s}	**2. VISUAL / SPATIAL** • diagrams • models • 2D / 3D)
3. 4th R " reasoning"	**3. MATHEMATICAL / NUMERICAL / QUANTITATIVE** • scale / numbers and fractions • statistics and graphs • units **4. VERBAL / LANGUAGE** • competence skills • performance skills *(continued)*
(continued) 5th R "social intelligence" "life skills" `5. Formal education	**5. COGNITIVE / SENSORIPERCEPTION** • intrapersonal • conceptual: qualitative • numerical: quantitative

	6. METACOGNITIVE • minds on • abstract notions about concepts **7. SOCIAL / SOCIOCOGNITIVE / ENVIRONMENTAL** • interpersonal • sustainability • "socio contextual"

♦ **INCLUSIVE METHODOLOGY FOR SCIENCE:**

Scientific methodology COMPRISES THE STRATEGIES AND TOOLS THAT SCIENCE TEACHERS USE TO INITIATE AND SUSTAIN LEARNING IN SCIENCE. IT USES ALL TYPES OF SKILLS IN MULTIPLE WAYS: IN A variety of models of learning THAT PROVIDE THE BEDROCK FOR DESIGNING STRATEGIES IN SCIENCE EDUCATION.

Science students develop and practice all the dimensions of skills when investigating or witnessing scientific phenomena in teacher demonstrations, in group or individual practicals, in fieldwork, in real life or through mediated sources. Group scientific talk engages the mind in multiple ways.

C. what is the problem, and, its solution?

CONSIDER SOME ISSUES THAT NEED ATTENTION. (TABLE 2)

♦TABLE 2: PUBLIC examinations results (APPROXIMATE AVERAGES) MAURITIUS

EXAM	***CYCLE***	***AGE***	***PASS %***	***FAIL %***
1. CPE	Primary	11+	68	32
2. SC	SECONDARY	16+	67	33
3. HSC	SECONDARY	18+	(A) 33 (O) 34	33

C.1.3 (O) CANDIDATES LOSING about 50 – 65% marks

C.1.3 (F) CANDIDATES LOSING about 65% or more marks

- ♦ FEWER STUDENTS OPTING FOR SCIENCE SUBJECTS AT FORM IV LEVEL (AGE 15+) AND FOR HIGHER STUDIES
- ♦ FEWER GIRLS OPTING FOR SCIENCE SUBJECTS AT FORM IV LEVEL AND ABOVE
- ♦ MISMATCH MALE: FEMALE RATIO IN PRIMARY GENERAL PURPOSE TEACHERS (more FEMALES) and
  (a) HEAD TEACHERS (more MALES)
  (b) UPPER PRIMARY TEACHERS (more MALES)
- ♦ MISMATCH MALE: FEMALE ratio in PROFESSIONS
- ♦ MISMATCH IN PERFORMANCE BETWEEN BOYS / GIRLS IN FORMAL PUBLIC EXAMINATIONS

There is no polarization: *Each gender may outperform the other in specific cases or competencies.*

D. guiding principles and a model for inclusive practices

♦ **Some suppositions / guiding PRINCIPLES:**

Beliefs drawn from experience and tested through practice guide our everyday actions. Table 3 summarises some principles for inclusive practices in science education.

TABLE 3:GUIDING PRINCIPLES FOR INCLUSIVE PRACTICES

1. Principle of MULTIPLE INTELLIGENCES	1. A multidimensional approach to developing skills is ***gender and ability inclusive*** and provides ***a supportive framework*** for science teachers and learners, using differentiation.
2. Principle of PRIOR EXPERIENCES	2. Diagnosis of present student competencies and difficulties enables the science teacher to focus on all dimensions of skills and build channels for active participation**:** constructivism
3. Principle of OPTIMIZATION	3. Systematically planned interactions in science lessons using resource based, accessible HANDS ON and MINDS ON strategies facilitate the acquisition of all dimensions of skills.
4. Principle of MIXED ABILITY PRACTICE	4. The interactive classroom group practices enthuse and empower the teacher and the learner in mixed ability science classrooms enabling the modeling of skills.
5. Principle of REFLECTIVE, INDEPENDENT & SUSTAINABLE ACTION	5. The process continues with formative testing, design of teaching learning tools (games, exercises, spot tests, self study approaches) becoming a reflective negotiated practice for science teachers and learners.

The gender factor is one among a web of influences that cause marginalization. It may or may not be predominant. Hence, the ADVOCACY OF A BROAD HOLISTIC SPECTRUM OF SKILLS COMPRISING ALL DIMENSIONS to empower and enthuse both teachers and learners.

Teachers and learners can then adopt ***a matrix of skills*** appropriate to their own teaching and learning styles and contexts.

Using a multidimensional skills framework allows teachers and learners to sustain the formal learning process into lifelong learning.

E TRIALS & TRIBULATIONS

♦ **ETHICS**

The following were considered:

- informing participants: students at MIE and in schools
- justice to gender platform
- MIE Teacher Education handbooks for ACE, TCP, TD (various), D SEN RE, TC Pre Voc, B.Ed, PGCE programmes & courses: advocacy – "reflective teaching"
- MOESR statements: "Equity", "Equality of opportunity" ["inclusive"] "All round development" "provide access" "make education meaningful and relevant"
- MIE and international platforms "Education for All" "Science Education for ALL" "Charter for Human Rights" "Education for Development" "Education for Sustainable Development" "life skills' and "relevance to post-scholastic life"
- assumptions, attributions and causal links

♦ **LIMITATIONS**

LIMITING FACTORS INCLUDE:

- transferring MODELS into ACTION
- embryonic ideas, rudimentary
- no quantitative evidence
- few limited attempts at lower secondary science
- translation to professional practice post MIE training
- definition of TERMS and applications
- time and resource constraints

THE MODEL NEEDS TO BE TRIED IN A GREATER VARIETY OF CONTEXTS.

♦ **TRIALS**

1. GROUP COMPRISING TEACHERS WHO PARTICIPATED IN THE TRIALS ARE SHOWN IN TABLE 4.

TABLE 4: TRIAL SAMPLES

	Programme	**Teachers**	**COURSE ITEM/CODE**
1. MIE Teacher Education	TCP 03 – 05	125	Aim 7, SCE 111 Professional Competencies
	TD 02 – 04	9	Instructional Strategies Chem 2320 TD
	B.Ed 02 - 05	7	Methodology I Ched 1211
	PGCE PT 02 – 03	11	Science Education SCE 410
	PGCE FT 03	5	Subject Didactics School Based Inquiry
2. School Based / Classroom TRIALS	TD 02 – 04	9	Forms I – V curricula
	BEd 02 – 05	7	Forms I – V curricula

2. Approaches
   - Demonstrative ACTIVITY / EXPERIMENT
   - Group Participative ACTIVITY / EXPERIMENT
   - Individual ACTIVITY (with learning / concept cards)
   - Individual presentations / group discussions

3. IMPLEMENTING THE SOLUTION AT SCHOOL LEVEL:

TABLE 5 SUMMARIZES THE IMPLEMENTATION PLAN

Table 5: school implementation plan (term 1, 2003)

Inclusive pedagogy as TOTAL INVOLVEMENT OF TOTAL INTELLIGENCE OF ALL LEARNERS THROUGH ALL DIMENSIONS OF SKILLS USING VARIED STRATEGIES		
1. Student's prior learning (previous class)	**DIAGNOSTIC TEST**	TOPICS COVERED IN FORMS 1 – V:

2. Identification of student learning difficulties	**FREQUENCY TABLE**	• Elements, symbols and formulae • Particles, states of matter • Writing word and chemical equations • Practical investigations • Acids & bases • Neutralization • Salts • **Numericals**
3. Design of (a) strategies and (b) supports to develop skills in all dimensions	Modeling of "demonstration lessons"	
4. Implementation (1st term 2003 scheme of work)	School classroom ACTION: Interactive Inclusive Pedagogy	
5. Outcomes / Follow up	FORMATIVE TEST PROACTION	

Conclusion:

Students, both boys and girls, are not able to cope with the varied demands of science lessons. This is largely due to lack of prerequisite skills. Under achievement and failures become customary. The multidimensional framework of skills implies that teachers guide students to practice each dimension of skills in every science topic. In addition to motivating both teachers and learners the approach empowers them leading to a liking for science. This becomes apparent in the choice of science subjects, improved classroom interactions and in enhanced achievements.
The approach builds on diversity: of students (gender), abilities (types of intelligence) resources (human and material) and contexts (school type, classroom characteristics). It is thus inclusive and leads to sustainable practices and outcomes.
Science activities become constructivist both experientially and socially rather than just inquiry or discovery learning.

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C. POLITICAL, SOCIAL AND HEALTH CHALLENGES

1. increase women in political, social and health related **decision making and debates**.
2. promote **participation** and leadership
3. prioritise maternal **health** and **care**, child **nutrition** and **safety.**
4. provide **clean water** and **pollution free environments**.
5. promote **indigenous** family and health practices
6. **reduce health hazards** for children, mothers and vulnerable groups (handicapped, impaired persons)
   [combat tuberculosis, diphteria, poliomyelitis, measles, tetanus, whooping cough, AIDS, SARS---)
7. ensure **peace**, democracy and freedom.

D. INTRAPERSONAL and INTERPERSONAL

1. provide **role models of Living Values**.
2. **reduce social evils**: alcohol as drink, drugs; exploitation of children, women and men
3. **reduce gaps** have: have nots.
4. promote **introspection** and coherent thinking in everyday matters.
5. promote **intrinsic goals** and reduce need for external discipline.

REFRESHER TRAINING COURSE FOR AFGHAN WOMEN ENGINEERS - PROFESSIONAL DEVELOPMENT IN THE POST-TALIBAN ERA

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Round Table Discussion

Abstract

In the current period of reconstruction of infrastructure in Afghanistan, the need for a well qualified engineering workforce is high. As opposed to many countries of the West, the ratio of female engineers in Afghanistan is high (approximately 30%) but because professional women, including women engineers, were banned from working during the Taliban regime, they face a gender-specific disadvantage in terms of degenerated skills and qualifications. Therefore, in this post-Taliban era there is a need for special refresher training for women engineers and this project was designed in response to this expressed need.

The overall objective of the project was to increase equity between women and men in Afghanistan. A more specific objective was to update skills and qualifications of a number of Afghan women engineers so they can compete on an equal footing with male colleagues for the growing number of positions within the engineering labour market. Another specific objective was to build capacity within the engineering sector.

In the paper I will describe the project, including the course curriculum, the participants and the teaching methodology which included project work. Further, I will reflect upon what I perceive as a 'cultural clash' between a national educational system based on teacher-controlled teaching and an internationally designed training course based on student-centred learning. Finally, I will assess whether the project objectives have been fulfilled. The questions which I want to discuss in the Round Table will mainly be centred around the issues of learning style, teaching methodology and cultural differences, including gender differences.

1. Introduction

Higher education in most Western European countries have in the last 10 – 20 years undergone substantial transformation in a number of areas, one of which is concerning study form, where a shift has taken place from teacher-centred teaching to student-centred learning. In connection with this transformation, problem-based and project-organised group work has been introduced in many curricula, including in engineering education. At the Faculty of Engineering and Science, Aalborg University, Denmark, where problem-based and project-organised group work has been the norm since the inauguration in 1974, the UNESCO Centre for Problem-Based Learning in Engineering Education (UCPBL) was established in 2002, with the aim of supporting and assisting engineering educational institutions throughout the world introduce problem-based learning. I am concerned about the implicit 'learning imperialism' and in this paper I will raise some of the important questions which in my opinion need to be discussed in connection with such an endeavour.

2. The case study

The case study is an Oxfam project, designed by a Gender Adviser and an Afghan Minister of Women's Affairs, with the purpose of conducting a 7 weeks Refresher Training Course for Afghan Women Engineers, at Faculty of Engineering, Kabul University during June – August 2002. The ratio of female engineers in Afghanistan is high (approximately 30%) but because professional women, including women engineers, were banned from working during the Taliban regime, they face a gender-specific disadvantage in terms of degenerated skills and qualifications. This project was designed in response to this expressed need for special refresher training for

Afghan women engineers.

The overall objective of the project was to increase equity between women and men in Afghanistan. A more specific objective was to update skills and qualifications of a number of Afghan women engineers so they can compete on an equal footing with male colleagues.
The following project description is based on the Final Report (Dahms, 2002) and on the End-of-Course Questionnaires (33 out of 51 returned), administered by the end of the course to provide information on the opinion of course participants about the course.

Teaching *staff* for the engineering part of the curriculum were 4 international (i.e. Oxfam) trainers and 4 university lecturers, while English and computer lessons were taught by teachers from private language and computer schools in Kabul. Written course *material* had to be translated into Dari and lectures by the international trainers were verbally translated in class.

The course *participants* were a total of 51 female engineers with a background in civil engineering, construction and similar engineering fields. The majority (3/4) were graduates from Polytechnic Institute, Kabul, an engineering institution which during the communist regime was strongly supported by the USSR both in terms of teaching materials and human resources. Many of the female engineers had considerable work experience (60% more than 5 years) but only one indicated that she worked as an engineer during the Taleban regime. The 51 participants were divided into 3 classes of 16 – 18 women, i.e. each lecture had to be repeated 3 times (apart from some few cases where 2 or 3 classes had a lecture together). The classes were further divided into 3 - 4 project groups of 4 – 6 women each.

The course *curriculum* included the topics and the indicated number of teaching hours, shown in Table 1:

Topic	**No. of teaching hours planned**	**Approximate no. of hours actually taught**
Civil engineering	40	50
Water and sanitation engineering	30	30
Project management	16	16
English	30	40
Computer training	24	32
Project work	133	75
Self study	0	15
Total	**273**	**258**

Table 1: Course topics, including planned and actual number of hours taught.

The *didactic* approach planned for the course was a combination of teacher-controlled lecturing in class, using audio-visual teaching aids and student-controlled project work in project groups, using the computers to produce written project documentation, including a project report to be produced by the end of the course. As can be seen from Table 1, there was a marked discrepancy between planned and actual project work hours which was partly due to the fact that the international trainers could not cope with the tasks of preparing course material and project tasks at the same time as teaching in class. I will elaborate on this issue in the next section.

The discrepancy between planned and actual total teaching hours was due to the inclusion of extra-curricula activities, such as ceremonies, presentations by relevant NGOs, a session on networking etc. Time for such activities was normally taken from the project work time. Thus, project work time came to function as the 'elastics' which allowed flexibility to cope with a number of unforeseen situations.

Teaching *time* was from 8:00 am to 3:30 pm, 6½ hours per day, 6 days per week, 7 weeks, i.e. a total of 273 teaching hours. The timetable was divided into two 2-hour morning sessions and an afternoon session of 2½ hours, with a 10 minutes break during the morning and a 50 minutes lunch break. English classes and computer classes were concentrated during the first 3 - 4 weeks, with the rationale that after these first weeks participants would be able to understand sufficient English to make translation superfluous and be sufficiently familiar with computers that they be able to produce project documentation in English on the computer. This did not happen!!

For reasons of *monitoring and evaluation* of the course, a Students' Committee was formed which met 4 times during the course, a Mid-Term Evaluation was carried out and an End-of-Course Questionnaire, translated into Dari, was distributed to all 51 participants, of which only 33 returned the filled questionnaire.

Assessment of participants' learning outcome in the form of tests, exams etc. was not carried out. The plan had been to assess the project work – and via the project work assessment also assess the learning outcome of lectures which were meant to support the project work – by having the project groups write a project report in English and then have an oral exam, based on a discussion of this report. Due to the poor English language capability of the participants and the limited translation capacity available, this plan had to be given up and no attempt was made to put in place another assessment of learning outcome, since this would have meant extra work for the trainers.

3. Reflections on teaching and learning in a cross-cultural setting

The following reflections are partly inspired by the article "Cultural Differences in Teaching and Learning" (Hofstede, 1986) which deals with the 'school' as one of the fundamental institutions in any human society and the 'teacher-student role pair' as one of the archetypes of interaction between human unequals which is not only a product of a given culture but is also the device by which this culture reproduces itself. When teacher and student come from different cultures, a number of complex problems may arise. Hofstede (1986) lists the following areas as problematic:

- differences in social positions of teachers and students;
- differences in the relevance of the curriculum;
- differences in the profiles of cognitive abilities;
- differences in mutual role expectations in teacher-student interaction.

In his article Hofstede (1986) mainly discusses the last area, the discussion being based on a 4-dimensional model of cultural differences developed in connection with research on work-related values (Hofstede, 1980; 1983). The 4 dimensions of the model of cultural differences are:

- Individualism as opposed to collectivism.
- Power distance, i.e. the degree to which the less powerful persons in a society accept inequality in power.

- Uncertainty avoidance, i.e. the degree to which people within a culture try to avoid situations perceived as unstructured, unclear and unpredictable by maintaining strict codes of behaviour and belief in absolute truths.
- Masculinity as opposed to femininity, i.e. the degree to which social roles attributed to men are dominated mainly by male values (such as competitiveness, ambitiousness and material success) or by female values (such as caring for the weak, interpersonal relationships and non-material qualities of life)

Based on each of these 4 dimensions Hofstede presents 4 lists of suggested differences in the teacher-student interaction and he describes these differences as the extremes where real life situations lie in between the extremes (Hofstede, 1986).

According to Hofstede 'culture' is defined as "the collective programming of the mind which distinguishes the members of one human group from another" (Hofstede, 1980, p. 25) and 'values' are "broad tendencies to prefer certain states of affairs over others" (Hofstede, 1980, p. 19). For the following discussion I will adopt these two definitions and although I do find the 4-dimensional model of culture much too rigid to be useful in cultural analysis, I will not go into a critical discussion of the model in this paper. Rather, I want to discuss a problematic area not mentioned by Hofstede: differences in teaching methodology. As mentioned in section 2 the course consisted of lectures and project work and differences in teaching methodology were most pronounced in the project work which will therefore be the topic of discussion in the remainder of the paper.

The rationale for introducing project work into the curriculum was to create a learning situation where the participants could interact in an active way and would be able to draw upon the work experience they already had, thus securing a learning rooted in present knowledge and thereby a deeper learning than what was judged possible by lecturing. Another aim of the project work was to allow the participants to look for necessary information and facts for themselves rather than to expect the teacher to present it in a lecture.

The plan was that project facilitation be carried out by a team of 1 university lecturer and 1 international trainer per project group. In order to prepare the university lecturers for this task, a training-the-trainers session of 4 hours was conducted before the start of the course. In this session the importance of independent participant work was stressed and the role of the teacher as a facilitator, not a teacher, was discussed. The language barrier did, however, create a problem for the project facilitation. Project facilitation (as I know it from Aalborg University) is mainly based on discussions with the project group, trying to assist them in formulating clear questions and encouraging them look for answers in the sources of information available to them. This way of project facilitation was obviously not very feasible because translation was required throughout. Therefore, the university lecturers took over most of the project facilitation which then – in spite of the training-the-trainers session – quite often took on the form of lecturing in class during project work time and thus eventually changed most of the project work from a student-centred learning situation to a much more teacher-controlled teaching situation than was the original intention, a situation which seemed to be not only accepted but even welcomed by both participants and teachers.

The project work was intended to take place in the smaller project groups, but the women preferred to work in bigger groups, i.e. in the class. Spontaneous observations indicate that whenever the project facilitator was not present in class a good deal of peer learning took place, in the form that a more experienced woman engineer would be at the white board lecturing to the other women present in the class, sometimes interrupted by other participants. Thus, the project work did indeed further an active interaction between participants which is confirmed by the overwhelming satisfaction with the project work as expressed in the questionnaire: 30 of 33 found project work 'good' or 'very good' and 19 stated that the project work contributed very much to the learning outcome of the course. A few comments in the questionnaires does, however, seem to indicate that the concept of student-centred learning was not fully appreciated. One participant said that the worst thing about the project work was when the head of the group was absent and another participant commented that it would have been better if every group had a teacher to advice the group.

From the list of differences in teacher-student interaction related to power distance (Hofstede, 1986, p. 313) a few differences should be brought out that might illustrate the above:

Small power distance societies	**Large power distance societies**
Teacher expects students to initiate communication	Students expect teacher to initiate communication
Teacher expects students to find their own paths	Students expect teacher to outline paths to follow
Effectiveness of learning related to amount of two-way communication in class	Effectiveness of learning related to excellence of teacher

From the list of differences related to uncertainty avoidance (Hofstede, 1986, p. 314) some differences worth mentioning are:

Weak uncertainty avoidance societies	**Strong uncertainty avoidance societies**
Students feel comfortable in unstructured learning situations: vague objectives, broad assignments, no timetables	Students feel comfortable in structured learning situations: precise objectives, detailed assignments, strict timetables
Teachers are allowed to say "I don't know"	Teachers are expected to have all the answers
Students are rewarded for innovative approaches to problem solving	Students are rewarded for accuracy in problem solving

In planning the project work, an attempt to adapt what might in Aalborg have been an unstructured problem-based project work to an Afghan situation, it had been agreed that in the beginning the project work would take the form of small and simple group assignments, with all necessary facts and information being provided and with necessary procedures for problem solving being presented in a lecture before the project work. From these simple assignments the project work would then gradually move on to more complex assignments with a larger degree of independent work and by the end of the course the sum of documented assignments would constitute the project report.
In spite of this attempt to create a structured learning situation while still doing project work, the participants expressed uncertainty about what they were supposed to do, often they opted out from project work because there was no fixed time table and many of them felt considerably more comfortable when the university lecturers took

over the project time for lecturing on the project tasks. Similarly, the lecturers were working hard on providing the 'correct' solutions to the project questions, not appreciating attempts from the international trainers to suggest that more than one solution might be possible to a given problem.
A problem which does occur regularly in project groups is that not all group members participate on an equal footing in the discussions and not everybody contributes equally to the project work. Spontaneous observations during project work time seemed to confirm that this has also been the case in the project work but even so all participants (33 of 33) answer that everybody participated equally in discussions and 26 of 33 say that everybody contributed equally to the work. This might be due to the difference stated by Hofstede in relation to the individualism versus collectivism dimension. In individualist societies "formal harmony should be maintained at all times" while in collectivist societies "confrontation in learning situations can be salutary; conflicts can be brought into the open" (Hofstede, 1986, p. 312). The hesitation to express any dissatisfaction might also explain the fact that hardly any critical comments were brought forward in the anonymous End-of-course questionnaires.

4. The Important Questions

This section will not be a conclusion but rather some of the most important questions which arises in connection with cross-cultural teaching-learning situations. The concept of situated learning, where learning is seen as a social process taking place in a given context, is often stressed as a given. This being the case, one important question to ask is: Is there a universal learning style that can be supported by a universal teaching methodology? In discussing this question social categories such as age, sex, ethnicity, language etc. should be taken into account.
The next question which begs answering would be: If there is a universal teaching/learning methodology/style what is it like? And how best to develop this style and methodology?
Another question which arises in a situation as described above is: In which ways do former teaching-learning experiences influence the way adult learners learn in universities?
The core of the problem can be expressed in the following question: Can problem-based learning be exported from one cultural context to another cultural context?

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THE USE OF INDIGENOUS KNOWLEDGE IN SCIENCE CLASSROOMS: A USEFUL STRATEGY OR IMPOSSIBLE TASK?

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Research (Murphy, 1994; Hennessy, 1993) indicates that presenting science learning to girls in contexts that are appropriate for them and that they are interested in is more likely to motivate them to engage with science than presenting them with abstract concepts that they do not see any use for in their lives outside school. It seems to be the case that some boys are more willing to take learning on board for its own sake and are not so concerned about its relevance, other than a belief that some understanding of science will be good for their future employment prospects.

Contextualising science learning in real-life situations is now being taken up by some education policy makers (e.g. Miller and Osborne, 2000) particularly as a strategy to increase participation in science education and to retain students. This approach may also result in more embedded learning which is retained for longer; it may make students more employable and so have a vocational agenda; it may empower culturally disadvantaged groups particularly when indigenous knowledge is used; and it may be viewed as a more holistic way of learning. But the way this approach is implemented in the classroom varies greatly and depends on many factors. This paper reviews a number of approaches that aim to use a contextual approach in science learning, and raises some questions about the viability of using this approach in formal learning situations.

A spectrum of context-based approaches exist with applications-based approaches at one end and apprenticeship models of learning at the other. The applications-based approach simply relates science content to applications in the real world, e.g. how the second law of thermodynamics applies to how fridges work. This is how I remember being taught over 30 years ago. This approach can work for some students, but probably only motivates students who enjoy physics for its own sake because the physics content has to be learnt before the reward of the application is revealed and understood. At the other end of the spectrum an apprenticeship model may release students from the classroom to spend time in a workplace environment, for example in a dentist's or veterinary practice (Chin et al., 2002). Between these two extremes are other projects that take a variety of approaches.

Theoretical Background

The notion of relating learning to topics students are interested in outside school is what every good science teacher already does and is supported by learning theorists such as Bruner (1996). In his notion of the spiral curriculum he advocates starting with an intuitive account that is within the reach of the learner before progressing to more complex and theoretical approaches. So this intuitive account may be one that situates the content of the learning in a real life situation. Examining the nature of science from a feminist perspective, Brickhouse (2001) suggests that feminist thinking about theories of learning in science are only just beginning to be developed, but indicates that theories of situated cognition may prove to be helpful. Brickhouse says that: 'Science classes might be a place where students could take up identities like environmentalist, feminist or smart heath-care consumer. The teacher could work towards connecting students to relevant communities of practice outside of school' (p. 289). Hodson (1998) also supports the usefulness of situated cognition and describes this position as one where 'learning is successful when embedded in authentic and meaningful activity'. (p.118.)

Other theorists have pushed the notion of situated cognition still further. Roth and McGuinn (1997) describe what they term a *strong* view of situated cognition, where they believe that learning through contexts is really cheating students (and they use the term con-text to describe this method) by leading students to think that they are learning something about how the science content is used in the real world but in fact they are being given a very sanitised view because complexity found in real life contexts has been stripped away. Their 'strong' view on the other hand leads to a learning situation where the context is embedded in the learning situation so that all the content is learned through material that is related to that context, e.g. all practical work uses the tools that would be used in a real-life situation, field trips may be part of the curriculum, assessment is carried out within the context etc. This approach also demands that the contexts used are culturally appropriate for the learners. This may create problems for a multicultural society such as the UK where a culturally diversity of learners may exist in each classroom.

Review of some initiatives taking a context approach

In recent years several context-based approaches have developed, one of the earliest was the Physics Curriculum Development Project (PLON) (Eijkelhof and Kortland, 1988; Lijnse et al., 1990) in the Netherlands. More projects followed and I now

discuss four of these and consider some of the challenges that approaches may raise in formal learning situations.

(i) The Supported Learning in Physics Project (SLIPP)

During the nineties I led the development of a project to produce independent learning materials for post-16 students in physics which aimed to embed physics learning in everyday contexts. (Whitelegg, 1996.) The SLIPP materials consist of eight books of self-study material each designed around a particular context. The contexts are presented holistically – such that is each book has a single context and the physics concepts relevant to that context are introduced through that particular context. Students get to learn about the context (in perhaps a descriptive way) before they are introduced to the physics and the context determines which physics content areas are covered and in what order. So, for example, in the *Physics for Sport* book (Supported Learning in Physics Project, 1997) the concept of equilibrium of forces is taught through consideration of the way rock climbers use hand and foot holds at various angles on a climbing wall; pressure laws are taught through a discussion of SCUBA diving and both circular motion and simple harmonic motion are taught in the context of springboard diving. These contexts are introduced before the physics concepts being taught and the context approach is maintained through the questions and practical work that students do as part of their study of each book.

A colleague and I (Whitelegg and Edwards, 2001) investigated the effect of learning physics using this approach. Three groups of physics A-level students were studied – at school 1: a group of students from a mixed sex comprehensive; school 2: a group of girls from a single-sex independent school and school 3: a group of boys from a single-sex comprehensive. Three contexts and associated physics concepts were studied over a 12-week term.

The results of the research showed some interesting differences between the male and female students' reactions to the context-led approach. Girls, in particular, mentioned how the relationship between the physics concepts and their out-of-school interests made the physics more interesting and understandable for them. Some boys at the single-sex school had difficulty in recognising the existence of a real-life context, and they choose to ignore the context for fear of wasting time. They also were concerned that approaching physics learning in this way might lead them to learn more ideas than they might need for their exams and that some of the context material was not relevant to their course. Their teacher also contributed to this, sometimes dismissing or undermining the context in order to lay bare the 'real' physics.

(ii) Salters' Advanced Chemistry (SAC)

The second context-based curriculum project I wish to consider is the Salters' Advanced Chemistry course. Barker and Miller (2000) describe the consequences of adopting a context approach for the SAC course. They say that the

'chemical ideas are introduced only as contexts demand, thus breaking down the traditional physical, inorganic and organic divisions of chemistry. This encourages students to draw several aspects of the subject together to understand specific chemical context. Second, students only learn the chemistry required to understand each storyline, so any one chemical topic is delivered in a 'drip-feed' fashion through several units which are taught in a prescribed order. … Third, chemical ideas are revisited as the course proceeds, allowing students' understanding to develop over a longer time period that is possible with a 'traditional' type course.' (p.1172)

In her analysis of the implementation of this course in a post-16 college in England, Gwyneth Hughes (2000) and mentions the resistance to its introduction from some teachers and their students, particularly 'academic' boys who are in training for careers as scientists. Hughes argues that this will always be the case until an understanding of the socio-scientific aspects of science are valued as much as the acquisition of science facts. It is particularly striking that exam questions on the SAC course do not ask students to engage with any themes that are uncertain and open to debate (these themes will be part of the context elements of the course), but rely on a 'discrete and indisputable body of facts.'(p.436) i.e. the chemical content.

The following similarities between the implementation of SLIPP and the SAC course strike me. Firstly, the role of the teacher as gatekeeper, particularly where the teacher believes in their role of providing the route for the masculine elite to enter Higher Education and allow others to drop out. (Hughes, 2000.) Heavy syllabus content demands reinforce this and allow students to ignore content they don't see as central to the exam syllabus — as was the case with some boys in School 3 of the SLIPP study. Secondly, some of those in Hughes' SAC research also did not even recognise that a context-led approach was being taken.

(iii) The Victoria Certificate of Education (VCE)

The third curriculum development project I wish to consider in this review is the Victoria Certificate of Education which was introduced in 1992 into the State of Victoria, Australia. This was a new course in physics for the senior years of secondary schooling (years 11 and 12). The initial course design was highly innovative, developing a context-led approach. Christina Hart, one of the course

designers, says, ‘In the early draft, physics was presented as a tool and its ideas were to be studied, not as ends in themselves, but because they were relevant to, and illuminated, particular contexts taken from the students’ physics and social worlds.’ (Hart, 1997, p. 1)

In the development of the Australian VCE physics course, the centrality of the context approach gradually diminished as the contexts were relegated to the optional status of illustrating the central ideas. Hart (1997) fears that the integrity of the contexts was compromised and the extent to which the contexts determine the physics content has now been substantially reduced. However, teachers using the VCE course vary in their understanding of what context-based learning means. In a study of teachers’ views, Wilkinson (1997) found that ‘many think it simply refers to the traditional teaching of physics concepts with applications and everyday examples included in a attempt to make the subject more relevant’ (Wilkinson, 1997, p. 7). Like SLIPP and SAC the success of the course depends heavily on the teachers’ enthusiasm for the approach, some choose to ignore it and some actually undermine the approach, and although they may appreciate that it makes physics more interesting for their students, others do not believe that it helps understanding.

In formal learning situations, assessment plays a key role in determining how science is taught by influencing what weight teachers give to the various parts of the syllabus and whether students focus on learning science for understanding or learning science to pass exams. If science courses are to achieve the goal of learning for understanding (whether understanding is needed as a future citizen or as a professional scientist) rather than purely acting as a way of sorting and screening students, the assessment tasks students are required to undertake must emphasise the same goal, otherwise students and teachers will not see the importance of understanding science in terms of real world problems.

(iv) The Rekindling Traditions Project

The final project I wish to include in this review is the Rekindling Traditions project that is facilitated by Glen Aikenhead from the University of Saskatchewan. This Canadian project has produced science learning materials called Cross-Cultural Science and Technology Units (CCSTU) which aim to make connections between everyday life in a northern Saskatchewan community and science content in the school curriculum. The majority of students in the northern Saskatchewan community are of aboriginal descent (First Nation peoples) but within this community many different cultures exist. The units aims to ‘enrich students’ understanding and

appreciation of Aboriginal science and technology …and to encourage students to continue their studies in school science in the future and to demonstrate to students that they can achieve at Western science without setting aside their Aboriginal values and knowledge. …'. (Aikenhead, 2000.) Of the projects I have examined in this review, the Rekindling Traditions project is the most ambitious in the sense that it aims to present science content within a Aboriginal context so that it 'brings Western science into the student's world rather than insisting that students construct a worldview of a Western scientist'. (Aikenhead, 2000, p.21.) Various parts of the formal science curriculum (prepared by Saskatchewan's Ministry of Education) are integrated into the teaching units but the main learning contexts of the units are focused on topics and activities that are an essential part of the Aboriginal way of life and have evolved from the communities' cultures. This project demonstrates the importance of developing learning materials that are culturally appropriate for the learners. Even within the Province of Saskatchewan there are several different Aboriginal cultures, so each unit is written to be appropriate for that culture. It is difficult to see how materials contextualised for one Aboriginal culture can be used in a multicultural classroom as is often found elsewhere. In multicultural classrooms in the UK for example, indigenous knowledge is introduced into science classrooms in a piecemeal way to interest a variety of learners from many different cultures and countries.

Concluding points

Constraints of space have only allowed me to touch on a few aspects concerning the implementation of context-based science learning in formal learning situations, but the following issues strike me.

Formal assessment at National, State or Province level places the context approach in jeopardy. In all four schemes considered in this paper, students had at some point to step outside the context approach and engage with formal assessment that was either not in sympathy with, or even undermined the approach, if they wished to continue their study of science further. This places great demands on students who are motivated by the approach and may actually set them at a disadvantage. Unless the contexts are properly taken up in the formal assessments, I fear that the approach may fail to survive in the longer term. Within a strictly defined National Curriculum, as we have in the UK, it is difficult to implement a context approach within multicultural classrooms. An applications approach using some examples of a variety of

indigenous knowledge may be possible but embedding of all the science content within appropriate contexts for a culturally diverse group of learners is problematic.

In order to be valued the approach must be for all students and not just for those who are not intending to continue studying science. All students seek connections with the world around them and as Hodson says 'who we are or who we believe ourselves to be or aspire to be determines what we pay attention to and what we seek to learn' (p.112-113). So developing science learning out of indigenous knowledge within a culturally appropriate context is in my view an essential strategy to both increase the scientific literacy of future citizens and the pool of potential scientists. However formal assessment systems currently present a great challenge to this approach.

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WOMEN, POWER AND PROGRESS

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Abstract

To review the progress of women in science and technology is depressing. We don't seem to be getting anywhere, and we are not even sure where we want to get to. What are the goals of women's movements? Can they have a shared goal at all? Essentialism has been rejected and little seems to have taken its place. There seems in fact to be quite a crisis. Michel Foucault, one of the prime exponents of the idea that people are social constructs and that there are no essential qualities on which to base morality and shared goals, was not dismayed by this type of situation. It is therefore not surprising that feminists have turned to him and his ideas. I give my reflections on why this might be the case.

How Women Are Faring in Science and Technology

For the last ten years the central focus of my research has been on the shortage of women in computing and ICTs. I'm afraid that, if I ask myself what has been achieved in that time, the answer has to be 'not a lot'.

Judith Glover (2000) presents a rather sombre picture of science (not just computer science) from the 1970's, and earlier, through to 1996 using data from three countries: USA, UK and France. She distinguishes between 'getting in', that is entering the scientific disciplines at school and undergraduate level, 'staying on' which is about not leaving a scientific career after having embarked on one, and 'getting on' or getting promoted. She notes how, since the 1980s, there has been an emphasis on getting women in, or adding more women, to the sciences. But the effect of increasing numbers at these early or 'low' levels ignores the problems of improving gender ratios further up the hierarchy. Indeed even in those sciences where the proportions of women are 50% and over, e.g. the biological sciences and psychology (the latter she does not mention), the proportions of women higher up the hierarchy are still low. (Incidentally, Glover demonstrates how France differs from the USA and the UK.) In other words, in some countries, there is still vertical gender discrimination in all the sciences and technologies. One lesson from this is that these add-more-women campaigns are only of limited use. By 'adding more women' I mean simply that: having more women on the payroll with no accompanying change to the culture or the substance of the discipline – a quantitative not a qualitative change. So we are not even succeeding in what is surely only a modest part of what we should be aiming at.

The Moral Aims of Feminism

I am suggesting that there is stagnation and a lack of direction within women's movements and this is reflected in and made worse by the lack of agreement on the moral aims of these movements. There is a proliferation of organisations and events whose purpose it seems to me is to add more women, but beyond that they have no

well articulated or shared goals.

Clearly, feminism can take many forms with different sets of priorities in terms of means and ends. Moreover, as we will see later, it is probably misguided to look for a set of moral objectives common to them all. It is not clear that it is possible to have shared goals. The absence of any moral aims seems to me to be a crisis to which we are blind except that we can congratulate ourselves for having banished essentialism; this is in theory if not always in practice – I shall say a bit about essentialism in practice in a moment. So there seems to be a lot of talk about adding more women as if this were the only common ground we could be sure of, possibly realising intuitively the conflicts that would result from trying to actively discuss further moral aims.

Essentialism: What Does It Mean in this Context?

I shall follow Nancy Goldberger in defining essentialism as the view that there are 'enduring, distinctive, and possibly 'natural' or biologically based sex differences' (1996, p.7).

A classic instance of this essentialism is perhaps Carol Gilligan's comparison of men and women's moral thinking described in her book *In a Different Voice* (1993). She described men as using rules that involved separated, impersonal thinking. Women, on the other hand, are 'connected' and work through compassion rather than impersonal rules.

Kathleen B Jones follows this work of Gilligan's in an analysis of authority. Authority as seen by men '…orders existence through rules. Actions and actors are defined by these rules.' In the case of women their connectedness results in a compassion which 'cuts through the orderly universe with feelings that connect us to [the individuality] of actions and actors. Authority's rules distance us from the person. Compassion pulls us into a face-to-face encounter with another.' (1988, pp. 120-1) In this Kathleen Jones gets at least quite close to attributing essential, and of course, differing qualities to men and to women. Moreover, these are the kind of essential differences that call for changes that break the male monopoly of authority, and that includes changes in our notion of authority. This kind of essentialism suggests a moral programme; a range of changes in ideas, attitudes and practices that ends the lack of opportunity for women to talk in terms of authority.

In this way it looks as if these descriptions of what women 'really are' and how they 'really think' could form the factual foundation for a shared morality on which we could base practical changes in society. But these essential features are illusions not

facts. We cannot say that all women possess such and such an attribute. As Donna Haraway says 'There is nothing about being 'female' that naturally binds women' (1985, p. 72). Women are social constructs; as Simone de Beauvoir famously wrote: 'one is not born a woman, but, rather, becomes one' (Beauvoir 1973, p. 301). So these facts on which it was hoped to build shared moral outlooks turn out to be not facts at all. But even if they were facts, it would not be possible to read off a set of moral ideals based on them. As the moral philosophers put it, you cannot get an 'ought' from an 'is'. Some facts are welcome and some are regrettable and ought to be changed. Classifying things as good or bad cannot be established simply from the facts alone.

Moreover, what 'essentialists' were often doing was not so much reading off a set of values from the facts, but rather reading into their description of the facts the values that they wanted to see there, typically, qualities like nurturing, caring and non-competitiveness.

Michel Foucault

In this paper I examine some of the ideas of Michel Foucault because he also had come to the conclusion that there is no essential nature of people. He also concluded that it is impossible to derive a universal morality from facts. Religion and law had, in his view, lost their plausibility as grounds of ethics. Indeed he argued that 'The search for a form of morality acceptable to everybody in the sense that everyone should submit to it strikes me as catastrophic.' (Diamond and Quinby 1988, p. xiii). And yet Foucault was not dismayed by this and, as we shall see, proposes an ongoing struggle. Although Foucault had little to say about the position of women, his ideas are applicable to their relative position vis-à-vis men and have provided a rallying point for feminists. Let us examine why.

As Irene Diamond and Lee Quinby point out, one striking area of agreement between feminism and Foucault is that 'both identified the body as the site of power, that is, as the locus of domination through which docility is accomplished and subjectivity constituted' (1988, p. x); hence the importance of sexuality to both Foucault and feminists. The starting point for his work on the history of sexuality was its all pervasiveness in modern society. Sexuality, Foucault argues, is a historical social construction, or an apparatus 'designed to mould sexual practices towards certain strategic and political ends' (McHoul and Grace 1993, p. 77). These ends are to promote the goals of the bourgeoisie. They are achieved partly through taking over the physical bodies of individuals and also controlling the population as a whole. To

summarise this I quote Foucault himself: 'The disciplines of the body and the regulations of the population constituted the two poles around which the organisation of power over life was deployed.' (Foucault 1990, p. 139) The two together he termed 'bio-power'.

Women and men's fashions, body language and other aspects of behaviour confirm their sexuality. Foucault's ideas have been applied by feminists to issues like the normalising role of female fashions (for example, tight fitting bodices, foot binding, high heeled shoes), body language (while women take up little space, men are expansive), male and female cosmetics, and cosmetic surgery. (See, for example, Bratky (1988).)

Foucault argued forcibly that the body is not something given and biologically fixed, but has been modified in various ways and over long periods of time. By a process of normalisation, men and women are convinced that the current defining criteria of how the body should be describes the biologically normal and therefore ideal body, presenting a norm for people to aspire to. Society uses various pressures to encourage each of us to adopt these as standards. Those who fail are judged and often informally punished for failing to reach them.

These are the kinds of things that made feminists look at what Foucault says about common aims, if there are any, for women. To follow this through we must talk briefly about the notion of power that was crucial in Foucault's thinking.

Power

Sources and Directions of Power

Foucault's unravelling, or deconstruction, of power clarifies how power operates. He deconstructs the traditional view of power, which was that it is a purely negative force, something that is synonymous with repression, and promotes it as a positive force. So in Foucault's view power is much more than merely repressive. Another important feature in his view of power is that it is not unidirectional; it is everywhere. 'Power is everywhere; not because it embraces everything, but because it comes from everywhere.' (Foucault 1990, p. 93)

> 'When I think of the mechanics of power', he said in an interview, 'I think of its capillary form of existence, of the extent to which power seeps into the very grain of individuals, reaches right into their bodies, permeates their gestures, their posture, what they say, how they learn to live and work with other people.' (Sheridan 1980, p. 217)

Power, as he perceives it in the modern world, is not simply exerted from above. 'Power comes from below…' (Foucault 1990, p. 94) Neither the state, nor the law, nor other institutions are the origins of power but they are 'an overall strategy and

effect' (Martin 1988, p 6). In the UK for example, laws concerning discrimination on the grounds of gender and race, and including equal pay, have been in force for over 25 years. And yet women's pay in UK universities was, in 2000, 16% lower than men's (AUT 2001).

Discipline and its Normalising Effects

In medieval society power was exercised by and in the name of a sovereign who had ultimately the power of death over his or her subjects. According to Foucault, this somewhat 'external' model of control has been replaced by another model whose main function is to regulate lives more thoroughly. In this modern scheme this control is exercised through the discipline of the body. Disciplining the body is of course one of the poles of Foucault's bio-power that I mentioned earlier. In schools, prisons, the military, hospitals, police forces, administrations and in units of employment, people are observed, measured, compared and thereby disciplined. (Sheridan 1980, pp.192-3) (Modern day 'call centres' are a striking example of this.) One result of continued observation, be it of the prisoner, the patient or the employee, is that eventually they discipline themselves. In other words the discipline comes from within. As Foucault wrote '…the perfection of power should tend to render its actual exercise unnecessary' (1991, p.201). And part of this process of observation and measurement is the collection of knowledge about individuals. This gives rise to notions of power/knowledge: knowledge about individuals gives other people power over them. This collection of knowledge through measurement is the basis for *setting* norms and for recognising the dividing line between the 'normal' and the 'abnormal' – an important function if your aim is 'the administration of life'. These observations and data supply the basis for categorising people and their varying degrees of 'deviance'. Rather than a division between loyal subjects on the one hand and enemies of the sovereign on the other, we now have a division between the normal and the abnormal. In fact the division isn't quite as binary as that; we now have a norm that eventually produces a calibrated, measured, hierarchical society. A society that normalises its subjects is the historical effect of a technology of power centred on the body, hence the importance of sex as a political issue.

Just as Foucault argues that power is not only repressive, he also holds these processes of normalisation do not produce conformity. 'We must not make the mistake of thinking that techniques of power have crushed those natural forces which mark us as distinct types of human beings with various 'personality' traits. Rather,

differences, peculiarities, deviances and eccentricities are ever more highlighted in a system of controls concerned to seek them out.' (McHoul and Grace 1993, p. 72) On the face of it this appears somewhat paradoxical. On the one hand he is saying people are being made to conform to some norm and, on the other hand, he is saying that this very process highlights differences. What I think is happening here is that differences are highlighted in order to make people conform.

Now I give a few examples of how we are controlled through the power of the norm. First, Anne Fausto-Sterling's book *Sexing the Body* (2000) provides a compendium of detail on the efforts of the medical profession to use the notion of a norm to enable them to get intersexuals to fit into 'one or the other cubbyhole' (p. 8). She has a telling cartoon to illustrate this (p. 59). As a second example: people who want sex changes sometimes have to show the medics that they really want to become a 'real' woman or man by cross-dressing before they are allowed to have surgery. For a man-to-woman change the pressure is on the client to behave according to some notion of a 'woman' if they want the surgery. Who supplies this notion of a 'real' woman?

Resistance to Power

Just as power comes from a multiplicity of centres, so too does resistance to that power. Just as there is no centre of power, so no frontal attack on the state is going to work and a quite different form of struggle has to be adopted. The struggles must be 'local [ones] that undermine institutional power … as it operates in homes, schools, prisons, therapists' offices and factories, wherever the work of normalization is carried on.' (Martin 1988, pp. 9-10) Indeed Foucault refuses to suggest grand solutions and only refers to these local struggles, and when asked if he would propose something, replied

> My position is that it is not up to us to propose. As soon as one 'proposes' – one proposes a vocabulary, an ideology, which can only have the effects of domination. What we have to present are instruments and tools that people might find useful. By forming groups to make these analyses, to wage these struggles, by using these instruments or others: this is how, in the end, possibilities open up. (Foucault 1988, p. 197)

Far from working to fulfil some universal moral aim, Foucault in the last phase of his thinking suggested an aesthetic mode of life in which each should 'search for styles of existence as different from each other as possible' (Diamond and Quinby 1988, p. xii). So this gives some clue as to how to choose what actions to take and which power points to resist and what form this reaction should take. We should make choices on the grounds of aesthetics. Instead of the universal moral rules that he rejects, he calls for diversity in life-style.

One That Got Away

Some More Foucault and a Story

I would like to tell you a story concerning the way in which feminist work has been received in one traditional scientific department. I tell this story because so much of it reflects some of Foucault's ideas on power and so on.

First I need to amplify what he said about the role of sexuality in our society. Sexuality has become an instrument of power. 'It appears rather as an especially dense transfer point for relations of power: between men and women, young people and old people, parents and offspring, teachers and students, priests and laity, an administration and a population' (Foucault 1990, p. 103).

One of the mechanisms by which sexuality attained its centrality, certainly by the early 19th century, was that of the hysterisation of the female body, which, according to Foucault, involved its medicalisation (Foucault 1990, p. 104). So, I interpret 'medicalisation of their bodies' to mean that the female body became a legitimate focus of attention for the medical profession, including the then newly emerging psychiatric profession. Indeed, as well as the medicalisation of women's bodies there are also their 'conjugal and parental obligations' (Foucault 1990, p. 120) within the family. This hysterisation of women would presumably be part of the moves to get people to discipline themselves to avoid opprobrium from society. This goes along with discipline in schools, the military, places of employment and so on.

Another observation of Foucault that is relevant for the story I am about to tell is that of the interaction between the law and the medical profession. Foucault's discussion of a case of parricide in the early 19th century provides all the available documentary evidence relating to the murder of three members of his family by a young man called Pierre Rivière (1978). This documentary evidence includes that of doctors and lawyers. Simplifying their views somewhat, the doctors found him insane and the judicial system that he was of sound mind. The point of my mentioning this is not that it has directly to do with gender, but with the conflict and tensions that were then beginning to emerge between doctors and lawyers in determining what madness is – a still unresolved conflict.

Now to my own experiences that I shall relate to Foucault's theories. In 1979, four years after the Sex Discrimination Act became law in the UK, I won a legal case against my employer for their failure to promote me on the grounds of my sex. Employment cases like this are heard before special tribunals which it was hoped would be accessible to the individual and would operate without lawyers. However,

employers soon started to use lawyers to defend themselves.

I engaged a lawyer, as did my employer. After I won, the reaction of senior managers was denial – denial that it was any more than a quasi-legal win. I received the minimum redress in that I was promoted; there was no financial compensation. After that, they just waited for a short period and things went back to normal. In Foucauldian terms there are two points to make here. The first is that I exercised power by taking the case and by winning it. Then my employer resisted this win and in turn exercised power by denial. The second point that I derive from Foucault is that the law is not a straightforward source of power - it brought me little benefit.

In order to complete setting the scene I should add that I have long been an active trade unionist. There is also a law that is designed to protect people like me who engage in trade union activities. Again, as you will see, this is ineffective.

Next came my research into gender that I started in 1991/92. I work in a very traditional Computer Science department. While all around me people were doing research into gender in European literature, in history, philosophy and law nobody could accept that there was a problem in the sciences – least of all computing. The more publicity I got, the more there were mutterings about getting me to stop this work – 'we must be careful', 'we must stop her doing this' and so on. There was also the inevitable ridicule. My immediate colleagues read very little of what I write, let alone discuss it in any depth.

I applied for promotion. It was bizarre. They ignored my referees, got their own and then ignored what the positive ones wrote. My application failed and I appealed. That process took the better part of two years and it failed. What I did hear was that it had been decided at a senior level that I would not be promoted because of my trade union activities. I have no proof of this; I understand that a lot of evidence was destroyed, but it is reasonable to infer that this was a reason for their failure to promote. Most people who get involved in trade union work give it up at some point and then get promoted. I didn't, so I wasn't 'normalised'. Again the law was no deterrent.

My employer's next moves are really interesting in the context of Foucault. I was deemed to be ill and should 'see a doctor' and, since I vehemently refused these 'offers of help', the time had come to start disciplinary proceedings against me. It was never said what I had done to require disciplining. Here there was confusion as to whether I was 'mad or bad'. I was clearly way outside some expected norm. At one meeting with a senior manager there was also a strong implication that I should retire and look

after my husband and my elderly father. I.e. one way I could 'save my soul' and return to normality was to take my proper place in my family.

There was a further side-show. They started a risk assessment. Usually risk assessments are for employees who may themselves be at risk from using chemicals, radioactive materials or are required to do heavy lifting or have to enter confined spaces and so on. This so-called risk assessment was interesting because the idea of risk became inverted and it was to ascertain whether or not I was a health risk to others. I saw a report in which my head of department suggested that he was concerned for the safety of the department and indeed for his own safety. Under pressure I agreed to see the occupational health physician who declared me normal. As a result my employer stopped trying to get me declared 'sick'. However, they ignored the physician's advice to have an open discussion. But it's interesting that that theme could ever have been seriously entertained; that I was a threat, a danger to public health. Psychiatry was being used in Foucault's phrase as a 'sort of public hygiene'. (Foucault 1988, p. 134)

What Should We Do?

As far as the absence of a universal morality is concerned, Foucault suggests criteria of aesthetics, matters of taste rather than morality. He suggests that the question is not 'am I living a morally good life?' but 'am I leading an aesthetically pleasing life?' He discusses his own intensity of pleasure; the decisions to be made are matters of taste and not of morality i.e. we do not expect to dispute about them. Nevertheless one can feel very strongly about them, for example, for things one doesn't like: 'I cannot stomach them', or, less strongly 'they're distasteful'.

Like Foucault, I don't believe the answers are moral ones. For my own part, I sometimes think I'm looking for justice for women, but in reality I'm looking first and foremost for something that pleases me. We have as individuals to look at our own lives and define what is aesthetically pleasing for us and strive towards that.

To conclude, Biddy Martin points out that the women's movement has been criticised for fragmentation, lack of organisation, absence of a coherent theory and the inability to mount a frontal attack. Foucault has argued persuasively that these were not realistic goals and that there is much more potential in the kind of view he has of things than there is in the centralisation and abstraction that critics like Biddy Martin still seem to be looking for. (1988, p. 10)

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