

## **CHANGING LANES: WOMEN IN SCIENCE AND TECHNOLOGY**

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### ***BACKGROUND***

The Hypatia Project, situated in Nova Scotia on the east coast of Canada, is a partnership of private and public sectors. The Project designs and implements long-term sustainable strategies to improve the representation of women in science and technology. The Hypatia Project has three long-term goals: a) to increase the participation of girls and women in science and technology; b) to promote the participation of women in the policy development process within science and technology; and c) to promote economic equality for women. Ultimately the aim of the Hypatia Project is to build the capacity of participating agencies, institutions and workplaces to provide a culture and environment which encourages the recruitment and retention of girls and women in science and technology education and careers. The strength of the Project lies with the integration of four program areas – School System, Post-Secondary Education, Workplaces and Communities – recognizing that systemic and institutional barriers exist throughout society and cannot be addressed through isolated, unconnected programs. Systemic and institutional changes are cornerstones of the Hypatia Project.

Many post-secondary institutions and workplaces have policies which support gender equity. Frequently, however, practice and behaviour within the institution are inconsistent with these policies, and the implementation of guidelines and monitoring of compliance to equity policies are often absent. Subsequently, women are not enrolling or graduating from science and technology training programs and are not entering the science and technology workforce.

Only about 16 % of Nova Scotians employed in applied science and engineering occupations are women. Equal participation of women in the science and technology workforce will not occur if current enrollment levels of women in science and technology programs at post-secondary institutions continue. Women represent only 21 % of students enrolled in engineering and applied science programs at local universities and only 15 % of students in engineering and technology programs at the Nova Scotia Community College. On the other hand, girls represent about 50 % of students enrolled in high school science courses and 48 % of those enrolled in math courses. Regardless of their interest and academic achievement in high school

science, most girls choose not to pursue careers in science and technology or to enroll in related programs at post-secondary institutions.

The Hypatia Team has examined various publications, journals and web sites to identify current and relevant research. The literature abounds with references about how stereotypic images and attitudes, institutional policies and practices, instructional practices, and workplace culture and environment influence the participation of girls and women in science, engineering and technology. The research tells us quite clearly that gender-role stereotyping is a major barrier for women, whether it manifests in the home, the science classroom, the research lab or the engineering and technology workplace. However, the vast majority of gender initiatives over the past two decades have focused on girls and women themselves, not on societal images and attitudes, not on institutional policies and practices, and not on workplace culture and environment. Even with all that has been learned about the influence of systemic barriers, most of the energy, time and funds have been focused on programs designed to change the girls or the women, not the system. It is for this reason that the Hypatia Project has been determined to focus its energy on developing long-term strategies for systemic changes in institutional policies and practices that sustain systemic barriers. *Changing Lanes* is one of Hypatia's initiatives aimed at institutional change.

### **HYPATIA RESEARCH**

In 2001, Hypatia Working Groups developed a package of three inter-related activities to capture the perspectives of Grade 9 and Grade 10 students. The research activities included:

- ***Draw-A- Scientist*** This widely used assessment tool was adapted to provide information and concrete examples of how students perceive scientists and their work.
- ***Survey*** Questions were developed to collect information about students' plans for post-secondary education and training; their perceptions of careers in science, technology and trades and what skills and qualifications are required; whether gender has an impact on people's ability to engage successfully in these careers; and whether there are other barriers to successfully engaging in these careers.
- ***Focus Groups*** Small group discussions were conducted with the students, to probe their perceptions, attitudes and current understanding of the world of science, technology and trades.

## **What We Learned**

The findings of the Hypatia research were consistent with other research studies:

***Perceptions of science, technology and trades*** Overall, the data suggested that students have rather narrow and stereotypical views of what science is and of what scientists do. Students' views of technology training and careers were more limited, and their understanding of trades was even more so.

Students associated *science* with chemistry and biology, and almost 40% of them associated science occupations with doing research in a laboratory. Students perceived science generally to be hard and sterile. Further, there was a widespread perception of scientists as 'nerds', wearing glasses and white lab coats. Female students portrayed both men and women as scientists, however none of the male students portrayed scientists as female. This corresponds to stereotypes about who can do science, and it also matches the reality of the low participation rates of women in science in Canada.

Students' comments about *technology* suggest a restricted knowledge of the widening range of work-related technologies. More than two-thirds of the students, both male and female, associated technology simply with computers. Students' views of *trades* were particularly constrained. Some students associated trades with the trading of stocks and hockey players. Many said they simply did not know, and a few spoke of the traditional trades.

***Perceptions of future possibilities in science, technology and trades training and occupations*** Almost half the students seemed interested in pursuing science as a careers. About one-quarter of students were oriented to health professions while applied sciences such as engineering and oceanography drew about 10% of the students. Of those females who are considering science, most want to be in health care or veterinary work, 'helping people', 'helping animals', or 'working with people'. Only about a quarter of the students seemed open to going to the local Community College, a primary site for trades and technology training. They saw Community College as a viable post-secondary possibility, but since they had limited perceptions of the range of jobs in science, technology and trades, they had limited understanding of community college training possibilities.

***Views on whether gender makes a difference*** An encouraging research finding was that many students felt that 'gender doesn't make a difference' or that 'gender

shouldn't make a difference,' although more females than males supported this view. Girls simply had to 'want to work in that field badly enough', had to 'work really hard' and 'be really smart'. The students had attributed success in science and technology to individual attributes of desire and commitment. A handful of students understood that gender does sometimes make a difference because of stereotypes: 'there are gender stereotypes' and 'deep down there are people who associate guys with science' and 'there are societal perceptions of how a girl or guy should be, like women working with children.' That there were systemic processes that might serve as barriers to women – factors such as bias in hiring, lack of child care facilities, and less pay – seemed visible to only a few of the students.

### **HYPATIA LITERATURE REVIEW**

Given the significant under-representation of women in science, engineering and technology, researchers have repeatedly asked, why do girls make the choices they do? Why are they rejecting science and technology for post-secondary education and career opportunities? Not surprisingly, researchers across Canada, the United States and Europe have discovered similarities between the answers to these questions and the barriers faced by girls and women. Specifically, girls' choices of career paths and further education in science and technology appear to be influenced by a combination of (1) attitudes and expectations of parents and teachers; (2) learning environment, teaching strategies and instructional materials; (3) images of science and technology; and (4) self concept and role models.

#### **Attitudes and Expectations**

Parents and teachers are powerful role models, and their approval of young women's choices of non-traditional careers is critical. If parents and teachers subscribe to stereotypical ideas of appropriate behaviour, this may lead to sex-differentiated expectations about career choices. Parents seem more accepting of lower achievement of daughters than sons, and teachers have been found to have lower expectations of girls than boys in math and science related subjects. Walkerdine (1990) describes how teachers evaluate male and female under-performance differently, attributing male under-performance to the fact that while capable, they have not worked hard, while for females it is because they are not good at science. Other common attitudes hold that women are technically incompetent, that males are better in spatial and quantitative ability, and that women's analytical abilities are weaker than men's.

Other issues relate to deeply held cultural beliefs among educators, employers and parents about the appropriateness of science and engineering careers for girls. Attitudes about which jobs are appropriate for males and females are linked to attitudes about which jobs make it hard to have a family at the same time. This concern arises out of a social organization of society where assumptions of gender still underpin ideas about work, and where domestic roles continue to be manifestations of gendered assumptions and practices.

### **Learning Environments, Teaching Strategies and Instructional Materials**

There has been much research on the differences in the learning environments experienced by males and females. Something as simple as whether instructors are male or female can affect girls' and women's sense of belonging in science and technological programs and workplaces. Research findings regarding other aspects of learning and teaching environments include the fact that women's experiences and accomplishments in science and technology are often ignored or simply tacked on at the end of a curricular unit or course; that knowledge is often presented as fragmented and disconnected, an accumulation of factual information; that chosen topics in science often do not reflect people-oriented applications; that individual effort and ingenuity not encouraged; and that genuine investigation is not distinguished from highly directed laboratory tasks.

Classroom interaction has undergone thorough gender analysis over the last twenty years at all levels of education. In public schools, boys have been found to dominate in the use of computer time and in hands-on projects in laboratories, and they continue to get more (and higher quality) attention from teachers. Research also suggests that girls are asked fewer analytic questions than are boys. Teaching strategies often favour competitive rather than collaborative learning styles, with a focus on right answers, leading to an image of science and technology which is rigid and lacking creativity.

Interesting studies exist on the reactions of female students to 'chilly climate' issues in university: "That's just the way it is, you learn to ignore it, you just don't pay attention, you laugh along with them." Female students do see the culture problems, but have judged that their role is to adapt to it. The culture remains intact. Those who write about women in science say that the educational culture itself has to change in programs which traditionally have had low enrolments of women and other equity-

seeking groups. Genuine equity requires a change in the overall educational experience, not simply in initiatives to increase admissions.

### **Images of Science and Technology**

How girls and young women perceive science and technology influences their decision to choose an educational path leading to science and technology occupations. Whether or not young women choose science and technology in part is shaped by the character of technologies, and the extent to which they are seen as “something men do.” Research suggests that science is perceived by girls as: objective and rational rather than creative and imaginative; difficult, elitist, lacking human dimension, overly competitive, and a threat to their concept of 'femininity'. Science and technology careers are not seen to be consistent with girls' and women's interest in a more holistic view of the world, nor as being careers which are 'people' oriented. Girls see computer science as isolating, or related to games with a violent theme, and science and technology workplaces are seen to be dominated by men.

It is crucial to move beyond a debate that simply says we need to change the girls' *stereotypical* images of science and technology. It is also the case that images based in *reality* do shape the young women's thinking, and it is misleading to claim that those images are wrong. Rather, it is interesting to see the extent to which young women are clear about the difficulties they may face in science and technology education and employment. Evidence of change is needed within workplaces where science, engineering and technology is carried out. Thus, changes in reality are required before we can hope for shifts in images about reality. Henwood (1996) argues that “equality cannot be achieved unless the underlying causes of inequality are tackled directly. Negative images cannot simply be dismissed and replaced with more positive ones because the images women have of engineering are not simply ‘misconceptions’.” It is not just the images of science and technology that are at fault. It is the actual social organization of the discipline and the workplace.

### **Self Concept and Role Models**

Research suggests that girls continue to see themselves as less capable in science and math than boys, they doubt their own abilities and therefore are less likely to consider a career in science and technology. Hypatia research in Nova Scotia reports girls saying they cannot do science and technology because ‘you have to be really smart.’ This links to findings that girls are more likely to internalize their performance in science and math as a failure: 'it's my fault; I'm not smart enough.' This is

corroborated in universities.

For young women, there is a link between images of technology and their images of their 'future selves', with concerns about whether being a scientist will have negative consequences in their relationships with others, or whether they may end up as isolated professionals consumed by the work, or that having a career in science and technology and having a family are mutually exclusive, or that to be successful in science and technology you have to follow patterns set by men.

### **CHANGING LANES – The Project**

*Changing Lanes* builds on the findings of previous Hypatia research and a review of national and international literature. At its core, *Changing Lanes* involves girls and women identifying the factors that influence the choices they make about careers, and the specific issues and systemic barriers they meet in science and technology training. The results of this analysis will assist in the development of recommendations leading to institutional changes within high schools and community colleges, pedagogical shifts for teachers of targeted courses, and resource materials which would assist girls and women, teachers, faculty members and communities at large to recognize and to address those barriers. Through their participation in this initiative, girls and women will develop the skills necessary to collect and analyze data related to gender stereotyping and systemic barriers and to design strategies to initiate change. *Changing Lanes* aims to promote policies and programs that take account of gender implications, the diversity of women's perspectives, and enable women to take part in decision-making processes.

### **CHANGING LANES: Goals And Objectives**

Hypatia research and literature review demonstrates that gender-role stereotyping and systemic barriers are major issues for women. Regardless of these findings, few gender initiatives in science and technology focus on institutional policies and practices, on societal images and attitudes, or on workplace culture and environment. Many initiatives have focused on changing the attitudes of girls and women through such venues as summer science camps, remedial math classes, and career days. While these initiatives are important, the need for systemic and institutional change is great.

**Goal:** To identify and analyze barriers to current and future participation of girls and women in science and technology training and identify institutional change

strategies designed to foster a culture and environment which promotes the participation of girls and women in science and technology training.

**Objectives:**

- a) To involve secondary and post-secondary education institutions, female students, teachers, faculty, community and parents in all phases of a research-analysis-action cycle involving data-collection, data analysis, and the building of a framework for change for students and teachers
- b) To develop resource materials to support teachers, faculty and students in analysing gender issues and stereotypes in science and technology training
- c) To disseminate these materials to the education institutions and to work with them to implement the institutional change strategies.

**CHANGING LANES: Approach**

An action research model is being used. It is conceptualized as a spiral of research, analysis, action, documentation, reflection, and implementation. Research and analysis provide the framework for the action. Documentation and reflection determine subsequent stages of further action and implementation. Participants will include female high school students and their parents, science and mathematics teachers, community college science and technology faculty members and their female students, and groups promoting women's economic development.

Building on research conducted in other parts of Canada and internationally, focus groups will be designed and implemented during May and June 2003 to identify the gender issues, personal experiences, and institutional barriers for girls and women in science and technology in Nova Scotia. Research findings will subsequently be compiled, data-based, and analysed to propose appropriate actions to be taken to address those barriers.

The research-analysis-action cycle will provide a comparison of rural/urban students' attitudes and conceptions about careers in science and technology and will include participation of aboriginal communities, African Nova Scotian communities, as well as the increasing numbers of New Canadians in urban Nova Scotian schools and postsecondary institutions. Girls and women living with disabilities will also be encouraged to participate and to contribute their unique experiences and knowledge to this initiative. An inclusive data-base will be created from which we can more fully understand the social and systemic contexts of young women's experiences in science

and technology and which will enable us to extrapolate information for a wider range of contexts.

An information package including highlights of the research analysis will be communicated back to students, parents, teachers, faculty, and community groups to heighten their awareness of the impact of gender stereotyping and systemic barriers on girls and women in science and technology. By June of 2004, a resource kit will be developed which will provide action-oriented prescriptions to assist students, parents, teachers, faculty members, administrators, and community members to identify strategies to address gender stereotyping and systemic barriers.

### **CHANGING LANES: PARTNERS and SPONSORS**

- Status of Women Canada
- Nova Scotia Community College
- Halifax Regional School Board
- Women for Economic Equality Society
- Nova Scotia Power
- Annapolis Valley Regional School Board

### **RELATED HYPATIA ACTIVITIES**

The *Equality in Technology Project (ET)* is a 17 month project designed to assist women entering science and technology programs at the Nova Scotia Community College. A primary goal is to create a new model which will improve women's access to non-traditional training and employment.

The *Bedford Institute of Oceanography (BIO) Hypatia Project* was developed with the ultimate goal of building awareness of the value of diversity to science and making changes that promote diversity within the science and technology community at BIO.

*Public Policy and the Participation of Rural Women in the New Economy* addresses the question of how rural women can take advantage of new economic opportunities particularly those linked to new technologies. Policy gaps, overlaps and contradictions will be identified.

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## **BARRIERS TO CAREER PROGRESSION OF WOMEN IN THE SERVICE SECTOR OF MAURITIUS**

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### ***ABSTRACT***

In spite of significant improvements in the status of interactions between women and men at work, many organisations still fail to secure women's commitment to corporate missions and objectives because of the persistence of outdated attitudes and organisational structures (Powell, 1993). This study\* examines this assertion from a service-industry context in the island of Mauritius.

Ethnographic interviews were carried out amongst a sample of organisations for this purpose, and conclusions include the confirmation that the 'glass ceiling' is well and truly present; that the existence of the old boys' network represents a threat to women's career progression; that personal and family life considerations weigh heavily against women's decisions to apply for or accept promotion, especially to managerial positions. The prospect of an increase in stress, perceived as high in managerial work, was also found to be a deterrent.

**KEYWORDS:** Glass ceiling; Women; Mauritius

### **Introduction**

Women represent approximately half of the total workforce of Mauritius, and, over the last decade or so, have attained educational levels comparable to males and have found employment in occupational areas previously only held by men. However, although girls' and women's improved education has created a pool of qualified women available for jobs at all organisational levels and in all sorts of functional areas, statistics persistently show the existence of a 'glass ceiling' or 'sticky floors' which seemingly prevent women from making significant progress in their careers. Whereas organisations must today relentlessly find new sources of competitive advantage, and whereas the human resources of firms are accepted as being a key asset, it is still a routine practice to deny thousands of qualified women important jobs and opportunities for advancement (ILO, 1997).

Human Resource specialists continually exhort decision-makers that if they (the decision-makers) continue to exclude - deliberately or otherwise –qualified human

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resources from key positions and from managerial ranks, they will find that the organisation will be unable, over time, to compete in a dynamic global environment, for suffering a shortfall in talent, creativity and competence, but also for being out of touch with the increasing diversity of markets. Schwartz (1989), for example, implores employers to “stop throwing away the investments we make in talented women and to become more responsive to the needs of women [whom] corporations must employ if they are to have the best and the brightest of all those (now) entering the workforce”. Since the rate at which educated and skilled women are entering the workforce in all areas in Mauritius, it appears that both human resource managers and other key decision makers must rethink the ways in which organisational policies and cultures affect the careers and lives of competent, talented and professional women, and the new strategies needed to attract and retain women and support their progress up the corporate ladder.

The findings reported in this paper are drawn from a wider study of gender issues in human resource management generally and career management specifically in the island of Mauritius.

We report here the results pertaining to the existence of the glass ceiling in the service sector of Mauritius, and the particular factors in and out of the work context that pose themselves as barriers to women's progression, as perceived by women themselves, but also by the human resource managers of their employing organisations.

### **Conceptual Framework and Research Context**

In recent years, job opportunities in Mauritius for women have increased mainly in two areas, the Export Processing Zone (EPZ), and the service sector. Whereas in the EPZ, most of the women work in low-skill occupations, in the service sector, the workforce is required to be skilled and qualified for the very particular customer and market demands. Not much is known of the career patterns of women in Mauritius, but Morrison *et al* (1987), studying women's work patterns in the service sector, found that women enter the service sector at levels comparable to men, with similar credentials well as career aspirations.

Much of the original work on career development has focused on males, but research in the area of women in management and on the glass ceiling has been gradually increasing, such that we now know that, not only are women at a disadvantage –

relative to men –in employment situations generally, (Davidson and Cooper, 1992) but that women even limit their own careers for a wide range of reasons, not always linked to their basic abilities or career aspirations. Indeed, differences in definitions and perceptions of ‘career’ may also lead to hasty conclusions about women’s ‘failure’ to progress in their career (Germain & Heath, 1994; Woodd, 2000). All in all, Wood (2001) suggests that attitudinal, behavioural and structural barriers that existed long ago persist today, suggesting that there are forces and dynamics at play that have yet to be brought out into the open and confronted, so that individual potential and growth is unleashed and not restrained. In a nation-wide study of Mauritian women managers, Ramguttty-Wong (2002) found that CEOs were mostly insensitive to the real problems faced by women managers, be they child-care difficulties, sexual harassment or exclusion from high-profile training opportunities. Considering, in addition, that national trends in work and family patterns point to increasing difficulties with child care, intensifying work pressure and longer working hours for women (Ministry of Labour, 2003), along with increasing female employment in the growing service sector, it would seem more than urgent that appropriate policies and practices be put in place to address the issue nationally and sectorally. This is further thrown to the forefront as an issue given the (forecasted) critical role to be played by the services sector in the ‘new economy’ of the island. The values are known to be particular, but are the potentials and capabilities of qualified women being developed systematically, and in a sustainable way, in the right skills areas?

Conceptually, whether a career is defined as an ordered, vertical series of development stages over a period of years, usually with progressively added responsibility and status, or lateral growth across one hierarchical level, or within-job "extensions", or in terms of improving ‘employability’, it is now established that men's and women's career paths differ significantly (Larwood, 1992, Marshall, 1994). As such, men appear to be recruited *for* a managerial career track, with complex and high-profile assignments, requiring job rotation and opportunities for learning, women are recruited for a clerical, administrative track, with less complex, and more routine tasks, limited job rotation and transfers, and promotion opportunities no higher than supervisory level positions (Lam, 1993). This latter stagnation is the phenomenon known now as the glass ceiling, a barrier or set of barriers preventing women from reaching important management positions, even though women are at least as well

educated and are being hired in approximately equal numbers (Davidson & Burke, 1994).

The glass ceiling thus represents what women (but men also) can see themselves being capable of doing, yet invisible barriers defy this objective logic, and prevent women from breaking through to demonstrate their competence and potential at more important echelons and areas of the organisation. In the end, not only do individuals grow frustrated and embittered, but employers who do nothing to break down the barriers are failing to optimise their human resources.

The literature is rich in suggesting reasons for blocked or slowed-down career progression of women. Among those topping the list are: making accommodations to family and personal life, at the expense of a fast career track, work-related stress (greater as compared to men's); being in stereotyped functions, much more in staff rather than line jobs (Powell, 1993; Taylor and Ilgen, 1981) discrimination in training opportunities (Begg and Fischer, 1994). The existence of 'old-boys' networks (Izraeli, 1994), and societal expectations (Eagly, 1991; Marshall, 1994; Wood & Lindorff, 2001).

### **Research Organisation and Methodology**

A description of the state of career progression of women is necessary, before even attempting an analysis of possible obstacles to career progression. For this study, data was first collected from sixteen case study organisations using a two-tier approach: all women reckoning at least ten years' service, and holding relatively high formal qualifications, were interviewed, and a survey was also conducted amongst the human resource managers' of the same organisations.

A combination of methods yielding both qualitative and quantitative data was used, namely, face-to-face interviews, and survey questionnaires.

A convenience sampling approach was used, due to the impossibility of obtaining a ready-made frame representing the population of females with ten or more years' service and formal qualification. Nevertheless, based on the breakdown by industry of females working in the service sector (see table 1.0), a sample of forty firms, spread evenly over all the industrial areas, was determined, according to (what was considered) their accessibility level.

<b>Industry</b>	<i>No. of female employees</i>
Electricity and Water	200
Wholesale and Retail Trade, Hotel and Hospitality	28,100
Transport, Storage and Communication	3,300
Finance, Insurance, Real Estate, Business services	5,900
Total	37,500

**Table 1.0: Female Employment by industry**

*(Source: Central Statistical Office (Mauritius), 2000)*

The resulting sample consisted of forty firms, with 3 staff to be interviewed in each, after prior formal consent being obtained from management. The profile of responding organisations is given in Table 2.0. In total, thirty-two questionnaires and informal interviews of the female staff group were achieved and 12 interviews of the Human Resource Managers were conducted.

<i>Sector of activity within the service sector</i>	<i>No. of Respondents</i>
Air transport and services	4
Cargo	4
Financing and Banking	4
Hotels	4
Insurance	2
Corporate Services	3
Telecommunications	2
Informatics	2
Total	25

**Table 2.0 Profile of responding organisations  
by sector of activity**

## **Results**

Qualitative data collected was content-analysed and categorised, in as far as they would yield themselves to the dimensions emerging from the quantitative data. These dimensions are: -

- Career development
- Glass ceiling indicators
- Cultural factors
- Organisational policies
- Effects on and implications for employees and management

### **Profile of female respondents**

Most respondents either held a Higher School Certificate ('A' levels) (32%) or some Diploma (40%). Sixteen percent held a bachelor's degree, eight percent a Master's degree and four percent held a School Certificate ('O' levels).

In terms of remuneration, it was found that 36% earned between R5000 and R10000 monthly, another 36% earned between R1000 and R15000, and 28% earned between R1500 and R20000, with no respondent (not even those holding either bachelor's or master's degrees) earning more than R20000. Unfortunately, the study did not obtain remuneration data on males with comparable profiles, but Ramguttty-Wong (1998) reported an enormous disparity in salaries between males and females at all managerial levels, suggesting possible discriminatory practices in wage policy, but also frustration, lack of job satisfaction, and low organisational commitment among females.

### **Career Development**

The results of the study indicate that 36% of responding (qualified) female staff are seemingly 'stagnant' in their current position, being so for over ten years. Forty percent were found to have remained in the same position for five to nine years.

Twenty-four percent of respondents, all working in staff (in effect, 'support') jobs, report to have never experienced any change in job situation, are "strongly dissatisfied" with their careers, and admit that they feel they are hitting against a glass ceiling.

67% of respondents stated that it was wrong to assume females do better in 'support' jobs while 33% thought that it was true to say that females are better in such jobs. Of the Human Resource Managers interviewed, less than half also agreed, while almost sixty percent did not think that females did better in such jobs, as compared to their performance in non-support jobs. When the qualitative data is analysed, it emerges that Human Resource Managers' views do not appear either consistent across the profession, nor are they expressed very coherently by the individuals concerned.

Consider a sample:

- *"work is seen either as men's work or women's work and women are regarded as better organisers"*

- *“Administration and support activities are dominated by women and one cannot deny the fact that they are better in supportive roles. But there are some of those who can get on and make it to middle management without difficulty.”*

When we consider that Human Resource Managers are those who determine policies and establish practices for the selection and promotion of staff, it is alarming to note that these professionals themselves think in job-stereotyped ways, but worse, that they do not perceive progression for women as getting beyond a supervisory or middle management position (in any type of job, whether support or line).

### **The Glass Ceiling**

In most of the surveyed organisations, the ratio of men to women in management position was four to one (4:1), suggesting that women are under-represented at the higher echelons of organisations in the service sector (where women’s participation has reached 50 percent). When the glass ceiling concept was explained (where it was necessary) to the Human Resource Managers, 25 percent said that it 'definitely' existed in Mauritian organisations, 34% that they 'suspected' it existed, 16% that they had not "thought about it", while 25% claimed that it "definitely did not exist".

The following table distillates the findings and depicts a rather bleak picture on the glass ceiling issue:

<i>Statement Category</i>	<i>% Response of women</i>
1. Glass ceiling's a common feature in Mauritian organisations (HR managers' opinion)	25%
2. Missed promotion because of gender	20%
3. Dissatisfied with career progress	60%
4. Never moved up the latter	24%

**Table 3.0 – Indicators of the existence of the glass ceiling**

On the question of career aspirations, the findings of our survey did not corroborate with other research where women were reported to purposely *not* seek promotion.

Our findings report a vast majority (92 percent) of qualified women actively seeking advancement of the hierarchical, vertical, kind, for reasons which are given under the following categories of responses:

- a. I deserve to be promoted on the basis of my qualifications;
- b. Promotion would be my reward for hard work;
- c. Promotion motivates me to work;
- d. The desire to do new things, to take on challenges, motivates me to seek promotion;
- e. I believe in my ability to shoulder greater responsibility; this urges me to seek promotion;
- f. I want career advancement for its own sake.

### **Barriers to Progression**

The literature provided a ready conceptual framework for examining the extent to which various 'barriers' were present. However, the data was analysed by grouping the barriers, as identified by the respondents in the study, into those considered as 'organisational' and those as 'personal':

Of the most salient organisational barriers to career progression were:

- unfair appraisal system, favouring males – 64% of female respondents mentioned this;
- inequitable remuneration – 64% percent of female respondents mentioning this;
- lack of opportunities and/or openings in management, mentioned by 60% of female respondents;
- The old-boys network, referred to by 52% of female respondents.

The majority of these respondents still claimed that support from their male colleagues was not lacking, and that this in fact bore no link with the fact that they were not progressing in their careers. As far as the human resource managers' views are concerned, those expressed indicate the lack of a concerted professional approach to the issue of 'investing in women', since 55 percent merely disagreed that women were poor training and promotion investment without expressing strong convictions on this view.

Factors considered by the female respondents as barriers of the 'personal' type included:

- family considerations (which were difficult to accommodate)
- social life (affected negatively by long hours linked to managerial work)
- stress at work (perceived as higher in management)
- hours of work (unequivocally viewed as too long in management)

## **Conclusions**

It emerges that the glass ceiling in the service sector of Mauritius is very much present, at least in the minds of many women working in that sector and aspiring for promotion to managerial ranks. The study reported here reveals the clear preference of women for career progression of the hierarchical, sequential type, confidence in their own abilities to do well at higher levels, and a lucid view of the personal, but more especially organisational obstacles to such progress. Interestingly, human resource managers of their employing organisations, while conceptualised by the general public as looking to optimise and develop the human resources –*all* the human resources –of the firm, have but a vague notion of the stakes involved in not investing in training, development and career advancement of women. As Woodall *et al.* (1995) argue, in many people's heads, including HR managers', measures to be taken to help women's careers must concentrate on the domestic, 'personal' hurdles, but –and the findings here reinforce this –the real problem lies in seeing women gain more opportunities for advancement through training and development and proper career management, in valuing their special talents and skills, and in rewarding them in proportion to their contribution to organisational success. Skilled workers and professionals tend (Driver, 1992) to choose their career paths, pursue the training and development required and follow a consistent pattern. If the service sector is to drive the economy of Mauritius now and in the future, strategically-minded human resource professionals must see the writing on the wall and begin devising systems to promote and develop women with the special skills required for the growth and success of the sector.

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# **BOOSTING COMPUTER SELF-EFFICACY BY TEACHING STRATEGIC USE OF COMPUTER APPLICATIONS: A PRELIMINARY INVESTIGATION.**

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## **ABSTRACT**

Recent economic policies have catapulted South Africa into globalisation and its accompanying demands for a computer literate workforce. This has led to an increasing awareness that efficient use of computer applications by end users is of enormous strategic value to the organisation in which they function. There are many initiatives to train people in using Information and Communication Technology but several international studies have shown that despite experience, many users do not make efficient use of computer applications and that female users in particular have little confidence in their computing ability. This may be caused by a lack of strategic knowledge that is difficult to acquire just by knowing how to use commands. Research by Bhavnani and others indicates that the efficient use of computers requires task decomposition strategies that exploit the capabilities offered by computer applications, and that these general strategies can in fact be taught to students of diverse backgrounds in a limited time without harming command knowledge. They have developed a framework for teaching such strategic knowledge and have used it successfully in controlled studies with freshman students. The results of these experiments indicate that such an instructional framework enables students to learn strategies for using computer applications efficiently and also has the potential for enabling the transfer of this strategic knowledge across different applications. This paper reports on a preliminary investigation into whether such research might be the key to fast-tracking users from technologically poor environments in general and female users in particular, into the mainstream of efficient use of complex computer applications. The investigation will be conducted within an interpretative paradigm using Activity Theory as a theoretical framework.

## **Keywords**

Computer Training, ICT literacy, Strategies

## **INTRODUCTION**

In terms of the number of end users of information and communication technology (ICT) there has been tremendous growth and an increasing awareness that efficient use of computer applications by end users is of enormous strategic value to the organisation in which they function. For developing countries like South Africa it is imperative for economic survival that there be a body of workers with sufficient skills in the use of ICT to enable the country to participate in the global economy and be part of the 'knowledge society'. It is also vitally important that the country's women are empowered to participate in a post-modern economy that is based upon advancing integration and interdependence and the ever-increasing speed of business.

The majority of students entering historically black technikons come from schools and communities which do not enjoy the same technologically-rich environment as that of the developed world, yet on graduating, these students will be expected by employers to be able to perform effectively within a technology-driven economy bent on competing globally. Several of the students come from rural areas of South Africa.

In these areas many homes still do not have electricity and running water. Some of the schools are similarly without essential services and are very poorly equipped. The urban schools in the black townships also suffer from the legacy of the inequalities of apartheid education, even eight years after the advent of democracy. Here schools are targets for vandals and criminals and what little equipment there might be is under constant threat. Schools and parents are reluctant to spend money on valuable electronic equipment that is likely to be stolen as soon as it is installed.

The researcher begins by briefly describing her earlier research into technikon first-year students' technological environment together with a discussion on the link between computer self-efficacy and the effective use of computers. Next, she describes Bhavnani's instructional approach to teaching the strategic use of complex computer systems. She continues to hypothesize as to whether such an approach could be used to fast-track students with low-level entry computer skills into effective, confident computer users and proposes an experimental design to test her hypothesis. Finally she reports on current progress with her preliminary investigation.

## **RESEARCH INTO ENTERING TECHNIKON STUDENTS' TECHNOLOGICAL ENVIRONMENT**

### **Description of the research**

The researcher asked a sample of 365 first year technikon students in their first week of attendance to participate in a survey of their technological environment and an assessment of their computer awareness. The students were drawn from 3 historically disadvantaged technikons. The survey section that investigated the student's technological environment gathered information on the types of technology used in the home (such as microwave ovens, video recorders, computers, etc) and in the school. The computer awareness test was designed to assess basic knowledge of computers as well as the student's understanding of the role of the computer in modern society and his/her expectations of the benefits of a computer literacy course. The researcher found that the students surveyed came from a poor technological environment with little exposure to digital devices in general and computers in particular. They did not have a developed awareness of the importance of the computer in the society in which they were to study and later find employment. Their most obvious lack was that of a computer in the home. It goes without saying that

children who are not brought up with a computer and are unable to use it as a tool in their studies or as an adjunct to imaginative play are seriously disadvantaged in our increasingly computer-based society. This lack of exposure could have consequences for such a student's self-confidence when working with computer hardware and applications software and other interactive technology. Female students' computer confidence would be further compromised by societal stereotyping.

### **Significance of the research findings**

These results are significant in the light of the students' potential as effective users of ICT. According to leading educational theorists such as Jonassen (1994) and Berryman (1991), it is important for learners to have expectations of the phenomena they encounter if they are to truly create their own meanings and understanding; students who have high expectations of the outcomes of the learning process are inclined to be more successful than those with limited expectations.

The researcher maintains that strategic interventions are required to improve these students' understanding of the underlying computer concepts and principles and to give them the confidence to use computer applications to solve problems. Recent studies show that there is a distinct relationship between a student's belief structure (self-efficacy) and his/her performance. Bandura (1977) and Betz and Hackett (1997) maintain that self-efficacy is influenced by a person's expectations about his/her capacity to accomplish certain tasks. Furthermore they postulate that there is a distinct relationship between self-efficacy expectations and an individual's socio-contextual environment. When students have a low self-efficacy expectation regarding their behaviour (e.g. mastering computer skills), they limit the extent to which they participate in an endeavour and "switch off" at the first sign of difficulty. Students who have to overcome internal and external barriers to computer self-efficacy because of a poor technological environment are especially in need of positive learning experiences that help them to understand how to use computer tools efficiently and enable them to move swiftly from novice to competent users.

Hill, Smith, and Mann (1987) also found that it is the type of computer experience that is important rather than computer experience per se. Positive past experience with computers will increase self-efficacy beliefs while negative experience will reduce

self-efficacy beliefs. This research suggests that it is the quality not the quantity of experience which is a critical factor in determining self-efficacy beliefs of students.

### **A POSSIBLE INTERVENTION**

The human-computer interaction (HCI) research community has focused on the design of computer interfaces that reduce the time taken by end users to learn the computer applications. This approach was intended to enable users to perform tasks quickly and it assumed that thereafter they would improve their computer skills by exploration and experience. However, several studies on the use of computer applications (Bhavnani & John, 1996; Nilsen, Jong, Olson, Biolsi & Mutter, 1993; Thomas, 1998, 2000) have shown that, even after a considerable period of experience and exploration, many users do not progress to use computer applications efficiently. For example, Nilsen et al. (1993) observed experienced spreadsheet users perform a task requiring a change of width of several adjacent columns with the exception of one. They found that most of the users modified the column widths one by one in order to avoid modifying the exception. A more efficient method to perform this task is to aggregate all the columns (including the exception), modify their widths, and then modify the exception back to its original width. The researcher has observed the same problem with student end users, particularly female students, at the Technikon. Many Information Technology diploma students in their third, or even fourth, year of computer experience, still do not use EUC software appropriately and efficiently.

Research by Bhavnani and his colleagues (1997, 2000) maintains that the efficient use of computer applications requires strategic knowledge in addition to command knowledge. They identified a set of strategies that can be used across computer applications such as word processors, spreadsheets, CAD systems and Web page design. They maintain that such strategic knowledge is difficult to acquire spontaneously even though the interface that users are interacting with is good. However, they maintain that users can be explicitly taught to use these strategies. They identified efficient and general strategies for using computer applications and the components of the strategic knowledge required for using them. These strategies are shown in Figure 2.

<b>Iteration</b>
1. Reuse and modify groups of objects 2. Check original before making copies 3. Handle exceptions before/after modification of groups
<b>Propagation</b>
4. Make dependencies known to the computer 5. Exploit dependencies to generate variations
<b>Organization</b>
6. Make organizations known to the computer 7. Generate new representations from existing ones
<b>Visualization</b>
8. View relevant information, do not view irrelevant information 9. View parts of spread-out information to fit simultaneously on the screen

*Figure 2: General and efficient strategies to exploit four powers of computers. (Bhavnani & Reif, 2001)*

Bhavnani et al. have also developed a framework for teaching such strategic knowledge and have used it successfully in controlled studies with freshman students initially at Carnegie Mellon University and subsequently at the University of Michigan and the University of Western Australia. The results of these experiments indicate that such an instructional framework enables students to learn strategies for using computer applications efficiently and has the potential for enabling the transfer of this strategic knowledge across different applications.

Each of the strategies in Figure 2 requires three knowledge components: command knowledge, application-specific strategic knowledge and application-general strategic knowledge. Bhavnani incorporated these three components into the instructional framework which relies heavily on teaching the knowledge components in an order that enables "the tight coupling of commands and strategies" in clearly described steps. Detailed specifications of this method are embodied in "teaching scripts" which are then used by the instructors during the classroom instruction. The instructors are rigorously trained in the use of the teaching scripts prior to their giving the instruction.

## **HYPOTHESIS**

The researcher hypothesises that the instructional framework described above can be successfully used to teach students from technologically disadvantaged backgrounds and particularly female students, to acquire strategic knowledge as well as command knowledge of complex computer applications. Furthermore, this training approach will aid such students to transfer strategic knowledge across different computer applications. The positive empowering effect of such instruction will encourage the development of the students' computer self-efficacy beliefs.

## **PROPOSED EXPERIMENTAL DESIGN**

The experiment is designed to answer the following research questions:

1. Does the instructional approach enable the acquisition of strategic knowledge without detriment to the acquisition of command knowledge? (Experiment-1)
2. How effective is the instructional approach for teaching students from technologically disadvantaged backgrounds? (Experiment-2)
3. Does the instructional approach have a positive effect on the students', particularly female students' computer self-efficacy beliefs? (Experiment-3)

### **Method for Experiment-1**

The experiment is being conducted in the context of an existing semester EUC course for first year Engineering students. The students are being taught basic computer knowledge and Windows followed by MSWord and MSExcel. Bhavnani's instructional method will be introduced in the latter two sections of the course. The Civil Engineering class of 40 students are being taught using the instructional framework encompassing all the components of strategic knowledge described in Figure 2 whilst a control group of 38 Electrical Engineering students are being taught from scripts identical in content except for the omission of the strategic content. Strategy 9 will not be taught in MSExcel in order to test whether the students will be able to transfer that strategy from the MSWord instruction. The same lecturer is teaching both control and experimental groups. The lecturer has undergone 3 days training on how to teach the strategies from the teaching scripts and practise the instructional approach under the guidance of the researcher. (The researcher spent the 2002 Summer Term visiting Suresh Bhavnani at the University of Michigan and received training in his instructional approach). At the end of the course, both groups will undertake a post-test specifically designed to provide opportunities for students to use the 9 strategies shown in Figure 2. The students' scores on the EUC course's regular continuous assessment tasks which test command knowledge will be analysed to ascertain whether the added strategy content had any effect on the experimental group's acquisition of command knowledge.

### **Method for Experiment-2**

In order to add qualitative depth to the study, the learning environment of the

experimental class will be described within an interpretative paradigm using Activity Theory as a theoretical framework to guide the collection and analysis of data by an outside expert. Activity Theory is a useful framework to describe the structure, development and context of tasks that are supported by a computerised system since it seeks to focus on a unit of analysis that captures the individual in context and 'activity' is such a unit. The individual engages in actions in particular contexts and these actions involve the use of material or mental tools that play a mediating role between the individual and the context in the process of the 'activity'.

### **Method for Experiment-3**

Students in both control and experimental groups will be given a pre- and post-computer self-efficacy questionnaire to determine whether there has been a change in self-efficacy levels particularly those of female students.

### **PRELIMINARY WORK ON THE EXPERIMENTS**

Work carried out by the researcher to date has been to ensure that she will be able to train instructors in the teaching of Bhavnani's strategic use of complex computer systems. She has also embarked on applying Engeström's version of Activity Systems to the EUC learning environment.

### **Learning to teach the strategic use of complex computer systems**

The researcher visited Prof Bhavnani in the School of Information of the University of Michigan from June to August 2002. During this period she was trained by Bhavnani in the learning principles that inform the teaching scripts and the correct methodology to be employed in teaching the strategies. This involved practising the instructional approach with critiques from Bhavnani and fellow instructors.

The researcher has drawn up a companion document to the teaching scripts which explains these principles and their benefits in a simple and concise manner and which points out specific examples of the principles in the teaching scripts. The document is designed for inexperienced computer literacy lecturers with little or no educational training. Guided by Lanham (1990) and Langhan (1993), the researcher has also examined the teaching scripts for language, cultural and gender bias and has ensured that they are appropriate for South African users who are not English mother tongue speakers.

### Applying Activity Theory Systems to the EUC learning environment

Broadly defined, Activity Theory is a philosophical and cross-disciplinary framework for studying human practice as development processes, with both individual and social levels interlinked at the same time. It is becoming increasingly used in HCI to describe human-computer activity especially for providing a set of perspectives on problems in such practice. The researcher has embarked on a framework for applying Engeström's Activity theory model to an EUC class as set out below:

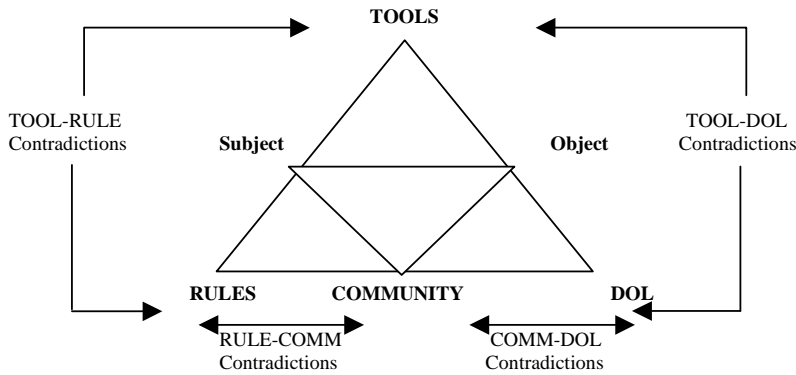


Figure 3: Engeström's Activity Systems Model (1987).

In the model 'subject' refers to the individual or sub-group whose agency is chosen as the point of view in the analysis. The 'object' refers to the 'raw material or 'problem space' at which the activity is directed and which is moulded and transformed into outcomes with the help of physical and symbolic, external and internal mediating instruments called 'tools'. The 'community' (COMM) comprises multiple individuals and/or sub-groups who share the same general object and who construct themselves as distinct from other communities. The 'division of labour' (DOL) refers to both the horizontal division of tasks between the members of the community and to the vertical division of power and status. The 'rules' refer to the explicit and implicit regulations, norms and conventions that constrain actions and interactions within the activity system. 'Contradictions' arise when the activity does not go the way it is intended and they are pointers to the problems that are manifesting themselves. Figure 4 proposes how the model's components can be applied to an EUC learning environment.

ELEMENT	DESCRIPTION
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Object		To develop understanding of computer applications To demonstrate acquired understanding in the following tasks: : :(these are like objectives or outcomes for the course)	
Subjects		LECTURER	STUDENT
Tool	Material	Finance, computer software and hardware, literature, books, computer manuals, marks, e-mail, Internet,	Computer hardware, study manual, stationery, e-mail, Internet, notes, books, money
	Conceptual	Concepts and terminology, attitudes, communication, teaching style,	Concepts and terminology, attitudes, communication, learning style,
Rule	Institutional	Lecture timetable, mark allocation, consultations, venue allocation,	Rules re registration, DP, examination, fee payment, venues,
	Lecture session	Attendance, assignment deadlines, work layout, submission times, late penalties	Attendance, assignment deadlines, work layout, submission times, late penalties
DOL	Lecturer	Lecture, formative and summative assessment, consultations, tutoring	
	Student	Learn, attend lectures, do assignments, achieve outcomes	
	Technikon Admin	Provide infrastructure, issue certificates, publish results	
Community		Lecturing staff Student community Technikon Administrators IT Advisory Committee	

Figure 4: Proposed application of Engeström's model to an EUC learning environment.

The present stage of the research is to undertake the three experiments described above, applying the models depicted in Figures 3 and 4. The results will be reported at the GASAT 11 Conference in July 2003.

## CONCLUSION

Access to ICT not only means possession of the necessary computers, software and connections, but also of the basic skills for using them effectively and efficiently. This latter aspect might prove to be ultimately the biggest barrier to participation of students from the developing world in the knowledge society. It is vital that students are not just given training in the basic computer application packages and Internet navigation but that they are taught to use their computer skills in innovative and effective ways to solve real-life problems. Bhavnani's method of teaching the strategic use of complex computer systems provides a promising alternative to traditional computer literacy instruction that typically focuses on command knowledge. The researcher hopes this approach will have the dual effect of enabling students, particularly female students, with low-entry level computer skills to employ general and efficient strategies for using applications effectively as well as raising their computer self-efficacy to a level that will ensure their continued confidence in the face of technological change.

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## **RELATIONSHIP BETWEEN GENDER AND CINEMA - RE ASSIGNING MEANING BY HEALTH EDUCATORS**

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### **Introduction**

The Freirean categories of oppressor and oppressed are relevant to characterize gender relationships that still prevail in Brazil, which should be understood as a social construction that results, to a large extent, from a “discourse” historically produced. Language, that has always had a central role in Paulo Freire’s formulations, gains prominence among the postmodern thinkers, who begin to raise its non-fixed and decentralized nature. At the same time, as Freire had already done, they help break with the rigid division between upper and popular cultures, favoring contemplation of diverse cultural manifestations in the pedagogical definitions and research.

Forms of visibility such as those constituted through the cinema produce a given discourse, bringing certain things into evidence, concealing others, establishing or distorting meanings.... Within this visual field, it is possible to affirm that people are produced, which contradicts the essentialist reading of the self, questioned in the last decades by the cultural studies, by feminists and poststructuralists. Discourse is related to power, as it acts as a means of discipline, subjectivating for a given way of acting and positioning oneself.

It is possible to state that the XXth century discourse on gender and sexuality was greatly constituted through which was told about being a man and a woman through different forms of representation, such as the media. In the last decades the cinema has become an important expressive and artistic mode of communication, capable of influencing and generating new ideas, and therefore deserving attention in the educational field. The moving image, marked by its impression of reality, demands the individual’s instrumentalization to deconstruct it and to break away with the notion of its’ transparency.

This study uses some Freire’s constructs extended to dialogue with cultural studies notions, such as subjectivity and language, to study processes through which health professionals/educators, based on reflection about their daily experiences in the relationship of man/woman, interact with films that focus on gender relationships. We are interested in knowing how they describe and relate the cinematography

discourses in relation to their own lives and how they construct the identities of the characters.

Data was collected through participant observation and group interviews during the development of the course, “Image, Gender and Education”, offered in 2002/2, at the Post Graduate Program on Educational Technology of the Nucleus for Educational Technology for Health-NUTES, Federal University of Rio de Janeiro, Brazil. This course involves students into the interpretation of films identified as having had impact into their lives. It aims at enabling students to develop a more conscious “reading” of the image, where the critical pedagogy is encompassed in the understanding of different historical constructions made from cinematography language about the relationship woman/man, and the possibility of an analytical look about the same.

### **Establishing and transforming meanings through the images**

Language’s incomplete nature, its’ constant postponement, was evidenced through the multiple readings and the different meanings attributed by the different subjects—changes into the narratives were constantly being introduced, with shades differentiation related to these subjects’ experiences.

These women were asked to bring for discussion films that had some type of impact into their lives. Among the 21 films identified and discussed by the subjects, one half were American productions, asserting the dominance of the American culture also among such group of people, who enjoy a higher level of education than the average Brazilians.

The subjects, as Freire would say, were invited to “take a distance” from the filmic representations. Each of them started by narrating the chosen film, and then coordinated a discussion on it. The narratives of the film narratives constituted a rich source for the study. These narratives were very detailed, focusing on aspects identified as important: the strength of a woman in a society dominated by men; women’s oppression in an oriental society; a certain eye of the camera, which in opposition to the traditional films, do not outrage women; a homosexual characterization that breaks with stereotypes... Valuing and affective implications marked the narratives, with judgmental statements concerning the masculinity and femininities. The outlines were clearly defined by these women’s subjectivity: how they defined themselves, their uncertainties, and their “mission” in life. . In other words, as they narrated the films, they were talking to themselves as much as to others. Therefore, these women’s perception of the films were related to their living experiences as health professionals, as educators, women, friends, mothers and daughters. Angela, a young dentist, established a relationship among the way she perceived herself and the main character of “Fried Green Tomatoes”(Jon Avnet, 1991,

USA). Such character, Ige, has served as a model during her adolescence and still stands nowadays, inspiring her behavior in the construction of her professional identity and other social relations.

“This film touches me especially in relation to Ige, the main character. Ige does not agree with the expectations for women’s behavior in the traditional social context of the film. Ige is a hybrid character with public and private features, masculine and feminine, and her sexuality is also questioned by the spectator, by his look...”

Such as Ige, in her daily life Angela rejects the expectations put by society upon women’s behavior, actively avoiding stereotypes and bravely affirming her way of being. She has seen the film over and over, each time perceiving something new, but her admiration for Ige has remained the same.

Time served as reference in Angela’s as well as in several other discourses. The way one was in the past was seen as influencing the meaning construction, in relation to the way one presently perceives oneself. Lélia, a corporal expression teacher, talks about how she perceived “The law of desire” (La ley del deseo, Almodóvar, 1986.) fourteen years ago, when she was 27, establishing relationships with today:

“This film immediately came to my memory. I was very constrained when I saw it at first, looking at those scenes... Not today anymore... Now, it has much to do with one’s upbringing, where you come from (she pauses and laughs) I am from Minas, you see? [referring to a very traditional Brazilian capital]. Sexuality is a private matter, the parents don’t kiss each other when the children are around... Although we were in the XXth century, I was raised this way... My girlfriend asked me to go to this movie, when we saw the gays scenes, we were horrified, men kissing each other the same way men and women do (...) To me, homosexual relations corresponded to violence, as my parents taught me not to experience anything...”

Lelia’s speech, permeated by laughs and pauses, accentuated when she describes a scene showing sexual relations among men, shows her introjection of sexuality as something that one can talk about, but contradictorily, as something one does not speak about easily. Images don’t appear as external objects brought for reflection, but as anchors that facilitate the knowledge one has of oneself. When talking about images, people seem to be talking of themselves.

Some films were mentioned as having authoritarian and closed discourses, seducing and involving, establishing an unilateral communication. Some were perceived as “erotizing” and treating women as objects, such as “Pretty woman” (Garry Marshall, 1990), and others as establishing dichotomies on the treatment of men/women relationships, such as Kramer versus Kramer (Robert Benton, 1989). When Angela

was invited to evaluate her engagement on film interpretation, she stated: “I was thinking, I could have brought 007, which is the most... This would allow very explicit gender relations discussion; manhood is equivalent to power, when everybody has money. .. Today, at the end, I think I have gained the capacity of looking at 007 under such perspective”.

Marcia, a nurse, brought “The Wall” (Pink Floyd, 1982), an autobiography of the musician Roger Waters, nicknamed Pink. She selected a scene where children march in line at a school courtyard, all wearing black formal clothes, in a metaphor of the military parades. Marcia establishes parallels of this sequence that impressed her since her adolescence, with her schooling. Submission is identified, from childhood to adulthood, to a persistent attempt by adults of conditioning and disciplining her into what was considered adequate to a woman and to a nurse. Appropriate ways of dressing, walking and talking, and an unquestioning behavior, were among the contents taught through the schooling hidden curriculum. Presently, as part of a health professional team constituted mostly by men, working at a psychiatric hospital, she perceives such process still going on. As put by a Brazilian feminist, mentioned by Marcia: “ The most permanent signs left by schools are not related to the contents that are presented, but to the daily situations that we live in our relations with teachers and friends, which are related to the way we construct our social identities, our gender and sexual identities”.

Marcia was clearly aware of the exclusion process involved into her identity’s constitution. Such attributes as loveliness, docility and helpfulness were among those desirable for a woman nurse, as they are considered to be natural to the profession. Others such as arguing, being critical and aggressive were adequate to other professionals, such as the medical doctors, but in her case were excluded. Marks of the established societal hierarchies of man/woman and nurse/ doctor were therefore inscribed not only into her mind, but also into her body.

According to this nurse, she has perceived in “The Wall” things that she had not seen before, such as the presence of strong women and the submission of the central character to these women. Obviously, this time her reading has incorporated other meanings, related to our previous discussion and readings about the contemporaneous dilemma of masculinity. She identifies her engagement in the films’ discussion, as contributing to “my growing up as a person! (...) to get in touch once more with certain concepts, but this time under another perspective, the discovery of the film images in education, was a sensation that I was encountering myself!”. She has

passed the selection for the Graduate Program in Educational Technology with a project related to the hidden curriculum in the nurses' formal education.

Vitória, in the first day of class, categorically affirmed that she had never witnessed gender relations differences in her 20 years experience in public schools. Gradually, important changes were observed in her views. Her interest in the film interpretation activity was evident, and after discussing a hollywoodian film, she asked for a chance of a second presentation, and brought the film "The Talented Mr. Ripley" (Anthony Minghella, 1999). Her discussion was very centered on understanding the intentions of the director for the character Ripley – was he a "normal" homosexual, or a pathological one? Clearly, she did not allow herself to bring up her own interpretations of the film, she was tied to the text. Through the group discussion, other elements of the film were introduced and problematized. At the end, evaluating the experience, she affirms "My capacity of interpretation has been enriched, today I have another perception of the filmic meanings, "another way of seeing". She has enrolled in two other graduate classes in our Program and has made some further contacts, telling about changes she has introduced into her work.

As these women incorporated to their repertoire analytical elements concerning the cinematography language and gender relations, a transformation was perceived from a more naive to a more critical interpretation of the filmic meanings. Their capacity of seeing was enlarged – for example, bipolar constructions of the characters through gestures, sounds and other elements, at first invisible, became incorporated to their visual spectrum. Or, as put by Celina, "the chance of learning to see, hearing and understanding the films through a critical analysis was very important. I have perceived the degree to which we identify ourselves with these films characters." It is possible to hypothesize that this type of awareness will allow them to take some distance from image representations, going beyond its surface to understand how they influence the construction of their subjectivity's, introducing also changes into their professional educational activities.

An interesting public space took place as these women were given the opportunity of narrating, analyzing and discussing the films. Clearly, the interactive situations created were not neutral, implying on ways of constituting oneself. However, we believe that a dialectical process took place, as notions were not only incorporated, but also generated, and therefore new modes of subjectivation were produced, opening way for the agency of the subjects within the narratives.

The historical and cultural dimension of subjectivity was well captured by Lélia:

"The more subjective our world vision may appear, there is a developing objectivity, that is, our reading shows the extent to which the discourses result from the individual upbringing into the social and historical context".

We conclude that this process of critical interaction with films is potentially a powerful device in the conscientization of professionals about the strength of

language in the construction of subjectivity, and in the glimpse of the possibility of transformation. This corresponds to a concrete practice of “reading the world”, such as put by Paulo Freire, assumed the limitations placed by the mediation of power into all the pedagogical practices.

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***ABSTRACT***

*In 2002 the world summit on sustainable development was held in johannesburg. The wssd focused on a range of environment and development issues, many which have their roots in the rationalism, scientism and technological expansion associated with an ideology of progress that is characteristic of the modernist era. Many of the issues debated at the summit adversely affect the marginalized, which are often poor rural women and girl children (amongst others) in the so-called 'developing' world. Environmental issues and risks have been recognized as social issues, as they involve political, economic, cultural and social dimensions. They thus require responses which involve social change.*

*The wssd plan of implementation (wssd, 2002) re-emphasises the critical role of education in sustainable development; and calls for the integration of sustainable development concepts, actions and principles in all levels of education in order to promote education as a key agent for social change, thus emphasizing education for sustainable development as a part of educational reform initiatives. The iucn (2003) has defined education for sustainable development as 'learning for change' ... and as a process that involves '...people in all walks of life'. This paper will reflect on the way in which environmental educators in southern africa are beginning to respond to this challenge. The paper will focus on social change and environmental education (thereby addressing the themes of science, society, equity), and through a brief review of a number of hands-on case examples of initiatives taking place, provide insight into how environmental educators in the region are rising to the challenge of fostering social change through education.*

**Modernism, gender and the issues deliberated at the WSSD**

In 2002 the world summit on sustainable development was held in johannesburg. The wssd focused on a range of environment and development issues, including the need

to promote the integration of three components of sustainable development – economic development, social development and environmental protection – as interdependent and mutually reinforcing pillars (wssd, 2002). The wssd implementation plan notes that ‘poverty eradication, changing unsustainable patterns of production and consumption, and protecting and managing the natural resource base of economic and social development are overarching objectives of, and essential requirements for sustainable development’ (wssd, 2002: 1). The implementation plan further emphasises the need for the outcomes of the summit to benefit all, particularly women, youth, children and marginalized groups, as they are more often than not most affected by environmental issues and risks, poverty and the globalisation of inequality. To achieve sustainable development, the wssd implementation plan emphasises the importance of ‘... promoting women’s equal access to and full participation, on the basis of equality with men, in decision making at all levels and enabling equal access to economic opportunity, land, education and health-care services’.

Many of the environmental issues and risks discussed at the wssd have been linked to social, political and economic changes in the global arena, particularly associated with science, industrial development, technology, the increase of global trade, resource use, movement of populations, communication mechanisms and government changes prior to, during and after the colonial period. Most have their roots in the rationalism, scientism and technological expansion associated with an ideology of progress that is characteristic of the modernist era (shanin, 1997). Vandana shiva (1997) makes the link between environmental issues, the marginalisation of women, unequal gender relationships and inappropriate modes of development. Like sachs (2002) and others (e.g. Braidotti et al, 1997), she articulates the significant role that women play in the maintenance of biodiversity, particularly in the so-called ‘developing’ countries.

Sachs (2002:6) draws attention to, and emphasises the relationship between food security, biodiversity maintenance and livelihoods, and notes that there can be no poverty alleviation without environmental protection. He sees environmental protection as ‘a condition’ of poverty alleviation, and notes that ‘with regard to the poor, there will be no equity without ecology’. Both sachs (2002) and shiva (1997) argue that an adequate response to poverty requires a fundamental re-thinking of the way in which development is viewed. Shiva notes that the dominant mode of

development (as promoted by most development aid agencies) is western, patriarchal and based on a reductionist model of science and technology that serves the global market and is effectively destructive for women, nature and all 'others' - non-western peoples. Shiva's thinking stems from a search for an alternative development model. The western development model's commodification of nature, as well as women's and non-western peoples labour, has resulted in capital accumulation in the affluent countries and poverty in the so-called 'developing' countries (Braidotti et al, 1997; Fien, 2000). Fien (2000) notes that this had led to a mode of development in which 20% of the world's population (living in OECD countries):

- earn 85% of the world's annual income
- consume 75% of global energy and over 80% of other resources annually; and
- generate 75% of annual global pollution

Internationally, the environment crisis has been strongly linked to social and cultural changes associated with the modern way of living, and modern worldviews. Modernisation is a social process, which has changed the way many people live, bringing with it advanced cash economies and industries, sophisticated technologies and scientific discoveries and high levels of over consumption (as cited above). The social beliefs and values which accompany modernisation are called modernism. These beliefs and values include great enthusiasm for progress through economic growth; the pursuit of material wealth for individuals and the value of science and technology for human development. Sometimes people believe that material wealth (materialism) is the only thing worth striving for. This is a narrow view of achievement and well-being. Sometimes people believe that science (scientism)<sup>1</sup> is the only way of seeing things. This is a narrow way of understanding the world. Sometimes people believe in technology as providing the only solution to environmental problems (technicism). This is a narrow way of approaching environmental problems. Many people think that economic development (developmentalism) is the only form of development worth striving for. This is only one and a rather narrow view of development (Rueeu, 2002). These modernist beliefs are part of an unquestioning belief in the idea of progress. As we begin to question the values of materialism, technicism, scientism we bring the idea of progress as 'popular common sense' into question, and at the same time we bring dominant

perspectives on science and technology into question. Modernisation has brought many improvements in society, but it also has a shadow side. That shadow side is closely associated with the world environmental crisis and the perpetuation of global inequalities in many different spheres of society. Fien (2000) notes that responses to the shadow side of modernization will require integrated solutions including changes in public policy; consumption patterns and human relationships. He also indicates that education is internationally recognized as being a key 'social strategy' to respond to environmental issues and risks, and is therefore an important focus for re-orienting society towards more sustainable and equitable ways of living.

### Education for sustainable development

Since the rio earth summit in 1992 many african countries have signed a number of multi-lateral environmental agreements (mea's), including agenda 21 and numerous environmental conventions, influencing local policy and practice, including education. In south africa, for example, the constitution enshrined the right to free basic education and a healthy environment as part of the bill of rights, and emphasised the concept of sustainable development in south african policy discourse. This has led to a change in orientation in the formal education system, which now includes a strong focus on the relationship between human rights, social justice, inclusivity and a healthy environment. However, there are still enormous challenges facing education in the so-called 'developing' world which include both quantity issues (provision of education) and quality issues (the nature and purpose of programmes). Both of these dimensions have implications for ensuring equitable provisioning of science and technology education. For example, at the start of the millennium more than 125 million of the world's children are still deprived of any schooling while another 150 million drop out of school without learning to read or write (brazier, 1999, see also odora, 2000 for a critical comment on education in africa). Many of these are girl children in the so-called 'developing world'. Education for sustainable development (as outlined in agenda 21, chapter 36) therefore encompasses both a concern for provisioning of education, as well as a concern for improving the quality and relevance of education programmes in the context of the current 'state of the world'.

The wssd implementation plan makes numerous references to the need for education in achieving sustainable development. In particular it emphasises the need for

meeting the development goal contained in the millennium declaration of achieving universal primary education by 2015; and providing education for all as proposed by the dakar framework for action on education for all. The wssd implementation plan also argues for increased support for sustaining educational infrastructures and programmes in developing countries including environmental and public health education programmes. It also argues for improved integration of sustainable development issues into education programmes (clauses 110-117, wssd, 2002).

To further emphasise the need for an educational response to the current 'state of the world', the united nations have approved a proposal for a un decade of education for sustainable development (esd) (to run from 2005 – 2015). This 'decade' aims to encourage countries around the world to develop national esd strategies or shared action plans that provide strategic direction and support the efforts of all engaged in education for sustainable development. The focus is on raising awareness of, and highlighting the role of education in enabling changes towards sustainable development; emphasising a broad-based notion of life-long learning and involving all sectors of society in 'activating' society to find paths to sustainable development (iucn, 2003).

The certainties of science? Science & technology education

Scientists and environmentalists are becoming increasingly aware of the limitations of contemporary knowledge systems – and many are losing faith in the certainties of science (beck, 1992 & 1999). This is shown in an increased awareness of limited capacity to accurately predict or determine exactly what human impacts on the environment might be, or what the patterns of environmental risk might be (as recent debates on genetic modification of seed indicate for example). Scientists are also currently unable to accurately establish exactly what the earth's capacity for sustaining life indefinitely might be, as much of the recent literature on the precautionary principle indicates (o'riordan & cameron, 1994).

These realisations have had profound implications for the epistemological and economic certainty established in the twentieth century under the guise of modernism, and we start the millennium with enormous challenges associated with the need to re-orient and reconceptualise the very modernist foundations on which development/s

(and education systems and curricula) have been based. As indicated above, the basic premises of dominant models of development based on unlimited economic growth and the globalisation of culture and trade are being questioned (Burbules & Torres, 2000). These uncertainties associated with scientific epistemology, provide further impetus for educators to explore 'new pathways' for science and technology education, in which science becomes 'reflexive' (Beck 1992) and learning processes become reflexive learning processes (ibid).

Thus, it would seem that education for sustainable development requires much more than merely incorporating sustainability issues into educational programmes and curricula. It appears to require consideration of epistemological and ontological questions, questions about the purposes of education and a consideration of how and why science and technology education is conceptualized and offered. Science and technology education processes appear to be intimately linked with the current state of the world, and with issues of social change and sustainable development.

Environmental education processes and social change ... some case examples from the SADC region

Through a consideration of the above noted factors which characterize contemporary social life and which manifest as environmental issues and risks, environmental educators in the southern African region have begun exploring science and technology education processes which are aimed at a re-orientation of society towards more sustainable living practices, based on principles of equity, democracy and fairness in a finite world. The following section of the paper briefly reviews some of these science and technology educational initiatives, providing some pedagogical insights into ways in which science and technology education can be re-oriented within an environmental education processes framework.

Water quality monitoring

In the mid 1980's community groups in the province of KZN were experiencing severe health risks as a result of polluted water. This continues to be a significant issue in many rural areas in southern Africa. Not all pollution is 'visible' and often manifests as 'risk' (for example cholera risk) (see Beck's 1992, 1999 thesis of a risk society).

As part of an environmental education initiative, educators in the kzn province, led by rob o'donoghue pilot tested the development of low cost water quality monitoring test kits. These were developed and used in a way to make the 'science' of water quality monitoring accessible and available to learners in schools and to communities living near water sources which were contaminated or polluted. These simple science 'test kits' were developed in such a way as to 'give the tools of science away' and put them into the hands of the people (taylor, 1992; o'donoghue, 1993). In this way this project was able to demystify science, make it locally accessible and affordable, and useful to ordinary people in their everyday lives. The water test kits also present a good example of 'reflexive science' in which the tools of science are used to establish pollution levels and risk (which often result from production processes using science and technology). These test kits were widely used as a community empowerment tool, and in the western cape, kwazulu natal and gauteng, schools, teachers and communities are still using these materials to monitor local water sources.

#### Health and sanitation education

Similar approaches to giving the tools of science away have been applied to the arena of health and sanitation education. A project entitled 'sanitation works' (o'donoghue & ringdahl, 2002) was developed through a partnership project with the rhodes ee unit, the department of water affairs and forestry and the etekweni municipality. The purpose of this project was to provide learners in schools with the tools to establish health risks associated with poor sanitation in their schools and communities. A series of integrated activities were developed in which learners audited school toilets, made observations on hygiene practices (in life orientation); audited health risks in the community (in social sciences); made bottle hand washers (in technology) and tested for e-coli bacteria on their hands (in science). These integrated lessons were developed around a set of questions which stimulated teachers and learners to investigate these dimensions of health and sanitation education in schools and classrooms. Materials and tools were provided for learners to seek solutions to the questions and to investigate them in more depth.

#### Learning democratic processes

In another initiative, learners are encouraged to explore democratic processes through story, using the Hadedda island materials. Hadedda island is a story of a 'bird island' and the dilemma's of sustainability and democracy experienced by the birds on the island (Olvitt, 2003). Through fantasy and story, learners are encouraged to explore biodiversity; habitats; interrelationships and other scientific information and processes. By following the 'bird story' learners are encouraged to consider environmental issues and risks faced by the different birds in different habitats, social relationships and issues of representivity, democracy and justice. This resource therefore encourages learners to explore both the biophysical and the social dynamics of 'science'.

### Indigenous knowledge & inclusivity

Another project which has focused on inclusivity in science education has been the indigenous knowledge education project (O'Donoghue and Neluvhalani, 2000). In this project environmental educators have explored how common sense practices of local people have become overlooked or overshadowed by the conventional wisdom of institutional knowledge (science) in the present day. Through research processes these educators have uncovered some of the implicit knowing in context as this relates to environmental management and sustainable living practices. These educators have been involved in a re-appropriating interpretation (ibid) of practical wisdom and these narratives have become the basis of environmental learning support materials. These materials have provided the scope to enable learners to engage in inter-epistemological dialogue as the common sense wisdom / implicit knowing is brought into interpretive dialogue with scientific perspectives. These materials are then applied in educational contexts as a means of mobilizing locally significant indigenous knowledge in wider communities of learners; and in broadening inter-epistemological dialogue in educational settings.

### Conclusion

In all of the above cases, environmental educators have been exploring the relationship between human rights, social justice, inclusivity and a healthy environment, all important dimensions of a sustainable society. In the educational processes attention has been given to ways of re-orienting science and technology to

encompass a broader equity framework through for example giving the tools of science away; making science kits low cost and easy to access; and considering other epistemologies in relation to a rationalist, reductionist scientific epistemology. Providing a range of flexible tools and questions has also provided a useful way of encouraging locally relevant investigations into issues of local and social relevance. These processes have been significant for their open-ended nature. Through story, educators have also been able to provide learners with opportunities to explore the biophysical and the social dimensions of 'science' and to explore technological solutions to environmental issues and risks.

If science and technology educators are to confront the broad ranging socio-ecological challenges facing humankind at the start of the 21st century, then it would seem that new ways of thinking about and practicing science and technology education are needed. Shiva makes the point (noted above) that many of the contemporary problems in society (which impact on women and girl children) are rooted in inappropriate models of development, which in turn rely heavily on a particular (dominant) reductionist models of science and technology and an ideology of progress (see reference to shiva's 1997 work above). If we are to address issues of gender, science and technology, then it would appear necessary to consider these issues which lie at the heart of global inequality and which affect the majority of citizens on planet earth. Responsible and reflexive science and technology education has a key role to play in achieving sustainable development, and will more than likely be an important consideration for educators contributing to the un decade of education for sustainable development. As indicated in the iucn statement on the un decade (iucn, 2003) all sectors of society (including science and technology educators) have a key role to play in finding pathways to sustainable development.

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# **PARADIGM SHIFTS OF NIGERIAN WOMEN TOWARDS SCIENCE AND TECHNOLOGY ADVANCEMENT: A CASE STUDY OF GENDER SOCIALIZATION PATTERNS OF IBIBIO SUB –CULTURE**

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## **Abstract**

The study aimed at determination of a paradigm shifts of Nigerian women in gender socialization patterns of Ibibio sub-culture towards science and technology advancement in Akwa Ibom State of Nigeria. It adopted a survey design, used Paradigm Shifts Questionnaire (PSQ) instrument and employed mean for data analysis with 2.0 as the benchmark. 23 socialization practices were identified as features of Ibibio traditional society prior to independence with 2.01 obtained as the lowest mean. 15 changes in current gender socialization practices of Ibibio sub-culture were determined with 3.05 obtained as the lowest mean. In the determination of Ibibio women participation and contribution towards Paradigm Shifts in Science and Technology considering the pre and post independent periods, 12 contributions were identified with 2.10 as the lowest mean.

## **1.0 INTRODUCTION**

### **1.1 Background**

The Beijing Platform for Action (PFA) was one of the major summits aimed at achieving the goal of women’s advancements and development. Prompted by the provision of the United Nations document of Convention on Elimination of all Forms of Discrimination Against Women (CEDAW), the Federal Government of Nigeria has put in place national and local plans of action for implementation of CWDAAW. The Federal Ministry of Women Affairs and Social Development in collaboration with the United Nations Development System (UNDS) recently commissioned national baseline Survey of the Positive and Harmful Traditional Practices for Monitoring of progress towards this global initiative (Ministry of Women Affairs and Social Welfare 2001). “It was a taboo for Ibibio woman to participate in any programme affecting the welfare of her environment but, today, there are unprecedented and acknowledged changes in the Ibibio society” (Abbe 1989). It therefore becomes necessary to catalogue the changes in gender socialization practices and their reflections in the defined aspects of women societal development.

This study was purposed to determine the paradigm shifts of Nigerian women in gender socialization Patterns of Ibibio–sub-culture towards science and technology advancement in Akwa Ibom State. Specifically, to identify the gender socialization practices of the old traditional Ibibio society, determine the current changes in gender

socialization practices of the contemporary Ibibios and assess Ibibio women's participation and contributions towards paradigm shifts in science and technology considering the pre and post independence periods.

The following research Questions were formulated to guide the study

What are the gender socialization practices of the old Ibibio traditional society?

What are the current changes in the gender socialization practices among the contemporary Ibibio people?

What are the involvements and contributions of the Ibibio women towards paradigm shifts in development of sciences and technology considering the pre and post independence periods.

It is hoped that the findings of this study would possibly influence the attitudes and ideologies of the Ibibios and Nigerians to shift from harmful gender-based cultural practices and be encouraged to participate more effectively in science and technology advancement, contributing to the building of the Nigerian Nation and the African Society.

## **2.0 THEORETICAL FRAMEWORK**

### **2.1 Gender Socialization and Paradigm Shifts**

Gender socialization practices are the various practices, processes, activities, and methods employed to en-culturize or recruit the males and the females as members of a given organization, institution or society. Paradigm Shift refers to a positive and significant change or alteration from that which has been before towards a modular or exemplar patterns.

### **2.2 Gender Socialization Practices of The Old Traditional Ibibio Society.**

A comprehensive review of literature reveals the following practices as gender Socialization practices of Ibibio traditional society

Domestic Violence (Wife Battering) (Ekong 1983, Essen 1982)

The Use Of Cultural Institution As Symbol Of Supremacy (Udo 1983, Ekong 1983)

Harmful Widowhood Practices (Ministry Of Women Affairs And Social Welfare 2001)

Women Domestication (Okobi 1988, Okon 2002)

Sex Preference And Male Dominance (Abasiattai 1987, UNICEF Nigeria Zone A 1998)

Sex And Career Stereotyping (Akpan 1996, Suara 1999)

Female None Or Selective Access To Education (Essen 1982, Abasiattai 1987)  
Deprivation Of Right Of Inheritance (Essen 1982).  
Child Abuse (Etuk And Nyong 1993, Okon 2002)  
Polygamy: (Essen 1982, UNICEF Zone A 1998)  
Wife Abandonment (UNICEF Zone A 1998)  
Mutilation Of Female Genital Organ (Essen 1982, Okoko 1988)  
Harmful Delivery Practices (, Ekong 1983, Ekanem, 1992,)  
Early Marriage, Force Marriage And Child Betrothal (Essen 1982, Ekong 1983)  
Girl Withdrawal From School (Nwabah 1996, Amiola And Sule 1996)  
Denial Of Shelter For Women (UNICEF Zone A 1998)  
Women Suppression And Discrimination (UNICEF Zone A 1999)  
Culture Of Women Silence. (Essen 1982)

### **2.3 Changes In Gender Socialization Patterns Of The Ibibios**

Christianization has brought marked changes in the Ibibio traditional society. Gradual changes according to Ekong (1983) and Abasiattai (1987) have been noted in the Ibibio social system and structure. Socialization of the child to a great extent is being removed from the family to the formal institutions and the churches. Added to the traditional marriage rituals now is the court marriage and church wedding. The function of mate selection rests now on the spouse and child betrothal practice is obsolete amongst the present Ibiobios (Ekong 1983). The men now provide for their families and mothers have adopted various birth control methods to reduce family sizes.

The modern Ibibio girls do not appreciate female genital mutilation. The '*Ndam*' and '*Nyama*' traditional organization that prepared girls for marriage have been denounced by the Christian doctrines (Essen 1982). Instead of depending solely on traditional birth attendants, the Ibibio pregnant women receive adequate medical attention. Rather than celebrate in market squares after antenatal care, she organizes thanksgiving in church.

The present Ibibio wives resist being inherited by their deceased husbands' relations. Access to legal right in the Law court and writing of wills have given the Ibibio woman greater opportunity of inheritance against the customs. Modern Ibibio women now hold leadership positions in the society, and are opportuned to be seen and equally heard against the culture of women silence. Women domestication is

succinctly diminishing as husbands and parents realize the need to send their spouses and female children to schools.

#### **2.4 Participation And Contribution Of Women Towards Paradigm Shifts In Science And Technology.**

**A. *Agriculture:*** In the past, the presence and contributions of women were not strongly emphasized nor given prominence, but presently as observed by Saito e'tal (1991) there is growing realization of the role of women in agricultural development. This is evident in the Women in Agriculture (WIA) Programme in Nigeria which is an integrated programme of the Akwa Ibom Agricultural Development Projects (AKDEP) of the World Bank, aimed at making women active contributors to economic development of their nation in the agricultural sector, through improved techniques of agricultural production for increase productivity thereby shifting from crude and traditional methods of production. (Ekong 2001).

**B. *Industry:*** Reports from Akwa Ibom women NGOs/CBOs and Co-operative indicate that there are 803 women Co-operative Societies and 126 NGOs/CBOs, of which 74% are actively participating and contributing towards the development of science and technology in the state. Ibibio women engaged in Food processing such as palm produce, cassava processing, fish smoking, Rice Milling, Soap and Pomade manufacture, Construction Work, Launderette Services, Timber Work, Land Survey, Pastry, Textile Work, Pottery and Ceramic Works, Shoemaking, Craft and Raffia Work. A reflection at the different types of scientific and technical areas women engage in, show less emphasis on career stereotyping.

**C. *Education:*** Reduction of women illiteracy is achieved through campaigns organized by Adult and Non- Formal Education Agency. The promotion of science and mathematics during long vacation programmes for young females are highly commendable. The number of women science teachers have been on the increase in recent years. Women in science-based professions are battling with the issue of education and career stereotyping.

**D. *Health:*** Report from the Ministry of Health confirms that remarkable impact have been recorded in the Health sector. Ibibio women are educated on Expanded

Programme on Immunization (EPI), Oral Re-hydration Therapy (ORT), Nutrition, Acquired Immune Deficiency Syndrome (AIDS) and Sickle Cell. Women receive treatments at the family life center at Mbribit Itam, Uyo – Akwa Ibom State for Vesico Vagina Fistula (VVF). Under the Better Life Programme (BLP), significant number of children and pregnant women received immunization and vaccinations against diseases. (Abasiattai 1987). The Family Support Programme (FSP) pursued vigorously such programmes as the girl child programme, the drop out projects, among others. The Nigerian nation selected Akwa Ibom state women as the third best state, in the State FSP implementation programme under Mrs. Aisha Bako in 1997. The BLP and FSP brought a sure reality of rural transformation.

### **3.0 METHODS:**

#### **3.1 Research And Area of Study Design:**

The study adopted survey design was conducted in Akwa Ibom State, lying at the south-east corner of Nigeria territorial expanse, covering a land area of 7,246.499 sq km, The State is made up of 31 Local Government Areas (LGAs) categorized into three Senatorial Districts of Eket, Uyo and Ikot Ekpene, with a population of over 4 million.

#### **3.2 Population, Sampling Techniques and Sample Size:**

The population of the study comprised of Ibibio women in science and technology with specific reference to women Non Governmental Organizations, (NGOs), Women Corporate Body Organisations (CBOs), Women Corporative Societies and Government officials dealing directly with women in science, industrial and technological activities in Akwa Ibom State.

Purposive Sampling Technique was employed in the study. The sample yielded a total of 180 subjects drawn from 30 Women NGOs/CBOs (3 members each) across the three Senatorial Districts out of the 126 NGOs/CBOs in the state and 90 government officials were selected from five government ministries. Viz: Ministry of Women Affairs and Social Welfare, Bureau of Science and Technology, Ministry of Commerce and Industry, Ministry of Agriculture and UNDP Akwa Ibom State office. 18 Officials were selected from each Ministry.

#### **3.5 Instrument, Validation and Data Collection.**

A 50 item structured questionnaire “Paradigm Shifts Questionnaire (PSQ), with four point rating scale response options was developed validated by women experts in science professions and used for data collection by members of the research team.

#### 4.0 DATA ANALYSIS AND RESULTS:

Data were presented and analyzed based on the research questions and mean was employed to answer the three research questions 1, 2, and 3 using 2.0 point as the bench mark for decision making.

#### 4.1 *Research Question 1: What were the gender socialization practices of the Ibibio traditional society prior to 1960?*

**TABLE 1** **N = 180**

S/N	ITEMS OF SOCIALIZATION PRACTICES IN	X	REMARK
1	Mutilation Of Female Genital Organ	3.78	*
2	Sex Preference And Male Dominance	3.84	*
3	Women Domestication	3.31	*
4	Gift Wife Practice (Donation Of Girls As Gift)	3.12	*
5	Polygamy	3.84	*
6	Wife Abandonment	3.13	*
7	Large Family Size	3.36	*
8	Child Abuse	3.24	*
9	Deprivation Of Right Of Inheritance	3.49	*
10	Harmful Delivery Practices	3.13	*
11	Early Marriage (Teenage Marriage)	3.53	*
12	Forced Marriage	3.23	*
13	Child Betrothal	3.46	*
14	Denial Of Shelter For Women	2.01	*
15	Women Suppression And Discrimination	3.32	*
16	Culture Of Silence Among The Women	3.37	*
17	Use Of Cultural Institution As Symbol Of Supremacy	3.30	*
18	Harmful Widowhood Practices	3.44	*
19	Wife Battering (Domestic Violence)	3.41	*

20	Female None Access Or Selective Access To Education	3.77	*
21	Inadequate Sex Education	3.12	*
22	Girl Withdrawal From School	3.26	*
23	Preparation Of Young Girls For Marriage By Some CBO ('Ndam' And 'Nyama' Traditional Organisation)	2.25	*

Note: \* Accepted Gender Socialization Practices of Ibibio Sub-culture. Cut off point at 2.0 point and above.

Table 1 reveals all the items in S/N 1 – 23 with mean above 2.00 the cut-off base. It is evident therefore that the 23 items were the gender socialization practices of the Ibibio sub-culture during the pre-independence period (Pre 1960)

**4.2 Research Question 2: What are the current changes in the gender socialization practices among the contemporary Ibibio people?(post 1960)**

**TABLE 2**

N

= 180

S/ N	ITEMS OF CHANGES IN GENDER SOCIALIZATION PRACTICES	X	REMARKS
24.	The need to formally educate both the female and the male child is now appreciated.	3.76	*
25.	Ibibio women leadership positions are seen and heard against the custom.	3.36	*
26.	The Ibibio man shoulders great responsibility in producing for his family than before.	3.18	*
27.	The function of socialization is gradually removed from the family to educational institutions.	3.14	*
28.	Ibibio women appreciate and enjoy modern general medical services.	3.63	*
29.	There is reduced rate of female genital mutilation among the present day girls.	3.55	*
30.	Girls are now taught by their mothers and the church on how to be good house wives.	3.19	*
31.	Pregnant women today receive post-natal and pre-natal care hospitals.	3.49	*
32.	Ibibio women inherit their husbands' property through legal means.	3.44	*
33.	There is less emphasis on career stereotyping as more women are coming into science and technological based professions in Akwa Ibom State.	3.18	*
34.	Women domestication seen to antagonize scientific attitudes is succinctly diminishing.	3.34	*
35.	Ibibio traditional birth attendances are now trained on improved medical standard.	3.05	*
36.	The subject of child betrothal is a past story in the practices of Ibibios.	3.49	*

37.	The individual right of the woman is not deprived in the process of make-selection.	3.4 0	*
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*Note: \* Accepted changes in Gender Socialization Practices of Ibibio sub-culture Cut off point is 2.0 and above.*

Table 2 indicates that 15 items (S/N 24 – 38) have mean above 2.0 benchmark implying that these are the changes in gender socialization practices of the Ibibio sub-culture from post independence to the contemporary Ibibio society.

**4.3 Research Question 3: What are the involvements and contributions of the Ibibio women towards paradigm shifts in sciences and technology advancement in Akwa Ibom State considering the pre & post independence period?**

**TABLE 3**

N

= 180

S/ N	ITEMS OF WOMEN PARTICIPATION AND CONTRIBUTIONS IN SCIENCE AND TECHNOLOGY	X	REMARKS
39	Akwa Ibom women have now achieved increased food production due to improvement of technology compared to pre-independent period.	3.3 3	*
40	Manual processing techniques have been replaced by machine e.g. grinding machines, etc.	3.2 2	*
41	Women are now involved in launderette (cleaning) service.	2.9 8	*
42	They are now involved in land survey as professional than before.	2.1 0	*
43	They now involved in the manufacturing of soaps and creams more than the pre-independence days	3.3 1	*
44	They engaged in pottery and ceramics with improved technology	3.4 3	*
45	Women appreciate family planning and seek to cut down on family sizes	3.8 4	*
46	Female are realizing the need to take up science and technology courses in schools	3.6 3	*
47	Women appreciate and subject themselves and their children to immunization/vaccination exercise	3.7 5	*
48	Ibibio women were actively involved in health developments under the BLP/FSP	3.2 7	*
49	Ibibio women were actively involved in industrial developments under the BLP/FSP.	3.2 9	*
50	Ibibio women were actively involved in agricultural developments under the BLP/FSP.		

*Note: \* Accepted participation and contribution towards paradigm shifts in Science and Technology Advancement Cut off point 2.0 and above.*

Data presented in Table 3 highlights 12 items (Nos. 39 – 50) of women participation and contributions towards paradigm shifts in Science and technology advancement in Akwa Ibom State. All had mean above the baseline of 2.00.

## **Discussion**

### ***[1] Gender Socialization Practices of Old Ibibio Sub-culture***

The results of the study on gender socialization practices of the Ibibio sub-culture presented in Table 1 are in consonance with the numerous literatures on sub-heading 2.2 of this paper. The results indeed attest to the then suppression of the natural endowment and potentials of women, which could have been harnessed for sustainable development of the society. The situation calls for intervention to reverse the trend in line with universal development patterns.

### ***[2] Current Changes in Gender Socialization Practices of Ibibio Sub-culture***

The results presented in Table 2 confirm the reviewed paradigm shifts, articulated from literature in sub-heading 2.3 of this paper. The results support the theory of sustainable development, which stresses improvement over traditional societal practices. The changes in socialization practices forms the framework for re-orientation of women in science, technological development and ensures the relevance of Ibibio women in socio-economic, political cultural and educational scheme of affairs.

### ***[3] Women Participation and Contributions Towards Paradigm Shifts in Science and Technology Considering the Pre and Post Independence Period.***

The result of this study on women participation and contributions towards paradigm shifts in science and technology in Akwa Ibom State presented in table 3 authenticates literatures reviewed on women and their contributions in science and technology on subheading 2.4 of this paper. The result indicates participatory human development activities considering the women as key elements in the process. This conforms Ibibio women model shifts in science and technology and their efforts at sustainable development.

## **5.0**

## **CONCLUSIONS AND RECOMMENDATION**

The traditional negative gender socialization practices of the pre-independent Ibibio sub-culture had been a prominent bane in the wheel of overall development of Akwa Ibom society. The practices had negated the recognition of the status and roles of women in development process, but with modern education, science and technology, significant paradigm shifts as it affects the women have been recorded. It is imperative therefore to call for global cooperation with sub-cultures to put in place relevant policies and legislation for positive gender socialization patterns and practices for an assured societal development at sustainable level.

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## **MAKING CHOICES & MAKING TRANSITIONS – CREATING A WEB RESOURCE**

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Results of the authors' research with young women who have career interests in science, engineering, and technology suggest that: their knowledge of career options is limited, their early field selection needs to be reinforced if it is to be converted into a career choice, their experiences in industrial internship, co-op programs, and summer employment are powerful determinants of career selection, and that many of the negative experiences related to their fields of study quickly led to changes in their field choice or career goals. Educating bright, competent, young women in these fields only to have them move into areas that are more inviting is costly. The risk of under-employment of women in non-traditional fields appears to be high in comparison to their male counterparts given the experiences reported by some research participants. Women's experiences of the transition from general interest in a field to establishment in a chosen career were collected between 1994 and 2003 and a series of "fictitious student" profiles were compiled for use as a resource on the WISEST Web site. Participants will be invited to review a series of profiles, critique question/answer sections, adapt/modify profiles to suit their cultural settings, and share profiles via the WISEST Resource Network.

### **Background literature**

The process of field choice, career selection and ultimate career commitment for young women interested in careers in science, engineering, and technology is poorly understood. Results of longitudinal research conducted in Alberta, Canada (Madill, Montgomerie, Armour, et al., 1997; Madill, Fitzsimmons, Montgomerie et al., 2000; Ciccocioppo, Stewin, Madill et al., 2002; WISEST, 2002) indicated that young women who are interested in science, engineering and technology related fields in high school know surprisingly little about these fields when they enter the university, college or technical institute of their choice. This lack of information about careers continues into their post-high school years. Results of the first year undergraduate survey (Canadian Undergraduate Survey Consortium, 2001) sent to a random sample of 7,093 students (66% from females) from 26 Canadian universities indicated that 6 students in 10 reported at least some success in "finding useful information and resources on careers and occupations", but only 18% described being "very successful" in this area (p. 43). The majority indicated that the most valuable information they received came from other students. This lack of information is also reflected in the results of the Canadian Survey of Undergraduate University Students

(May, 2002), which showed that of those students attending a research-intensive university with professional programs (N=5,113), fewer than 1 in 5 students used employment services and career counselling; 73% of those who did so were satisfied to very satisfied with those services, but 21% indicated that the academic advising they received needed significant improvement.

Career decision-making is impacted by a number of factors. In the most recent study conducted by this research team it was found that hands on experience proved to be particularly influential: the opportunity for experience in research laboratories, co-op programs, summer employment, and educational experiences in required courses were all important. Without the opportunity for hands-on learning, students report that they do not automatically see the application of what they are studying to their personal aspirations and the things that they care about (e.g., poverty, disease, or preservation of the environment). Lack of relevance often drives students toward careers in applied fields. Here are a few examples: those seeking relevance and who are anxious about their employment prospects may leave general science programs after their first year of study and finish their education in 2-year technology programs where their role is clearly demarked; others transfer to applied science areas in their third and fourth years of study (e.g., genetics, environmental biology) after positive hands-on experiences. Even when hands-on experiences are available results of the 2002 survey of undergraduate university students revealed that about 4 in 10 students indicated that work-study opportunities and co-op programs needed significant improvement (Canadian Undergraduate Survey Consortium, 2002).

Once the choice of a career in science, engineering, or technology has been made commitment to that field or career does not automatically follow. Educational experiences, for example, have been shown to have a “cascade effect” on commitment. “A cascade of affirming experiences serves to amplify a string of positive effects, until there is a short-circuit and the process is reversed ...what had the potential for a cumulative positive cascade of experience becomes short-circuited by negative experiences” (Etzkowitz, Kemelgor, Uzzi 2000, p.133). In our most recent study, women commented on their need for positive reinforcement to boost and/or maintain their confidence in their own abilities. Lack of self-confidence and low self-esteem were cited as critical elements by new graduates and experienced professionals in science, engineering and technology related fields. Senior students, however, did not endorse these elements to the same extent (WISEST, 2002). When transcripts from focus groups and interviews were analyzed, evidence of the “cascade

effect” and the need for positive reinforcement to sustain career commitment, both in educational and work experiences, was found.

Like young men, young women’s choices and commitment are increasingly being shaped by financial concerns and the desire for work/life balance (e.g., steadily rising tuition fees, student debt, concerns about having a life beyond a job, flexibility). This is exemplified in the results of the Canadian Survey of Undergraduate University Students (May, 2002), which showed while 57% had chosen a “career field”, 28% were still undecided, and 14% had not made any decision. Although a greater proportion of fourth year students had decided on a career field than first year students (2/3 of fourth year versus 1/2 of first year students) the study found that, “as students near graduation, they become more pessimistic about the job opportunities. About 21% of students in their fourth year feel that there [are] few or very few jobs in their major area of study, compared with 11% first-year students.” (p. 27).

### **Developing a framework for career commitment**

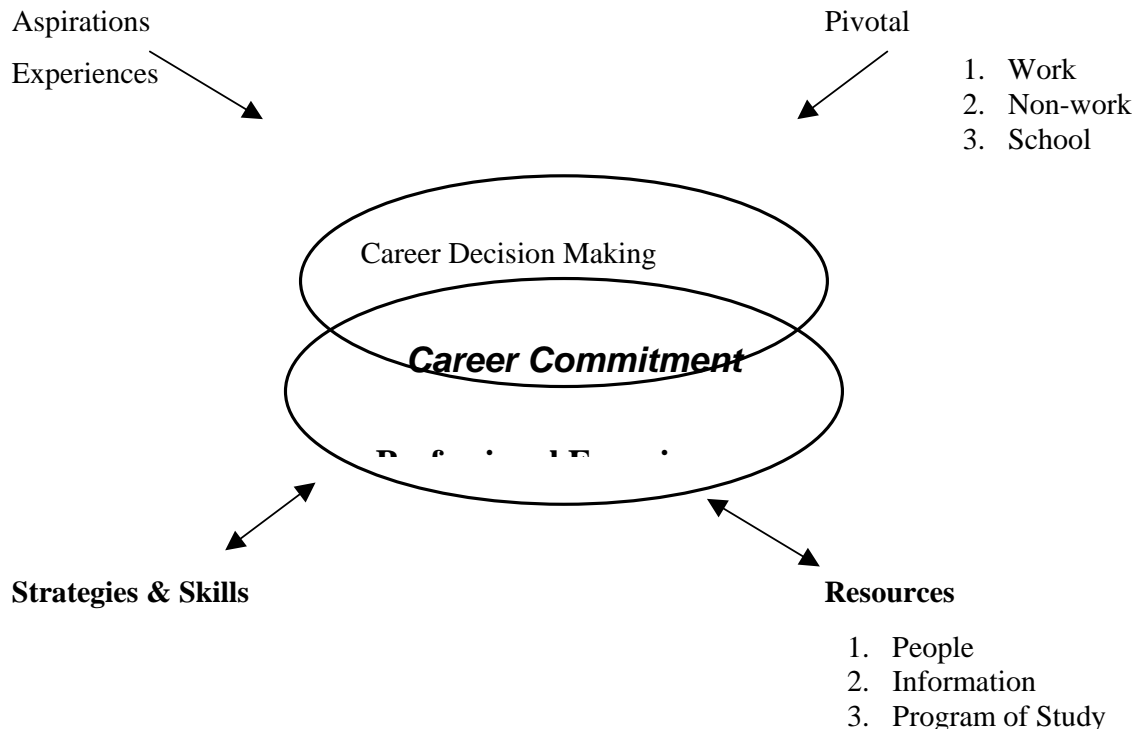
To investigate career commitment, the authors developed an explanatory framework based on participants’ experiences and perceptions of the critical elements in their career decision-making. That model will be tested in a future longitudinal study involving the use of a web-based, computer mediated, resource network.

The proposed model is shown below in Figure 1. Initial testing of the framework was completed by subjecting the thematic analysis of information from senior students, new graduates, and experienced professionals to a nominal group processing exercise with small groups of women in each of these categories. These were samples of convenience. Senior students were volunteers from a student organization related to women in science, engineering and technology; new graduates were volunteer graduate students in those fields; and experienced professionals were members of a professional society of women in those fields. During these group sessions participants were asked to prioritize issues that had been identified in one of these categories. The issues given the highest priority will be addressed within the resource network.

At the center of the proposed model (Figure 1) lies Career Decision Making (CDM). CDM is impacted by the individuals’ aspirations and what they have learned from pivotal work, school and non-work related experiences. CDM is also impacted by and impacts the strategies, skills, and resources that the individuals are using and plan to use. For senior students, the critical factors that impacted CDM were:

1. Consulting with an experienced professional about lifestyle issues, being a woman in the field, and work opportunities.
2. Work experience, particularly learning about new career options, confirming career choices, and learning what is expected in the workplace.
3. Positive and negative undergraduate experiences.
4. Information from career centers, web sites, and open houses.

Figure 1. Developing Career Commitment: A Preliminary Framework ©



So what do senior students identify as the necessary strategies, experiences, and skills, they need to determine their priorities and feel confident that they are on the right track in their career decision-making?

- Develop presentation skills, communication skills, team work skills, people skills, confidence, technical skills, leadership and management skills
- Recognize the importance of career networking and seeking support (co-workers, supervisors, professors, family, friends)
- Know how to take advantage of work experience within undergraduate programs to: make connections, increase level of self-confidence, increase capacity to deal with a work environment, learn to set priorities, think critically, and respect those in authority.
- Access a network of peers (male and female), seek mentoring, make contact with professionals in their field of interest

The majority of senior students who participated identified that an internet-based resource network would assist their career decision-making. Ideally a resource network would provide opportunities for career searches, posting questions, reading general information, making contact with professionals, learning from discussion forums, gaining information about various industries, linking with people with similar career interests, and linking with recent graduates in particular fields.

**What strategies/experiences/skills do experienced professionals suggest senior undergraduates should have before they enter the workforce?**

- Know how to take advantage of the work experience as a way of demonstrating their skills/abilities for a prospective employer.
- Possess good communication and teamwork skills.
- Know how to be adaptable in a changing work place.
- Have an appreciation of the reality of the working world and what characterizes a “good” company; the importance of financial independence, pensions, and benefits; alternate career paths.
- Possess an understanding of the psychology of interpersonal relationships.
- Know how to seek and receive appropriate mentoring; recognizing the importance of networking and how to find networking opportunities
- Acknowledge their need for support and having a support system.
- Know how to develop the necessary coping skills (gendered work place experiences: sole professional women, demonstrating technical competency, being heard, what to do when values clash, handling harassment).
- Recognize the need for resources to balance home/family demands.

Studying the similarities and differences between senior students and experienced professionals’ perspectives will provide information that is critical to understanding women’s career decision making and enhancing career commitment in SET fields.

**The plan for developing a resource network**

A web-based, computer-mediated, resource network will be developed that has the capacity to provide information to senior students, new graduates and experienced professionals in science, engineering, and technology related fields. It is apparent that such a system should: enable users to be actively engaged rather than passive recipients of information, enable users to search reliable sources of information, be overseen by responsible professionals, be accessible without charge, carry relevant information and/or links for participants beyond North America, be relevant to women in science, engineering and technology who are studying and working in

different cultures, and provide a place for active discussion of issues related to career decision-making.

Watts (2001) summary of the role of information and communication technologies in careers guidance classified online services into one of three categories; “promotional: promoting what the service offers off-line”, “adaptive: delivering some of these services in on-line form”, “innovative: delivering new services on-line which are not possible, or less feasible, off-line.” The proposed resource network falls within the innovative category as it will combine the use of various e-technologies (website and e-mail links, teleconferences, chat pages, message boards) to ultimately enable a large group of participants to exchange ideas with experienced professionals, resource people, and members of their peer groups both within and beyond their home communities. Although Canada has developed some excellent career resources and labour market information is readily available, there has been little attention paid to effective utilization of this data and there is no coherent framework for career development services within Canada’s educational system (OECD, November 2002). In an OECD working paper on career information, guidance, counseling and public policy (January 2002) the need for well organized career information, guidance and counseling systems in post-secondary education was addressed. Highlighted there is the fact that student choices at this level are not only more complex, but the consequences are also more costly.

effective advice and guidance on educational options, and on links between these options and later occupational destinations, can help to better match individuals’ learning choices to their interests, talents and intended destinations. This can help to: reduce dropouts from and back-tracking within education systems, and thus improve internal flows; improve flows between different levels of education, thus raising national levels of educational attainment; and improve transitions from education to the labour market. These outcomes help to make better use of educational resources, and to increase both individual and social returns to investments in education. (p. 3)

## **Conclusion**

It is evident from the authors’ previous research and Canadian student survey data, that students know surprisingly little about making a field choice or selecting a career, even when they get to their final year of study. They readily make use of the Internet, but many of the current career information sources available to them only highlight success stories. Websites may link students to a mentor, some are actually part of a sponsoring organization’s recruitment program, but there are no interactive sites that make full use of e-technology in the innovative way Watt (2001) has described.

Students in the authors' research were clear about their desire to be able to discuss career-related issues with experienced professionals, those in Human Resources, and their peers.

The proposed resource network will be designed to assist new students who are making an initial field choice and senior students who are preparing for their transition to the work place or graduate work. Later it is hoped that the resource network will connect new graduates with experienced professionals in SET related fields as these new graduates transition into their careers. To assist new students making field choices, a series of "fictitious student" profiles were created from information obtained through focus groups and interviews with students from Grade 11 through their first qualification (technical diploma, undergraduate degree), graduate students, and experienced professionals who participated in the authors' longitudinal research. Fourteen profiles have been developed and pilot tested with senior students. Participants in this GASAT 11 session will be asked to consider the applicability of this material to their settings. In small groups participants will review selected profiles and discuss such issues/questions as:

- Are the profiles relevant to the aspirations of senior students?
- Do the profiles incorporate the strategies, skills, and resources that senior students perceived as most important?
- Would "fictitious student" profiles be of use in your setting?
- Could the existing profiles be revised and be appropriate for students in your field, region, or country?
- Should a new profile be written for your field, region, or country?
- Would you be willing to contribute a profile or a series of profiles?

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# EVALUATION OF THE ANTIMYCOTIC ACTIVITIES OF SELECTED TROPICAL TREE BARK EXTRACTS AGAINST *COLLETOTRICHUM GLOEOSPORIODES*

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## ABSTRACT

This study was carried out to provide a cheaper means for controlling *Colletotrichum gloeosporioides*, a foliar pathogen with a wide host range, in the wake of high cost of agro-chemicals with their attendant environmental hazards. Bark extracts of thirty-two (32) tropical tree species were evaluated for their antimycotic activity against the pathogen. The highest inhibition of mycelia growth was exhibited by the extract from the bark of *Terminalia ivorensis* with mean percentage inhibition of mycelia growth of  $55.28 \pm 2\%$ . This was followed by that of *Piptadeniastrum africanum* ( $41.72 \pm 2.59\%$ ) and *Albizia zygia* ( $37.66 \pm 1.46\%$ ). Compared to control, the antimycotic effects of these extracts were highly significant ( $p=0.01$ ). Interestingly, the extracts of many of the tree barks also supported the growth of the fungi antagonistic to *C. gloeosporioides*. The inhibition of the pathogen by these extracts could be attributed to the presence of some active principles which need further investigation. The safety, sustainability and applicability of these findings in crop protection by women are highlighted.

## INTRODUCTION

*Colletotrichum gloeosporioides* is one of the foliar pathogens affecting some wild plants and cultivated crops including Para rubber (*Hevea brasiliensis* Muell.Arg.), an important commercial plantation crop in Nigeria. The negative effects of the pathogen on *Hevea* has been well documented by Rao (1975).

High cost of chemical control methods with the attendant environmental hazards is now motivating scientists to look for alternative methods of controlling plant diseases. Use of natural means to control and prevent plant diseases has been well elucidated by Stohl (1998). It is a method that can be incorporated into the integrated pest management of most plant diseases, and have the potential of alleviating the problem of resource-poor farmers because it is cheap and readily available.

Many plant extracts have been confirmed to exhibit inhibitory effects on some pathogenic organisms, and as such have been used for the control of pest problems (Nayar, 1955). According to Akachuku (2000), a lot of waste is being generated in the

sawmills and tree bark happens to be one of them. In this study, the potential antimycotic activities possessed by the different tree barks was investigated.

The objective of this study was to screen for the antimycotic activities of bark extracts of thirty-two economic trees in southern Nigeria against the foliar pathogen *Colletotrichum gloeosporioides*.

## **MATERIALS AND METHODS**

**Collection and preparation of tree bark samples:** Fresh barks of thirty-two economically important trees were collected from two sawmills in Benin City. The samples were separately packed in large brown envelopes and taken to the laboratory where they were air-dried at room temperature for one week. Thereafter, each tree bark was cut into chips and further dried at 70<sup>o</sup>C to a constant weight using Gallenkamp electric oven.

**Bark extract preparation:** One hundred grams (100g) of the bark chips were weighed out using a Metler PM400 weighing balance and were transferred into sterile glass bottles each containing 300ml of distilled water. This volume (300ml) was chosen because 200ml of water could not cover the bark chips sufficiently. The mixture was thereafter heated in a water bath for thirty minutes at 100 C, allowed to cool before filtering through Whattman filter paper into labelled containers. The bark infusions thus prepared were stored in the refrigerator at 4 C and used the following day.

**Determination of pH of extracts:** The pH of the various bark extracts was determined immediately after preparation by using the Jenway Meter 3305. The control was sterile water without extracts.

### **Preparation of culture media:**

1. Commercial type potato dextrose agar: Thirty-nine grams (39g) of the powder was added to a litre of distilled water. The medium was heated in a water bath till the agar dissolved completely.

2. Potato dextrose agar with bark extract (PDBE). The procedure was basically the same as in (1) above except that in the place of distilled water, bark extract was used. Accordingly, the various tree bark extracts were used for preparing different potato dextrose agar with bark extracts (PDBE).

All media were sterilized by autoclaving for fifteen minutes at 15PSI and 121C. The media were poured into sterile 9cm glass petri dishes at the rate of approximately 20ml per plate.

Determination of the growth of pathogen on PDA and PDBE: **After the medium had solidified, the plates were inoculated with 5mm mycelium plug of *C. gloeosporioides* taken from the growing edge of a 3-day old culture. Four replicate plates were prepared for each type of PDBE. Diameter growth measurement was carried out daily for 5 days. Percentage inhibition of mycelium was calculated using the formula given by Vincent (1972) and Jayasinghe and Wijesundera(1995):**

$$I = \frac{100(C-T)}{C}$$

where I = percentage inhibition of mycelial growth with respect to control, C= growth in control and T= growth in treatment).

Data analysis: **Analysis of data was carried out using descriptive statistics such as means, percentages and standard errors. Means were separated by using Least Significant Difference while the relationships between some variables were determined by calculating for their correlation coefficients (r).**

## RESULTS

Twenty-two tree bark extracts exhibited inhibitory effects on the mycelial growth of *Colletotrichum gloeosporioides* to varying extents. The highest level of inhibition (55.28%) was exhibited by the bark extract of *Terminalia ivorensis*, followed by that of *Piptadeniastrum africanum* (41.72%) and thirdly by *Albizia sp* which gave an inhibition of 37.66% (Table 1). Generally, differences between the treatments were found to be significant ( $p < 0.05$ ) while in particular, the differences between the effects of *Terminalia*, *Piptadeniastrum* and *Albizia* species, and control were highly significant ( $p < 0.01$ ). The least inhibition (3.79%) of mycelial growth of the pathogen occurred in the bark extract of *Blighia sapida*. Out of the thirty-two tree bark extracts used for this study, ten (10) of them significantly ( $p < 0.01$ ) encouraged the growth of the pathogen. Compared to control, extract of *Lophira sp*, *Mansonia altissima* and *Bombax buonopozenze* gave an increase of 17.93, 10.76 and 8.88% respectively (Table 2). Percentage increase in mycelial growth was calculated by modifying the formula for percentage inhibition thus:

$$I^* = \frac{100(T - C)}{T}$$

T

The least increase in mycelial growth of the pathogen was on the extract of *Milecia chlorophora –excelsa* with an increase of 2.47% over control.

All the tree bark extracts were acidic. The highest pH value of the tree bark extract being that of *Triplochyton scleroxylon* (6.49) while the lowest pH value (3.68) recorded was by the extract of *Termanalia ivorensis* . Most of the extract had pH values ranging between 4 and 5.5 (Tables 1&2).

Many of the extracts supported the growth of potential fungal antagonists with special reference to *Trichoderma sp* (Table 3). Eighteen (18) tree bark extracts supported the growth of *Trichoderma* while only 5 and 2 extracts respectively supported the growth of *Aspergillus* and *Penicillium spp.*

## DISCUSSION

In this study, twenty-two tree bark extracts had significant ( $p < 0.05$ ) inhibitory effects on the mycelial growth of the foliar pathogen, *Colletotrichum gloeosporiodes*. The inhibitory effect of most of the tree bark extracts compared favourably with that reported by Rai and Acharya (1999) who used selected Asteraceous plants. They also reported that *Elephantus scaber* and *Launea acaulis* enhanced the growth of *Trichophyton mentagrophytes* which is in consonance with the results obtained for some of the extracts in this study (Table 2).

Although the effect of pH on the growth of *C.gloeosporiodes* was not investigated *per se*, it appears that acidity may not be totally responsible for the inhibitory (or otherwise) effect of the extracts. It is however noteworthy to observe that the pH value of the extract that gave the highest inhibitory effect was 3.68 being the most acidic extract. Conversely, the extract having the highest pH value of 6.49 enhanced the growth of the pathogen (Table3). This observation therefore suggests some form of synergism between the active principles and acidity of the medium even though the relationship between the two variables was negatively correlated ( $r = - 0.254$ ) for those extracts that elicited inhibitory effects on the pathogen .On the contrary, the acidity of the extracts that enhanced the pathogen's growth was positively correlated( $r = 0.653$ ) with the mycelial growth. More so, the correlation was found to be significant at 95% probability.

This result therefore suggests the presence of some active principles in the extracts making them to either retard the growth of the pathogen or otherwise. Many *Trichoderma* species have been reported as good antagonists to some pathogens (Jayasuriya and Deacon, 1995; Jayasuriya *et al* 1996; Onsando and Waudu, 1994;

Osuinde *et al* 2002). Therefore, the ability of such a potential antagonist to the pathogen surviving in the presence of the extracts is a welcome observation. It is suggestive of the possibility of incorporating the antagonists into an integrated Pest management strategy for greater effect.

The advantages of natural crop protection have been well highlighted by Stohl (1998). One of the gains is that they diminish the risk of pest build up of resistance to treatment. The biocidal ability of plant extracts have been known for quite some time (Singh *et al*, 1980). The effect of the extracts that retarded the growth of the pathogen would have been greater but for the presence of adequate nutrients in the growth medium, a situation similarly reported by Osemwegie *et al* (1998). Therefore, our projection is that the field application of these extracts would yield more promising results, as there will be little or no additional substrate. In addition, the method of extraction (hot water infusion) may have also contributed to the reduced potency of some of the extracts against the pathogen.

The safety of the use of those extracts coupled with the simplicity of the method of extraction makes it adoptable by any category of persons. The application of this method for crop protection will be most welcome by resource-poor farmers /gardeners in the rural as well as city centers. Women, being the major operators of home gardens and vegetable farms (Ogbe and Osawaru, 1999) will find the use of these extracts very handy in combating diseases and pests on their crops. For one, the tree barks are available and cheap. Two, preparation of the extract is simple. Three, no fear of toxic side effects attendant upon the use of synthetic agro-chemicals. They would thus be saved the depletion of their meager finances on pest control.

This study therefore underscores the need to further investigate the use of natural means to control plant diseases. We also anticipate reporting on the economic analysis of the field application of plant extracts in future works.

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Table I *In vitro* inhibition of the mycelial growth of *Colletotrichum gloeosporioides* by some tree bark extracts.

Name of Economic Trees				
Botanical name	Local name (Edo)	Mycelial growth (cm)	Mean percentage Inhibition (%)	pH
Piptadeniastrum africanum	Ekhimi	2.15 ± 0.10	41.72 ± 2.59	4.79
<b>Terminalia superba</b>	Eghoin-nafwa	2.60 ± 0.04	29.53 ± 1.11	4.41
<i>Nesogordenia papaverifera</i>	Urhwaro	3.31 ± 0.18	10.22 ± 4.90	5.85
<i>Albizia adianthifolia</i>	Uwowenolaghabor	2.80 ± 0.04	24.11 ± 1.11	5.53
<i>Nauclea diderrichii</i>	Opepe	3.14 ± 0.07	8.53 ± 1.79	5.21
<i>Gaurea cedrata</i>	Obobonofwa	3.31 ± 0.05	10.22 ± 1.40	4.90
<i>Blighia sapida</i>	Ukpe	3.65 ± 0.06	3.79 ± 0.55	5.77
<i>Panda oleosa</i>	Otieme	3.29 ± 0.10	10.90 ± 2.62	4.67
<i>Albizia lebbek</i>	Segheseghe	3.00 ± 0.27	18.57 ± 7.19	4.35
<i>Combretodendron macrocerpon</i>	Owewe	2.90 ± 0.03	20.73 ± 0.88	4.34
<i>Lovoa trichilliodes</i>	Apopo	3.18 ± 0.07	13.95 ± 1.10	4.84
	Agbagon	3.54 ± 0.08	6.04 ± 0.64	4.84
	Ayedatan	2.85 ± 0.12	22.76 ± 3.23	4.65
<i>Terminalia ivorensis</i>	Eghoin nekwi	1.65 ± 0.07		3.68
<i>Lannea welwitschi</i>	Ewiwan	3.40 ± 0.24	11.34 ± 4.41	4.87
<i>Entandrophragma angolense</i>	Omu	3.14 ± 0.09	7.22 ± 2.47	5.20
<i>Cordia millenii</i>	Omah	3.41 ± 0.60	6.95 ± 1.69	5.28
	Marcurey	2.91 ± 0.19	10.33 ± 2.80	5.37
<i>Pausinystalia macroceras</i>	Likiba	3.18 ± 0.05	13.90 ± 1.41	4.73
<i>Berlinia gstandiiflora</i>	Berlinia	3.25 ± 0.02	11.92 ± 0.55	5.17
<i>Albizia zygia</i>	Ekpaghuda	2.30 ± 0.05	37.66 ± 1.46	4.43
<i>Barteria fistulosa</i>	Oko	2.85 ± 0.05	22.76 ± 1.24	4.73
<i>Control</i>		3.69 ± 0.06	0.00	ND
L.S.D (0.05)		0.309	7.31	ND

Table 2: Increase in the mycelial growth of *Colletotrichum gloeosporioides* by some selected tree bark extracts.

Name of Economic Tree				
Botanical name	Common/trade name	Mycelial growth (cm)	Mean percentage increase (%)	pH
<b>Lophira alata</b>	Iron wood	4.50 ± 0.07	17.93 ± 1.36	4.85
<i>Milecia excelsa</i>	Uloko	3.74 ± 0.05	2.47 ± 0.81	5.85
<i>Triplochytton</i>	Obeche	3.98 ± 0.06	7.12 ± 1.48	6.49

<i>scleroxylon</i>				
<i>Bombax buonopozense</i>	Obokha	4.50 ± 0.01	8.88 ± 0.01	5.25
<i>Guarea thomposonii</i>	obabonekwi	3.55 ± 0.10	4.60 ± 2.18	4.90
<i>Brachystegia eurocona</i>	Okwen	3.73 ± 0.10	4.39 ± 1.55	ND
<i>Cyclodiscus gabonensis</i>	Okan	3.98 ± 0.07	7.08 ± 1.69	5.24
<i>Sterculia oblonga</i>	Okoko	3.82 ± 0.01	3.31 ± 0.29	5.77
<i>Celtis adolfi-friderici</i>	Ohia	3.57 ± 0.026	3.20 ± 0.61	5.16
<i>Mansonia altissima</i>	Mansonia	4.15 ± 0.15	10.76 ± 3.00	5.68
Control		3.69 ± 0.06	0.00 ± 0.00	ND*
L.S.D. (0.05)		0.131	4.27	ND

ND=Not determined

**Table 3:** Survival of some potential fungal antagonist to *C gloesporoides* on selected extracts.

Medium	Organism		
	<i>Trichoderma sp</i>	<i>Aspergillus niger</i>	<i>Penicillium notatum</i>
1. Control			
2. <i>P. africanum</i>			
3. <i>L. alata</i>	+		
4. <i>T. superba</i>	+		
5. <i>M. excelsa</i>			
6. <i>N. papaverifera</i>			
7. <i>I. scleroxylon</i>	+		
8. <i>B. buonoposenze</i>	+	+	
9. <i>G. thomposonii</i>			+
10. <i>A. adianthifolia</i>			
11. <i>B. eurycom</i>	+	+	
12. <i>N. diderichii</i>	+		
13. <i>G. cedrata</i>			
14. <i>C. gabunensis</i>			
15. <i>S. oblonga</i>	+	+	
16. <i>B. sapida</i>			
17. <i>P. oleosa</i>			
18. <i>C. macrocarpum</i>			
19. <i>A. lebeck</i>			
20. <i>L. trichiloides</i>	+		
21. ( <i>Aye datan</i> )		+	
22. ( <i>Agbagbon</i> )	+	+	
23. <i>T. ivorensis</i>	+		
24. <i>L. welwitschii</i>			
25. <i>E. anglolense</i>			+
26. <i>C. millenii</i>	+		
27. <i>Marcurey</i>	+		
28. <i>C. adolphi-friderii</i>	+		+
29. <i>M altissima</i>	+		
30. <i>P. macroceras</i>	+		
31. <i>A. zygia</i>	+		
32. <i>B. grandiflora</i>	+		
33. <i>B. fistulosa</i>	+		