

Barriers to Participation of Women in Technological Education and the Role of Distance Education

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1. Introduction

The significance now attached to increasing the participation of women in technology and technological education reflects two world-wide trends. The first is the way in which technology is permeating all domains of activity in the contemporary world, with pervasive roles in national economic development and in our everyday experience. Not only are occupations involving technology on the increase, but populations in general, men and women, are engaging with the processes, products and effects of technology on a day to day basis. The second is recognition of the need for action by the international community in securing the advancement of women and the elimination of gender-based discrimination, particularly in the fields of education and employment.

Women choose to enrol in greater proportions in arts, human studies and social sciences than they do in mathematics, science and technology, the world over. The origin of this under representation of women has been largely structural, created in and through the social structures of institutions and the segmentation of the labour market, and internalised in values and beliefs about appropriate roles and expectations. These factors are manifested in a host of barriers to women's participation, both general and specific to the technological domain.

Distance education is seen as having a potentially important contribution to make in overcoming barriers to women's participation in the developed and developing world.

As Trivedi (1989) writes

Distance education has a very important role in women's development. Women have constraints of time, space, resources and socio-economic disabilities. Distance education can help them with its outreach to their homes. It enables them to learn at their own pace and take up vocations and skills for economic and individual development. It gives them a second chance to step into the main systems of education, including higher education, enabling them at the same time to earn and learn as well as to fulfilling family responsibilities (p. 21).

What is the part that Distance Education can play in facilitating women's participation in technology and technological education? What barriers does it need to address? What are its potential and limitations in different cultural contexts?

This paper addresses these questions, through selective review of literature and reports of significant action programmes. It aims:

- (a) to summarise and categorise barriers to women's participation;
- (b) to establish, as far as possible from available literature, whether, how far and under what conditions distance education may offer a means of reducing significant barriers to participation in different cultural contexts;
- (c) to develop a set of criteria to aid further investigation in different regional contexts.

2. Barriers to Participation

Barriers to participation are found to be of several kinds:

(a) *Cultural*: common patterns in role and status of women emerge across countries, despite widely different circumstances. They reflect the cultural and cross cultural social norms and traditions by which the subservient status of women is maintained. In some societies these create "almost insuperable obstacles to women's participation in education" (Evans and King 1991). Analyses of participation rates in different social and cultural contexts show that they reflect closely the relative status of women and the power of tradition, e.g. Kember (1981), King and Hill (1993).

(b) *Attitudinal*: perceived differences in male and female roles and capabilities, inculcated through socialisation in the home and family, reinforced through schooling, through vocational/career guidance services, through experiences in the workplace, peer pressure and through absence of female role models. Enormous motivation and self-confidence is needed to break through these barriers. Lack of confidence and self esteem is itself a major barrier, and one which every successful initiative in this field has found it essential to address directly and specifically.

(c) *Qualificatory*: lack of Maths/Science pre-requisites for entry to programmes is often perceived as a barrier, particularly by those involved in admissions to programmes (although evidence suggests that this is also perceived rather than real in some cases, Ellis (1987), for example, shows that women in the Caribbean attain higher levels of literacy and numeracy than males, and that in the CXC secondary Schools Examinations at General Proficiency level, a larger proportion of females were entering for chemistry and mathematics than males, and equal proportions for Physics. Despite this "the belief continues to persist that females are by nature technologically ignorant and unable to absorb scientific and technological information or to acquire technical skills"); in many countries as many women as men achieve general proficiency in Maths and Science, but remain grossly underrepresented in Science and Technology subjects at higher levels, once "choices" are made. Many women with university entrance qualifications in these subjects opt for human and social science courses at University level.

In other countries, social cultural and economic conditions conspire to encourage early termination of the education of girls. In Indian, Africa and Pacific cultures, it is argued that the effects of cultural sanctions on women's education are most marked, e.g. Commonwealth Secretariat, 1988. Low levels of general education are major barriers, which have to be tackled before the specifics of science/technology participation can be addressed. In the Middle East and North Africa, by contrast, higher proportions of women are found in science and engineering courses at University level than in many western countries. Nagat El-Sanabary (1993) attributes this to the good access to mathematics and science courses at secondary level.

(d) *Situational*: the barriers faced generally by women in attending courses apply: family commitments, lack of partner support, financial, living in rural/isolated areas. Fees requirements are major barriers where women do not have independent control of resources, where they are dependent on male partners who are unsupportive. Male partners are more likely to be unsupportive of entry to non-traditional, male oriented spheres. (Ellis cites examples of suspicion/jealousy of male partners as well as ridicule). Women who do have their own source of income are also, on average, lower paid than their male counterparts. Poverty is a major situational factor in many regions. (Trivedi, 1989, states that the combined effects of poverty and social/cultural sanctions create almost insuperable barriers in parts of South Asia.)

Social class factors also interact with gender in significant ways. High social class status of some women may remove some of these barriers; King and Hill point to the phenomenon of upper class women who buy in low paid domestic labour of other women in order to pursue

their educational/career aspirations. This phenomenon can be found in many developed and developing countries.

Situational and cultural factors intersect in the barrier of significant distances to travel to schools and other educational centres; this is a major barrier for girls and women in, for example, India and Pakistan, as Caldwell et. al. (1985) and Shah (1986) report, respectively.

(e) *Institutional barriers*: these are barriers which arise because of the ways in which institutions make their programmes available. Significant general barriers which apply to women are well documented:

- fixed hours;
- substantial attendance requirement;
- lockstep approach to curriculum; makes missed sessions hard to catch up on;
- lack of child care facilities;
- off putting, "unfriendly" course information;

These are exacerbated in the case of entry to technical and technological studies by:

- lack of female teachers/assumptions and attitudes of male teachers;
- male orientation in courses publicity/male "image";
- inflexible selection and entry requirements;
- often has large attendance requirement for practical skills/laboratory based work;
- male oriented language and male images in teaching materials;
- instrumental pedagogies and curriculum content which ignores the social context of technology.

Evans and King present these various kinds of barriers as a series of disjunctions, all applying generally to women's participation, but applying *particularly* in the case of technological education.

The **DISJUNCTIONS** are between:

maintenance of formal entry requirements and overall level of educational attainments among women;

- domestication of women's labour and educational/career aspirations
- charging of fees and financial dependency/poverty
- traditional curricula and experiential knowledge of women
- instrumental pedagogies and women's preferred learning modes

3. Significance of Barriers in Different Regional Contexts

The relative significance of these barriers will vary according to:

(a) the level of education and training envisaged;

(b) age of the women (young/mature);

(c) cultural/local context.

As King and Hill (1993) have stated, the barriers to women's education in developing countries are well known. What is significant is the relative strengths of the barriers in different regional contexts. "[T]he challenge is to identify which barriers are the prime ones in specific settings or sub populations and which policy measures are appropriate and affordable."

4. Three Cases: Africa, the Caribbean, and South Asia

Three cases in Africa, the Caribbean and South East Asia illustrate the disjunctions outlined above, in regional context.

(1) *Africa*: In Africa, Williams (Vice Chancellor of University of Benin) has shown that the "world-wide" problem of low participation in STM education is compounded by low enrolment rates of girls in formal education, when compared with boys, with the gap widening at the higher level of education. The implications are increasingly serious as women's contribution to agriculture and commerce is constrained by this lack of access to STM education. Williams (1987) identifies the barriers as follows:

- relegation of women to the home;
- parental perceptions of costs/benefits of educating girls, affecting low income families particularly
- patriarchy, female seclusion practices and early marriage;
- fear of cultural loss on emancipation;
- double/conflicting demands on girls of traditional and school learning;
- discriminatory labour market practices;
- irrelevance of curricular presentation in STM to girls' views and experiences of the world;
- masculine image of science projected in text books, media and popular assumptions;
- poor facilities, including teacher-supply, teacher quality and equipment;
- nature of STM occupations which are not easily combined with child-rearing and child-care;
- lack of role models and career counselling.

(2) *Caribbean*: Ellis points to the rapid technological developments which are bringing about change in Caribbean societies, and the slow rate at which women are penetrating the male dominated occupations in the fields of science, technology and trades.

Within the formal system, girls attend school from an earlier age, for a longer period and achieve higher rates of literacy and numeracy than do boys. At secondary and also now at tertiary levels the achievements of female students are higher than those of male students.

Obstacles and barriers are identified as:

- social pressures which operate inside and outside the classroom

- masculine image given to science and technology in the curriculum
- lack of female teachers and, more widely, absence of female role models
- Teacher-pupil interactions/inappropriate assumptions made by male teachers
- "counselling" on career choices carried out informally by the above teachers!
- peer pressure and ridicule
- perceptions of admissions tutors
- lack of appropriate vocational guidance and career counselling

(3) *South Asia*: Khan (1993) states that poverty is the most pervasive barrier to the education of South Asian girls and women. Other cultural factors such as early marriage, concern for girls moral and physical welfare limit and in some regions the practices of the segregation and seclusion of women restrict education. Khan also observes the way in which cultural practices are altered by economic conditions, citing the example of families actively promoting the education of their daughters to increase their chances of marrying a "white collar" husband, while poor families in Nepal will concentrate all their resources to educate one son through secondary education.

Women lag far behind men in terms of numbers of years of schooling and in grades achieved throughout the region, with the exception of Sri Lanka where enrolment in secondary education is high, with girls' enrolments reported to surpass that of males and research evidence (Jayaweera, 1991) that type of school and socio-economic status of the student are more important than gender in influencing student achievement in school. Throughout most of the region, however, the educational base for women's participation in technological studies and technological work is very limited.

At secondary level barriers can be summarised as:

- demands for females to care for siblings and do household/farm work;
- withdrawal of girls at puberty and early marriage;
- direct costs;
- location, physical facilities and hours of instruction;
- privacy of girls.

There are considerable variations according to social class, reflected in female enrolment in higher education, which is small and heavily weighted towards high income, wealthier families.

Labour market discrimination acts as a further barrier; women were hired less, often received lower pay for equal work and were in lower grades of post despite equal or better qualifications, at the time of Raj's survey in 1982. The exception to this was in scientific and medical fields, where women were more highly paid; they were however paid significantly less in engineering and technology and the same in teaching, according to a UNESCO study in Pakistan (Hussain et al 1987).

Given the nature of the barriers, Khan has argued that reorganisation of existing resources and policy changes requiring few additional resources can achieve as much in increasing enrolments as large expensive programmes, particularly when the former involves local participation. The Women's University in India is reported by Trivedi (1989) to have made substantial progress in the last few years, and many women have taken advantage of its outreach facilities.

Similarities in the barriers faced by women in the three regions are obvious. Differences lie in the strength of the cultural factors and variations in the extent and patterns of poverty. In all regions, there are considerable variations by social group. In Africa and South East Asia the low base level of education of "ordinary" women is an all pervading factor-a gender gap which must be closed if women's involvement in technological education is to be increased significantly.

5. Programmes to Increase Women's Participation

As well as formal research studies, reports of major measures/projects designed to increase female participation have been selectively reviewed particularly where these involve DE delivery. They are considered in terms of their effectiveness in reducing the **DISJUNCTIONS** identified above.

There is great diversity in cultural and regional contexts. In developing countries, much can be learned from review of programmes and policies designed to promote women's participation in education generally. King and Hill have identified the following strategies as successful in industrial countries:

- secondary and post secondary scholarships
- vocational/technological programmes linked directly with employment, with a strong recruitment and guidance element.

Bellew and King, following extensive research in developing countries from all regions, found that empirical evidence was lacking which could enable *strong* conclusions to be drawn about the relative effectiveness of measures designed to increase women's and girls participation in education generally. Some conclusions could be drawn about broadly effective or ineffective strategies, summarised in *Table 1*.

Table 1: Summary of the Effectiveness of strategies to Improve Girls' and Women's Education, Based on Country Experiences

Objective	Effective strategies	Ineffective Strategies	Insufficient evidence to draw a conclusion
Lower the cost of education	Scholarship	Free uniforms	Programmed instruction
	Culturally appropriate facilities		Home production technologies
	Female teachers		Day-care
	Alternative schools, flexible schedules		
Raise the benefits of education	Vocational training for sectors of the economy when directly linked to employment and strong recruitment	Vocational training for non growth sectors of the economy not linked to employment and no recruitment effort	Gender-neutral curricula and books School feeding programmes Information

campaigns

Source: Bellew and King (1993)

The successful strategies are clearly focused on the major disjunctions: *scholarships* to address barriers of poverty and financial dependency; *female teachers* as role models, to challenge traditional role assumptions; *alternative, flexible provision* to accommodate the double demands, expectations and constraints placed on many women; *direct linkages* into employment to counter barriers of employer resistance and other social pressures on completion of training.

In programmes designed to promote participation in technological education, THREE categories of direct provision for women can be identified, for the purposes of this paper.

Bridging programmes: updating and re-entry for women already qualified in technological subjects

Conversion programmes: first entry to technological education, for mature women, early school leavers and "mainstream" school leavers who wish to change direction.

Community-based, role related programmes: geared to local/environmental issues of direct relevance to the lives and more traditional roles of women

6. Bridging Programmes and the Role of Distance Education

That the Open University in Britain has had a high degree of success in recruiting women students is well known. However its open access policy alone was not effective in attracting women into non-traditional subject areas such as technology. Women students were less

aware of scientific and technological advances and related to technology as "passive consumers" according to Swarbrick (1987), who also reports that take-up of technology courses through the Open University was typically from male employees updating and improving their vocational qualifications while at work, with sponsorship from their employers in many instances. Barriers to female participation included "loss of personal/professional esteem" and fees when household budgets were stretched. The Women into Technology Project began as an updating course designed to help women who had qualified as engineers to bridge career breaks with updating education. The initiative was reported to have been greeted with scepticism initially, on the assumption that few women were in the intended target group and those that were would not be interested. (*The programme was extended subsequently to encourage new entrants to technology, providing conversion courses of the kind discussed in the next section*).

The courses had to take account of domestic commitments and the wide geographical spread of such a specialised audience, so Distance Education was seen as the ideal solution. Other features of the programme are:

- bursaries (non means tested);
- publicity appealing directly to women;
- building up of confidence and strong sense of group identity (with small groups led by women who had completed the course successfully);
- providing supportive network of peers;
- women staff: the programme being run by role models-a coordinator, two technologist advisers and secretary/administrator.

The programme has recruited well, given the restricted target group and has continued to grow. The key factors, according to Swarbrick were:

- bursaries (independent of partner's salary) and
- the prospects of career development, timed to coincide with children's progress towards independence.

7. Conversion Programmes

Where younger women tend to stay in full-time education beyond the minimum age in greater proportions than men, (e.g. Caribbean, Ellis, 1990) they can potentially build on a stronger general/academic base by entering training for higher technical/technologist levels, but significant incentives are needed, together with appropriate provision designed to minimise barriers.

Rural women are doubly disadvantaged in terms of general educational attainment as well as in access to science and technology education. An Australian initiative for rural women involved a community-based Distance Education programme, characterised by its consultative approach to programme development and strong student support systems. The objective of the programme was to increase the numbers of women entering science and engineering courses. The target group is mature age women and school leavers who had left school too early or made inappropriate subject choices. It involves the use of flexible, self-paced study materials. Barriers emphasised in mounting the programme (Warner 1993) were lack of self-confidence in the women themselves, time pressures they felt themselves subject to, in combining study with other responsibilities, and the "innate conservatism", the greater belief in traditional values, of rural peoples. Distance Education was the obvious answer for the isolated rural communities in question; there were few, if any alternatives. The distance education mode did, however face some significant problems. There were great constraints in

the support that could be provided for the participants in overcoming their fears and lack of confidence, an essential feature of programmes designed to facilitate women's access substantiated by much literature (e.g. McGivney (1993), Lewis (1988)).

Features of the programme contributing to its success (*as demonstrated by low dropout and programme growth*) are described by Warner as follows:

- participants encouraged to recognise the skills and competencies they had gained as home managers, farm managers and carers;
- materials on study skills and materials explicitly designed for awareness raising on issues of the status of women;
- peer support through teleconferencing/informal networking/student volunteers;
- open access, with no entry hurdles besides that of gender.

By April 1992, there were 306 women in the programme, distributed evenly between age bands, declining after age 44. Results compared favourably with those of mainstream school-leavers, despite the open access.

Lessons learned, as identified by Warner, are that the self esteem-raising and study skills components are absolutely essential; that self-paced materials can encourage procrastination, therefore goal-setting and time management need to be built in; that there is a need to capitalise on governmental/institutional equity policies for funding and support. The criticism that these are simply "band-aid" programmes is countered by Warner, who argues that they do not preclude, and should run in parallel with, action to remedy the wider conditions which act to subordinate women and prevent their access to education.

8. Local, Role Related Programmes

A good example of this type of programme is provided by the Construction and Use of Alternative Technologies project in Guyana. This involved training for local women in the design, construction and use of appropriate technologies related to energy saving. Through this programme, Ellis states, women were exposed to the domain of science and technology *in situ*, developed relevant skills and were better able to understand the links between science, technology and their everyday lives. To build on these kinds of initiatives, they need to be incorporated explicitly in policy development in ways outlined in the COL document *Women and Sustainable Development* (1994):

- empowering women as environmental managers within their communities through improved access to education and resources
- establishing strategies to involve female professionals and experts in project planning through training of women and girls; employing and promoting women in these fields; encouraging sustainability by local participation of design and implementation.

9. The Interface Between Technical and Technological Education

The traditional craft/Technician/Technologist boundaries are becoming blurred in the technological environments of the advanced economies: tech/voc levels are now being differentiated according to general/specific competencies required (e.g. in U.K., levels I-V are

specified, with I equivalent to basic skills, V equivalent to postgraduate level, by the National Council for Vocational Qualifications.)

At lower levels, moves to develop basic and broad "occupational competence" through flexible leaving programmes may create an upward pressure for further training/qualifications. Projects in which "supported self study" has played a significant part should be given particular attention.

Fretwell (1987) has argued that competency-based individualised and mediated instruction should be used more widely in developing countries' training programmes, as it has many advantages over traditional training.

Some of these advantages, particularly of flexibility and self-pacing, offer means of reducing barriers to women's participation. Other features such as traditional instructional procedures and top-down control (Fretwell 1987) are, by contrast, likely to reinforce barriers rather than reduce them. More research is needed into the design and implementation of competency-based education for technical and technological education, in a way which addresses gender issues as an integral feature.

10. How Far Can Distance Education Reduce Barriers? Some Conclusions.

The cases and examples given above show that Distance Education can achieve results in facilitating the participation of women, both young and mature in technological education, under the right conditions. The main forms of direct provision are **bridging courses**, allowing qualified women to update their knowledge and skills with a view to re-entry to the labour market; **conversion courses**, foundation programmes allowing mature women and school leavers who have either left too early or made subject choices they wish to change; **community-based programmes** providing basic technological education in a way which relates directly to women's traditional roles. The key lies in identification of the "right conditions" for these programmes. The first step is to establish the relative significance of the disjunctions identified earlier, and the specific forms they take in the given society and culture. The measures needed to tackle them can then be identified. If any of the disjunctions is "almost insuperable" then programmes geared directly to facilitate access will not be successful or represent a good investment even if all of the other disjunctions are effectively tackled. For example, distance education has been shown to be an effective means of reducing the disjunction between the domesticated role of women and educational/career aspirations, in the examples of bridging and conversion courses given above, by allowing women to combine study and domestic roles in a flexible fashion, while positioning themselves for new, non-traditional career opportunities as children become increasingly independent. While this disjunction can be effectively reduced in this way in the developed and some of the developing countries, the disjunction may be too great to deal with in this way in others, particularly in the rural areas. For example, social taboos and cultural sanctions have been described as almost insuperable in parts of India while in Tanzania, Muro 1988, states that women in village-based communities are so weighed down with domestic and farming duties, they have no time or energy for studies of any kind, and girls are withdrawn from schooling early to participate in these domesticated roles, essential to economic survival. For these women, community-based role-relevant programmes are more likely to be effective, although there is little evidence that they are stimulating entry into higher levels of education and training.

Many of the disjunctions can be overcome to some degree, however, by measures involving distance education. Distance education "failure" is likely to occur when western models are adopted without adaptation to the "acculturised behaviours" of teachers and learners, as Dunbar (1991) has demonstrated in Indonesia where the nation of social and learning behaviour and the strong oral tradition cut across the assumption of learner autonomy and relationship mediated through text. (See *Table 2*)

<i>Disjunction</i>	<i>Feature of Provision</i>
1. Entry requirements	<ul style="list-style-type: none"> • Open Access Programmes • Access Courses • Direct Recruitment Strategies, emphasising support
2. Domestication of women's labour/educational and career aspirations	<ul style="list-style-type: none"> • Delivery modes allowing for flexible home-based study, self-paced • Female role models/teachers • Job placement support
3. Financial dependency	<ul style="list-style-type: none"> • Scholarships, bursaries, subsidised fees
4. Traditional curricula/experiential knowledge	<ul style="list-style-type: none"> • Curriculum revision to emphasise social contexts of technology • Confidence building and awareness - raising components
5. Instructional approaches/curriculum presentation	<ul style="list-style-type: none"> • "Woman-friendly" materials and social interaction and peer support

11. Wider Strategies for Reducing the Gender Gap

Evidence suggests that, in developing countries, non-formal "women's projects" have been most successful in delivering outcomes in the short term, although special projects are often difficult to integrate into the mainstream.

It is significant that few of the programmes designed to promote participation have been sustained beyond their special project status, or have been mainstreamed. Provision for women needs to be part of a wider strategic programme, as Williams has stated. The other elements of this strategic programme, some of which also have distance education implications, are:

- Equal Opportunities monitoring/advisory body;
- *Requirements on employers to develop EO policy;*
- Institutionalisation of child care provision in training and workplace;
- *Use of media to change stereotyped expectations;*
- *STM Education part of core school curriculum;*
- *Safeguards against gender bias in curricular presentation;*
- *Ensuring that the social context of subjects of study is included;*
- *Inclusion of gender issues in units in initial and inservice education of teachers;*
- *Training for counsellors and guidance personnel.*

(The italicised items can potentially be addressed, at least in part, by distance education modes of delivery.)

12. Research Needs

Research must be able to estimate the increase in enrolments likely to arise from expenditure of resources on particular projects, and the likelihood of these projects becoming sustainable.

The first of these requires national databases containing detailed family community and educational information, broken down by gender. Khan has suggested that, because of the import of cultural norms for female enrolments, an index of conservatism should be identified or developed to capture these variables, and could be used in multivariate studies across social groups, cultural and/or national boundaries for the purposes of comparative study.

In assessing the relative significance of different factors, qualitative and quantitative methods may be employed. Qualitative approaches have been found valuable by Ellis and others, employing extended interviews to explore perceptions and experiences with policy-makers, project organisers, practitioners and women themselves, accessed through the active networks which operate in this field. A more quantitative approach would be to develop and trial an extended version of the "Barriers to Participation" questionnaires developed by Darkenwald (1988) in the United States. With suitably constructed items, clusters can be identified as factors, which can then be scaled into a range of indices which will reveal the differences in relative significance as perceived within and between groups. Layered methodologies may be developed which take "nation as context" and then sample different areas/labour markets/social groups, using a combination of qualitative and quantitative measures, to research the circumstances and policies as experienced (Evans and Heinz 1993).

"Impact" and "Process" evaluation of measures/programmes need to address:

- the objectives and the extent to which achieved;
- the ability of the implementing agency to organise and carry through the programme, including resourcing and provision of trained, skilled and competent staff;
- the effects of the environment and the local situation on the processes and outcomes of the project;
- the benefits derived directly and indirectly by the participants and wider community.

13. Conclusion

Overall, policy makers and practitioners engaged in measures to increase women's participation in technological education need to consider:

- What is the relative significance of the various disjunctions 1-5?
- What strategies are necessary to reduce the disjunctions?
- What affordable, appropriate programmes can be mounted?

Disjunctions, strategies, research needs and the essential features of provision are summarised in [Table 3](#).

Distance education programmes are likely to provide a solution if:

(a) disjunctions are not, per se, overwhelming;

(b) populations are dispersed and/or isolated and therefore not easily served by local community-based initiatives;

(c) practical ways can be found of providing the crucial support, encouragement and social interaction which secures continuing participation and low drop out rates.

Appropriate combinations of distance education and face-to-face interaction will be required, both to ensure retention and success, and to counter "ghettoisation of women" in home study.

If (a) applies, resources should first be put into strategies to reduce disjunction, which can themselves involve DE with other modes. In any event, both direct programmes and wider strategies need to be pursued in parallel if gender sensitive approaches are to become mainstreamed and institutionalised.

REFERENCES

Bellew, R.T. and E.M. King. (1993). "Training Women for Non Traditional Occupations" in E.M. King and M.A. Hill (eds.), *Educating Women: Lessons from Experience*. John Hopkins University Press, Baltimore and London.

Caldwell, J.C., P. Caldwell and P.H. Reddy. (1985). "Educational Transition in Rural South India," in *Population and Development Review II*: 29-51.

Columbo Plan Staff College for Technician Education. (1990). *The Role of Women in Technical and Industrial Development*. International Conference, June 1990, Manila, Philippines.

Commonwealth Secretariat. (1987). *Gender Stereotyping in Science, Technology and Mathematics Education*. Report of a Commonwealth Africa Regional Workshop, Ghana.

Jayaweera, S. (1991). *Gender and Education in Sri Lanka: Women, Schooling and Work*. CENWOR, Sri Lanka.

Darkenwald, G.G. (1985). "Factor Structure of Deterrents to Public Participation in Adult Education" in *Adult Education Quarterly*, Vol. 35, No. 4, 177-193.

Darkenwald, G.G. (1988). "Assessment of Adult Attitudes towards Continuing Education" in *International Journal of Lifelong Education*, Vol. 7, 197-204.

Dunbar, R. "Adopting distance education for Indonesia: Problems with learner, heteronomy and a strong oral tradition" in *Distance Education*, Vol. 12, No. 2, 163-174.

Ellis, P (1990). *Measures Increasing the Participation of Girls and Women in Technical and Vocational Education and Training: A Caribbean Study*. Commonwealth Secretariat, London.

El-Sanabary, N. (1993). "Middle East and North Africa" in E.M. King E.M. and M.A. Hill (eds), *Women's Education in Developing Countries: Barriers, Benefits and Policies*. World Bank, Washington, D.C.

Evans, K. and W. Heinz. (1993). Studying Forms of Transition: Methodological Innovation in a Cross-National Study of Youth Transition and Labour Market Entry *Comparative Education*, Vol. 30.

- Evans, T. and B. King. (1991). *Beyond the Text: Contemporary Writing on Distance Education*. Deakin University Press, Victoria, Australia.
- Fretwell, D.H. (1987). "Challenges to Implementing Competency-Based Vocational Training Programmes in Developing Countries" in *Journal of Industrial Teacher Education*, Vol. 24, No. 4, 47-51.
- Hussain T., B.C. Sanyal, M.H. Abbasi and R.K. Shahrukh. (1987). *Higher Education and Employment Opportunities in Pakistan*. International Institute for Educational Planning. Paris, UNESCO.
- Kember, D. (1981). "Some factors affecting attrition and performance in a distance education course at the University of Papua New Guinea" in *Distance Education*, Vol. 2, No. 2, 164-88.
- King, E.M. and M.A. Hill. (1993). *Women's Education in Developing Countries: Barriers, Benefits and Policies*. John Hopkins University Press, Baltimore and London.
- Khan, S.R., R. Siddiqui and F. Hussain. (1986). *Analysis of School Dropout Rates and Output in Pakistan*. Pakistan Institute of Development Economics Research Report 149. Islamabad.
- Lewis, L. (1988). *Addressing the Needs of Returning Women*. Jossey-Bass, California.
- McGivney, V. (1993). *Women, Education and Training: Barriers to Access, informal starting points and progression routes*. National Institute for Adult and Continuing Education, Leicester.
- Muro, A. (1988). "Providing post-primary education and training through distance tutoring in Tanzania" in *International Council for Distance Education Bulletin*, Vol. 17, May, 58-62.
- Raj, M.K. (1982). "Women Work and Science in India" in G. Kelly G. and C. Elliot C. (eds)., *Women's Education in the Third World: Comparative Perspectives*. Albany: State University of New York.
- Shah, N.B. (1986). *Pakistan Women: A Socioeconomic and Demographic profile*, E-W Population Institute, Honolulu.
- Swarbrick, A. (1987). "Women in Technology" in M. Thorpe and D. Grugeon (eds), *Open Learning for Adults*. Longman, London.
- Trivedi, J.H. (1989). "Women's development through Distance Education" in *ICDE Bulletin*, Vol. 21, 1989, 17-22.
- Warner, L. (1993). "WIST- a science and technology access programme for rural women: the determinants of success" in *Distance Education*, Vol. 14, No. 1, 85-96
- Williams, G.A. (1987). "Science, Technology and Mathematics Education for All, including Women and Girls in Africa." Keynote Address at the *Commonwealth Africa Workshop on Gender Stereo-typing in Science, Technology and Mathematics Education*. Report of a Commonwealth Africa Regional Workshop, Accra, Ghana

ADDITIONAL BIBLIOGRAPHY

- Birke, L. and C. Dunlop. (1993). "Bringing Women into Science" in *Adults Learning*, Vol. 4, No. 7, 181-183.

Coopers and Lybrand/European Commission. (1991). *E.C. Programmes and Networks in favour of Women*. Fact Sheet, No. 24. Coopers and Lybrand.

European Centre for the Development of Vocational Training (CEDESOP). (1992). *Equal Opportunities and Vocational Training*. CEDESOP, Berlin.

European Commission. (1992). *Skill Shortages, Women and New Information Technologies*. European Commission, Brussels.

Gardiner J., C. Gielnik and L. Brough. (1993). *Women's Training, Career and Development Opportunities: Barriers, initiatives and agenda for action*. Industrial Society, London.

Gerver, E. (1986). "The under-representation of women in computing" in *Open Learning*, Vol. 1, No. 2, 28-32.

Harding, J. (1983). *Switched off: the Science Education of Girls*. Longmans, London.

Kirkup, G. and M. Bruce. (1984). *Post-experience courses in technology for women*, Report No. 14, Institute of Educational Technology, The Open University, Institute of Educational Technology. The Open University, Milton Keynes.

Smith, C. (1993). "Women and Computers: a focus on the women enrolled in Correspondence School computer courses" in *Proceedings of the Ninth Annual DEANZ Conference*. New Zealand.

Swarbrick, A. (1986). "Women in Technology : a feminist model of learner support" in *Open University ICDE Bulletin*, Vol. 12, 62-68.

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