Women in ITEC
Courses and Careers

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A decade of new beginnings inevitably will produce new visions of where those beginnings might be leading. One such vision is that of the 'information society'; the idea that the information revolution opens a path to new opportunities for sustainable growth and development, new potential for social inclusion and representation, and new ways to achieve social and cultural expression. This vision, and ... [its] analysis, cannot be separated ... from the course of social, economic, and technological developments that make these new opportunities possible. (Mansell et al, 2000).

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Executive Summary

Introduction

This report represents the first systematic review and analysis of the participation of women in Information Technology, Electronics and Communications (ITEC)-related courses and careers internationally. It has been undertaken on behalf of the Department for Education and Skills (DfES), the Department for Trade and Industry (DTI) and the Women's Unit in the Cabinet Office. The project focuses on six countries: the UK, the US, Canada, Ireland, Taiwan and Spain. It draws on an evidence base of empirical data, literature and insights from interviews with key informants[1] in the selected countries.

The aims of this project are to:

- provide a comprehensive analysis of the position of women in ITEC-related courses,[2] that are expected to lead to a career in ITEC, within the ITEC sector[3] or ITEC jobs[4] more widely
- compare and contrast patterns in the participation of women in the UK with those in other countries
- identify lessons for education and employment policy and practice that can be learned from experiences abroad and which might improve the situation for women in the UK.

The research has provided copious evidence that in all countries there is a disparity between the participation and position of men and women in ITEC-related courses and careers. It is, therefore, not just a UK problem. Further it shows that the gender gap is much wider than it should be given the relative proportions of men and women in the graduate population and in the workforce as a whole.

The participation of women in ITEC-related courses

Women are generally under-represented among graduates in ITEC-related subjects and that is despite the fact that they form the majority, and a growing proportion, of university graduates generally. ITEC-related courses are not the only route into ITEC jobs but the currently low levels of participation are unlikely to enhance women's employment in ITEC, especially in the more technical areas such as product design and software development. The proportion of women ITEC graduates is lower in the UK than in the other five countries.

Some women appear to move away from ITEC as they structure their education towards a career. In the UK this starts before entry into higher education. Although similar proportions of males and females study ITEC-related subjects at school, smaller proportions of women qualify at GCE A Level.

There are more problems in the UK in attracting women onto ITEC-related courses such as computing, engineering and maths than courses in business and administration. Women represent a high and growing proportion of graduates in business and administration in all countries. The proportion graduating in engineering is beginning to rise in many countries but it remains stable in the UK where it is lower than in Canada, the US and Spain. Female computing graduates are in decline in all countries, with figures for the UK lower than for Ireland and the US. There are higher and rising proportions of female graduates in maths in the US, Canada and Taiwan but proportions in the UK are low and declining.

1 These included ITEC experts, employer representatives and members of industry specific professional bodies.

2 Defined to include Computer Science, Mathematical Science, Engineering and Technology and Business and Administrative Studies. See Appendix 1 of the main report for a more complete definition.

3 The definition of the ITEC sector is based on Hawkins, Mansell and Steinmueller's framework (Hawkins et al., 1997). This includes IT services, telecommunications, electronics manufacturing and broadcasting services.

4 ITEC jobs involve the design and production of ITEC goods and services, for example, computer managers, electrical and electronic engineers and technicians, software engineers and computer analysts and programmers. These exist within or outside the ITEC sector.

The participation of women in ITEC careers

Women are also severely under-represented in ITEC jobs in all countries and their participation in recent years has been decreasing across the whole sample. In the UK in 2000 only 13 per cent of women were working in ITEC jobs across the whole economy, down from 16 per cent in 1999. This is much lower than in the US, Canada and Ireland. Women's employment in ITEC sub-sectors in the UK is skewed towards broadcasting services. They are very poorly represented in IT services, telecommunication services and electronics manufacturing. The US, Canada and Ireland perform better in electronics manufacturing and IT services.

There are more opportunities for part time work in the US than in the UK. The proportions of men and women working part time are more similar in the US than the UK. This may be having a more positive impact on the acceptance of more flexible forms of working in the US than in the UK. Women in ITEC jobs are on average 4 years younger than men so age may also be discriminating against women in ITEC employment in the UK who delay entry into an ITEC career for example because of care for children and/or dependants.

Women may also be having more problems advancing once in employment and/or securing more professional, higher level jobs. Women in the US and the UK are concentrated in lower level ITEC jobs such as telephone operators or data processing equipment installers and repairers, jobs that typically receive lower pay. Men are also better rewarded for their work in ITEC than women in the same jobs. This differential appears to increase with occupation status in the UK and with experience in the US.

Encouraging greater participation and overcoming barriers – the lessons

Tackling access and education

Building ITEC capabilities among girls and women

Negative attitudes to ITEC are formed early in life through experiences in the home and at school and through the media. They limit girls' and women's 'psychological access' to ITEC, and reduce their inclination to engage with technology in order to develop ITEC capabilities. In the UK, girls tend to disengage with ITEC subjects at school after GCSE level. A large disparity develops between males and females in subject choices in further education. Counteracting the impact of these influences on women has been the key to successful initiatives, for example, in Canada, that have increased the propensity for women to engage with ITEC. Key features of these initiatives have been:

- the development of ITEC capabilities among teachers, especially female teachers
- the creation of privileged spaces for girls to interact with technology at school
- sensitivity to the gender implications of instructional material, including on-line teaching resources.

Tackling education and recruitment

Refining the image of an ITEC career

The masculine image of ITEC and ITEC occupations is a deterrent to women. However, many feel the image of ITEC employment does not reflect the reality and the diversity of ITEC work in modern society. Refreshing this image in order to promote the benefits of specific ITEC careers and/or studying ITEC courses (e.g. increased employability) is the key to encouraging greater numbers of women to build their educational profiles towards participation in ITEC employment.

Raising awareness of pathways into ITEC jobs

Information needs to be provided to girls and women about the routes into ITEC careers and the job requirements other than just having an ITEC-related qualification. Practical initiatives have been developed abroad to make women better informed and these are having a positive influence on women selecting an ITEC career. Such initiatives include:

- publicity and marketing drives
- initiatives to change the structure and content of ITEC courses
- the establishment of closer relationships between education and industry
- efforts to integrate women and girls into the community of professional/education practice in ITEC.

The Women's Television Network in Canada, for example, has developed a portfolio of approaches to employment and capability building that are available to girls and women at various ages/stages in their professional broadcasting careers.

Creating opportunities for skill conversion

The availability of opportunities for women to upgrade their initial skills is important when so many women leave education with few ITEC-related skills. This is not simply because education and/or training in an ITEC-related subject might lead on to an ITEC career. Improving ITEC literacy more generally will also clearly have wider social and employment benefits in an increasingly knowledge-based economy. The availability of multidisciplinary (joint) courses that include an ITEC-related subject (e.g. in Ireland) have been important in enabling women to engage with ITEC while pursuing other, more familiar course options. These courses have introduced elements of other disciplines into pure ITEC courses. Similar modifications to courses within the UK may also serve to strengthen education and business links, and generally improve the skills leading to an ITEC career in this country. Conversion courses that enable students to migrate from a non-ITEC first degree into ITEC have also been instrumental in Canada and Ireland in increasing the participation of women in ITEC employment. There may be lessons here too for the UK.

Creating multiple points of access to ITEC literacy

Limited opportunities for developing ITEC skills and cost constraints are barriers to women's participation. Widening opportunities for girls and women in all age groups to access ITEC technologies (including the Internet) in the home and elsewhere in the community, will provide women with important ITEC skills and also enable women in ITEC jobs to refresh and upgrade their capabilities. As firms adapt their recruitment activities to an on-line environment, access to ITEC technology is vital to identify opportunities for employment. The range of training provision is also increasing (e.g. basic computer literacy certification or professional vendor qualifications). It is important that women are made aware of all opportunities and can gain access to wider forms of skill development.

Tackling recruitment and employment

Creating opportunities for career migration

Alternatives to the traditional pathways from education to initial employment have always been important in the development of women's careers. Some firms have attempted to formalise the process of career migration through the development of springboard courses that enable some women to move more quickly to a senior and/or professional role in ITEC. The experiences of employers involved in such schemes could be more widely shared to create further opportunities for women to advance in ITEC.

Overcoming barriers to entry into the culture of employment in ITEC

Some consider ITEC still to be unwelcoming to women and the terms and conditions of work (including long hours, travel, lack of part-time work) not 'female-friendly'. As seen in the UK skilled women invariably come up against low status and unequal pay. Because of the tendency for young male ITEC managers to recruit in their own image, age also sits alongside gender in discriminating against women. Firms need to review their recruitment practices and selection criteria, their language and the images portrayed to ensure they do not discriminate against women directly or indirectly.

Tackling employment and retention

Enabling progression and achieving retention in ITEC careers

Women and girls do have the skills necessary to progress in ITEC employment. Yet few women achieve high status positions in ITEC occupations. There are certain ways that women can help themselves. Women have a responsibility to make sure that they are not overlooked in employment. However, their confidence and perceptions of their abilities are typically low and do not adequately reflect their competence. Firms have developed a number of initiatives aimed at retaining women in ITEC occupations, for example, the provision of financial and management support for flexible working and workplace diversity. However, statistics show that too few women are employed on a non-standard part-time basis in the UK compared to the US – there is clearly more that can be done in this respect.

Entrenching the new image of ITEC employment

The ability of the firms to value, recruit, promote and retain women with skills in appropriate ITEC occupations is critical to retaining their employment in ITEC. This involves changing the culture of ITEC employment and management.

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Main Report – Part A

1. Introduction

This Report is the final deliverable of a project, undertaken on behalf of the DfES, the DTI and the Women's Unit in the Cabinet Office to examine the participation of women in ITEC[5]-related courses and careers internationally. The aims of this project are to:

- provide a comprehensive analysis of the position of men and women in ITEC-related courses and occupations in six countries: the UK, the US, Canada, Ireland, Taiwan and Spain
- compare patterns in the participation of women on ITEC-related courses in the UK with those in other countries
- identify lessons for education and employment policy and practice that can be learned from experiences abroad and which might improve the situation for women in the UK.

The project uses literature review, analysis of secondary data, and interviews with policy makers, policy analysts, and members of training and other professional organisations in order to:

- examine, compare and contrast the participation profiles of men and women in ITEC-related courses in the six countries
- explore the views of women on courses (classified as ITEC-related courses) that would be expected to lead to an ITEC career in the UK about the factors that influenced their decisions in embarking on higher education
- investigate the education profiles of men and women in a range of ITEC occupations
- examine, compare and contrast the participation of men and women in ITEC careers
- identify the factors that influence the recruitment and promotion of people in ITEC jobs
- reveal examples of education and employment policy and practice that have been effective in encouraging women to participate in ITEC-related courses and careers internationally.

Secondary analysis of available existing historical data has been used to show trends in the participation of women in ITEC.

1.1 Setting the scene – skills and employment in ITEC

The information technology, electronics and communications (ITEC) sector, broadly defined to incorporate IT, telecommunications, broadcasting services and electronics manufacturing,[6] is the engine of economic growth in the emerging digital Information Society.

ITEC technologies are generally accepted to be at the core of the social, economic and institutional changes that are accompanying the emergence of the new economy and are affecting the structure and growth of productive output, occupations and employment (European Commission, 2000). In 1997, information and communication technologies (ICTs) contributed on average 7 per cent to economic growth in OECD countries and this figure has been rising, due, in particular, to expansion in telecommunications equipment and growth in services (OECD, 2000a).

[5] Information Technology, Electronics and Communications.

[6] The articulation of the ITEC sector, and of ITEC-related occupations, varies in countries where different sector and occupational classification systems are used.

Continued expansion within the sector has been fuelled on the supply side by rapid innovation in products and services, the development and growth of new products/services market segments and a shift away from manufacturing towards services, investment in R&D and the availability of venture capital to support investment. On the demand side, drivers of growth include the falling costs and increasing power of capital equipment and the liberalisation of trade and regulatory frameworks that have enabled the widespread application of ITEC technologies across all economic sectors.

Strong growth in ITEC markets, particularly in the market for software and services, has generated a substantial rise in employment that is expected to continue in the foreseeable future. Expansion has also created a 'complex pattern' of skill and training needs in the UK (Department for Education and Employment, 1999a) and internationally (OECD, 2000b) as traditional occupations are being transformed, new jobs created and old ones destroyed. For example, despite being considered to be in their infancy, electronic commerce and the diffusion of the Internet are generating fundamentally new occupations, such as Internet architects and webmasters, in the ITEC sector and in other sectors[7] at a 'startling' rate (Cisco Systems *et al.*, 2000). Yet the skill profiles that are associated with these emerging professions are generally not well understood and are being continually transformed through occupational practice. Moreover, the redefinition of occupations and the skill and training needs that are associated with them alter the paths that people must tread to enter those occupations. Lack of knowledge about the entry routes into new and revised ITEC occupations can hamper the flow of skills into those jobs.

However, forecasts of high levels of employment growth in the ITEC sector and of expansion in the demand for ITEC skills in other sectors have led to concern that core ITEC skills are in short supply in Europe (Ducatel *et al*., 1999; Harvey-Price, 1999; OECD, 2000b) and world-wide[8] (OECD, 1999b).

The expected positive impact of the emerging digital economy on growth and competitiveness, driven largely by the creation, manipulation and appropriation of knowledge and information, has created uncertainty about the mix of skills that will be required to support it (Department for Trade and Industry, 1999), their availability (OECD, 1999b) and the range of mechanisms that could be used to stimulate their flow onto the labour market.

Addressing the 'skills shortage'

It is now widely believed that the demand for ITEC skills is growing faster than the capacity of education to produce them (EITO, 2001; OECD, 1999b). Skill shortages are a serious threat to the commercial exploitation of ITEC technologies and constrain the further development, competitiveness and stability of the Information Society.

The main reasons put forward for these skill shortages relate to the problems of adjusting to fundamental change. According to EITO (EITO, 2001) they include the:

- rapid growth in the application of ITEC to support commercial and business processes (including expansion onto the web)
- lack of professionals in key skill areas, particularly in Internetworking and wireless communication technology (where a 32 per cent shortfall between demand and supply is anticipated) and e-business (where there is an expected 31 per cent deficiency in skill supply)
- an inadequate match between ICT curricula and industry skill requirements
- reluctance among firms to train and re-train staff (because of the costs and time involved)
- difficulty of retraining involving the transfer of expertise among specialist niche segments of the industry (such as client/server NT, legacy mainframe, Unix, datacom, networking, object-oriented programming, Linux)
- the image of the industry and its unattractiveness, for example, to women.

[7] Whether the net effect of e-commerce is employment generating, however, is open to debate.

[8] The OECD estimates that there are currently 600,000 IT jobs that are unfilled as a result of skill shortages (OECD, 1999b).

However, a range of measurement problems continues to constrain the ability of research to map the relationship between the supply of, and the demand for, ITEC skills. These include:

- business skill requirements being typically difficult to articulate and, possibly, being subject to on-going change.[9] This means that 'not only is it difficult for educational institutions to adapt programmes and curricula at the speed necessary to keep up with progress, but students themselves embark upon their courses without a clear picture of how the sector in which they will seek employment will look once they have graduated' (EITO, 2000)
- some skills perhaps being substitutable in the short, medium or longer-term. The ability to substitute one skill for another might stave off skill shortages, especially in occupations that are undergoing rapid change and for which skill requirements are unclear. However, the potential for some skills to be substitutable is seldom accounted for in analyses of skill shortages
- skill needs may not map neatly onto the skills that are provided by education and training bodies (Mason, 1999); as a result, estimates based on the assumption of a straightforward relationship between the supply of ITEC skills and demand for those skills are likely to be inaccurate
- rapid technical change, business process change, and associated changes in skill requirements together with the on-going dynamics of the relationship between supply and demand mean that, over time, the skills that are originally provided by the education system need to be updated and upgraded by life-long learning. Initial levels of education are generally accepted to be inadequate to support the early stages of an individual's career and certainly do not supply what is needed for many senior positions. For example, skill needs in the emerging economy, particularly in service sector occupations, are those that are associated with creativity, teamwork and innovation. It is particularly difficult to acquire such skills outside a particular work context. In earlier economic periods, other skills were considered vital to growth and were incubated through education and training[10]
- the sources of skills needed in ITEC occupations are continuously changing too. Employer, proprietary and community-based training programmes, and public/private partnerships in education are playing an ever-more central role in ensuring that the workforce is equipped with appropriate skills but data on the outputs of these activities are seldom available in the public domain and may not be represented adequately in assessments of skill supply which, typically, are based on the outputs from formal education
- as occupations and their skills requirements change so, too, do the pathways for entry into those occupations. Lack of awareness of the routes into employment can generate lags in supply that may not be reflected in the supply side data
- the lack of data relating to the supply and uptake of employment-based and proprietary training makes it difficult to assess the extent and nature of the gap between the skills that are being supplied and the demand for other skills in the economy. There is insufficient information about the relative balance between the contributions that formal education, non-formal education and lifewide, informal learning make to the creation of ITEC-related skills, and the integration of these various skills in professional practice
- little note is taken of the impacts of policy intervention or of the timeframe within which the effects of such policy might be felt.

Not surprisingly, forecasts of the likely shortfall between the quantity of the skills required and the number available in the labour market vary.[11] Accounts of a growing IT skills 'crisis' report an estimated shortfall between the supply of and demand for ICT skills in 1999 of around 860,000 in Western Europe

[9] The lack of clarity concerning the association between skills and particular occupational titles is being addressed in the UK by the e-skills National Training Organisation's Skills for the Information Age initiative, http://www.sfia.org.uk

[10] In the US in the 1970s, for instance, the excessive skill requirements of employers' were believed to be driving workers to obtain more education than was necessary for effective job performance and to have resulted in a glut of highly skilled workers on the labour market (Handel, 1999).

[11] Forecasts of occupational growth, for example, are typically based on approximate projections rather than precise measurements and statistical data collection techniques are not sufficiently sophisticated to provide an occupational analysis of labour market shortages.

(International Data Corporation, 2000). The International Data Corporation predicted that this shortage would rise to 1.74 million by 2003. Combined with the demand for e-business and call centre skills, the European Information Technology Observatory (EITO) anticipates a shortage by 2003 of 3.84 million ICT and e-business skills – 18 per cent of the forecast demand for these skills (EITO, 2001).

In the US the predicted high rate of employment growth among systems analysts,[12] computer scientists and computer engineers led the Office of Technology Policy in 1994 to warn of a 'global shortage of IT workers'(Office of Technology Policy, 1997). In April 2000 the ITAA (Information Technology Association of America) estimated a demand for 1.6 million new workers in the following year, and predicted that 840,000 IT jobs would be unfilled (Information Technology Association of America, 2000a). The Bureau of Labor Statistics (BLS) employment forecasts suggest that, in the US alone, between 1996 and 2008, more than 200,000 new 'IT workers', most of whom will need at least a Bachelor's degree, will be required to fill newly created jobs and to replace IT workers leaving the field, (Department of Labor, 2000).

As Table 1 shows, there is no consensus, even within single countries, on the scale of skill shortages and variations in the methodologies and forecasting techniques serve to confuse the situation still further.

Table 1: IT jobs unfilled owing to skill shortages

	Current estimate of unfilled jobs	Source
World	600,00	European Information Technology Observatory
United States	190,000	Information Technology Association of America[1]
United States	346,000	Information Technology Association of America[2]
United States	450,000	Microsoft
Germany	60,000	European Information Technology Observatory
Canada	20 – 30,000	US Office of Technology Policy
United Kingdom	20,000	European Information Technology Observatory

[1] February 1997 survey.
[2] January 1998 survey, with a different sample including small business and definition of 'core' IT workers.
Source: OECD, 1999, p.139.

In addition, the interpretation of these data is contested. For example, the OECD has reported that although the projected demand for IT workers in the US economy is high, 'there may be no real shortage [that is particular to the sector] or at least it may be smaller than sometimes described' (OECD, 2000b), partly because of the likely impact of policy intervention.[13]

In contrast, research in the UK has warned that 'it is ... likely that the reported level of shortages understates the true problem' (Haskel *et al.*, 1999). This is because firms may accommodate to skill shortages by adopting process technologies that have lower skill requirements than those that are 'best practice'. In the longer term, this strategy may reduce employee productivity and depress the firm's competitiveness and economic growth.

So, while it is clear that the individual elements of the 'knowledge triangle' (education, innovation, technology) that are essential to prosperity in the Information Society are becoming ever more important in

[12] The projected growth rate between 1994 and 2005 in systems analysts is 92 per cent. The number of computer engineers and scientists are expected to grow by 90 per cent in the same period.

[13] For example, to increase the supply of skilled workers by reforming the education and training systems and increasing temporary immigration.

influencing people's chances of 'getting in, getting on and getting up' (OECD, 1999b) in life, our awareness of the couplings between them, and the factors that influence how these develop and grow is limited.[14]

Nevertheless, research has indicated that there are acute ITEC skill shortages in particular occupations, such as computer analysts/programmers, and particular sectors, for example IT, financial and other business services (Department for Education and Employment, 1999a; e-business.nto, 2000; NOP, 1998), and that these trends may well be Europe- and US-wide (Ducatel *et al.*, 1999; Meares *et al.*, 1999; OECD, 1999b). It is considered essential to economic prosperity that the skills that are appropriate to ITEC employment are made available in sufficient quantity and at an affordable price.

Targeting the issues

The intensive exploitation of, and reliance on, ITEC technology in most economies, together with the tight labour market for ITEC skills, have fuelled more general concerns about the quantity, nature, and quality of available skills, and our knowledge of the factors that influence them (D'Amico, 1999; Harvey-Price, 1999; Office of Technology Policy, 1997). Questions are also being raised about the effectiveness of education and training programmes that supply skills to the economy (NOP, 1998) and the location of responsibility for their development.[15]

Policy concern is now directed towards the need to build and widen opportunities for skill acquisition and labour market participation and to attract and retain greater numbers of people in ITEC occupations. Strategies include:

- the creation of closer synergies between business and education[16]
- the wider distribution of educational opportunities over the Internet[17]
- the provision of support for on-line recruitment (Autor, 2000) and on-line work (including telework) in order to help match workers to firms and offer more flexible opportunities for workforce participation
- activating the unemployed
- encouraging labour mobility and migration into labour scarce areas
- the retention of people at work beyond normal retirement age
- the extension of temporary immigration
- the encouragement of under-represented groups, including women,[18] to embark on ITEC careers.

The focus of this report is on the last strategic issue, the participation of women in ITEC courses and careers.

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[14] Of course, the net impact of ITEC on employment is an open question. At the industry level, it depends on a range of factors including the nature of the jobs that are being created, the extent to which these displace other jobs and the implications of technology and employment strategy for competitor firms. At the sector level, it depends on the types of technology, the degree to which input substitution is possible, labour market flexibility and other institutional factors (OECD, 1999b).

[15] On the one hand, a large proportion of the new jobs that have been created are either part-time, or temporary contract positions and flexible employment is usually associated with lower levels of corporate investment in human capabilities (Ducatel et al., 1999). Employees therefore are encouraged to 'own their employability' and continuously refresh their skills. On the other hand, in the current tight labour market, the provision of access to education and training has become an important lure for recruiting and retaining people (including older workers) in work – to adopt a metaphor from the world of fashion, for many firms, retention is 'the new black'.

[16] Including, in the UK, the development of pilot programmes to link National Vocational Qualifications (NVQ) with proprietary qualifications from Microsoft, Novell and Cisco (Devo, 2000) and of further research at the university-industry interface (AISS, 1999). In the US, examples include the development of policies and practices to assist the transition from initial education to working life (Zemsky et al., 1998).

[17] For example, the planned creation and development of the e-University in the UK (http://www.hefce.ac.uk).

[18] For instance, through implementation of the recommendations of the National Skills Task Force (DfEE, 1999a, 2000).

1.2 Focusing on women

This report is about women, their participation in courses of study that could be expected to lead to an ITEC career, and the scale, scope and pattern of their employment in ITEC in the UK, the US, Canada, Ireland, Taiwan and Spain. The latter five countries were selected for comparison with the situation in the UK on the basis of known similarities and differences that might be expected to influence the participation patterns of women pursuing ITEC-related careers, including:

- the high economic significance and active development of the ITEC industry in the US (OECD, 2000a)
- the similarity between the education systems, for example, the UK, Canada, and Ireland
- the difference between the education system in the UK and Spain: for example, in Spain it takes between 5 and 7 years to obtain a first degree and this is expected to have a negative impact on women's participation[19]
- opportunities for life-long learning in the US and Canada, which, assuming they are taken up, may be expected to have improved the career prospects for women
- the rapid expansion of the ITEC sector in Ireland and Taiwan, both 'tiger economies', one (Ireland) showing increasing signs of labour scarcity, the other (Taiwan) with a history of labour abundance
- where there is some evidence to suggest that the position of women in ITEC courses and careers is better (Spain and Ireland) or worse (Taiwan)
- where the socio-political structure is notably different (Taiwan).

Lessons from the experiences of women in ITEC courses and careers in these countries were expected to help inform our understanding of the main drivers of problems concerning the relationship between women, employment and ITEC and the development of political and practical interventions that would contribute towards improving the situation for women in the UK.

Women are a valuable source of skills and talent. There has been mounting evidence to suggest that women are vastly under-represented in ITEC and on courses that would be expected to supply skills to, and upgrade skills in, ITEC occupations (Department for Education and Employment, 1999b; Department for Trade and Industry, 1998; Information Technology Association of America, 2000b).

Encouraging more women to enrol on and graduate from ITEC-related courses, to engage in ITEC-related training and to embark on ITEC careers would appear to be obvious solutions to the skills shortage problem. However, women seem to encounter significant barriers when they attempt to pursue a professional career in ITEC (Honey, 1999; Information Technology Association of America, 2000b; Woodfield, 2000). There is a need to understand and overcome these barriers if women are to make a positive contribution towards expanding the pool of local talent that is available to firms.

Until now the evidence base of existing research into women's participation in ITEC employment has been anecdotal and partial. For example, research has typically concentrated on information technology (IT) or on information and communication technology (ICT) related work at the expense of electronics manufacturing and broadcasting services.

This report provides the first systematic examination of women's employment in information technology, electronics, and communications both within and outside[20] the core ITEC sector (defined in section 1.3) internationally. The report draws together evidence from six countries in order to provide a review and analysis of information, data and literature relating to women's participation in education and the labour market internationally, and the factors that influence women's status and inclusion in the emerging digital economy. Two main hypotheses have guided this work.

[19] See Millar and Senker (2000) for an analysis of the university research system in Germany.

[20] That is, in other, non-ITEC, sectors.

- There is a 'gender gap', i.e. a disparity between the participation and position of men and women in ITEC-related courses and careers, that is much wider than it should be given the relative proportions of men and women in the graduate population and the workforce
- The factors that appear to influence participation seem to be aligned towards reducing women's engagement with ITEC and seem to have a cumulative, negative impact on women's participation in ITEC jobs.

However, it is important to begin by providing a context for this analysis of women's participation in ITEC and by charting the definitions (e.g. of the ITEC sector, ITEC occupations and ITEC-related courses) that have been employed in this report.

1.3 Defining the details

Understanding the relationship between the supply of, and the demand for, ITEC skills in the emerging economy is vital if effective support for the creation and development of appropriate skills that will make a positive contribution towards continued economic growth is to be provided. Until now, the assessment of this relationship has proved problematic for three main reasons.[21]

- First, because occupational skill requirements are often difficult to articulate and are subject to change.
- Second, because the pathways into ITEC careers and the practices that help to sustain employment once there are unclear.
- Third, because limitations in the design and use of quantitative data collection techniques have made it difficult to provide an accurate account of ITEC skills.

These limitations have meant that studies have not been based on common definitions of ITEC occupations and ITEC-related courses. Weaknesses in existing statistical classification systems[22] and the lack of consistency between data collection in relation to the sector in different countries have further thwarted international comparisons.[23]

The research instrument (Appendix 1) that was used to guide the research presented in this report was developed in order to address these limitations. It is based on a single conceptual framework of the ITEC sector, ITEC occupations and ITEC-related courses. This has been articulated into country specific maps of the ITEC sector, ITEC occupations and ITEC-related courses (Appendix 1). The conceptual framework is introduced in the next section.

The conceptual framework

The results of the quantitative research that form the evidence base for this report have involved review and analysis of existing data on ITEC-related courses and employment in the UK, the US, Canada, Ireland, Taiwan and Spain.

The conceptual framework that is outlined in this section provides the underlying definitions of the ITEC sector, ITEC occupations, and ITEC-related courses that have been used to construct the research instrument (Appendix 1) and direct the data review.

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[21] Part A, Section 1.1 presents a more detailed discussion of these.

[22] Occupational titles that are included in national classification systems are typically out of date, and consequently partial in their coverage of ITEC occupations. Occupational titles that are relevant to ITEC are also subject to rapid change and this does not help the longevity of the classification systems used. It is anticipated that the adoption of SOC 2000 will go some way towards addressing this in the UK with the introduction of new categories such as SOC2000 2131 IT strategy & planning professionals and SOC2000 313 covering IT service delivery occupations (Elias et al., 1999).

[23] Different national, educational and institutional classification systems often use superficially similar occupational descriptions and definitions that may vary considerably in practice. This means that it is generally difficult to make direct comparisons between the data that are collected within these various national frameworks.

The ITEC sector definition

The definition of the ITEC sector that has been employed to guide this research is based on the results of Hawkins, Mansell and Steinmueller's (Hawkins *et al.*, 1997) examination of international approaches[24] to mapping and measuring the ITEC sector. The resulting framework identifies twelve segments of ITEC-related activity, including networking services, broadcasting services, digitised content, software, computer equipment and peripherals, broadcast and network equipment, basic network services, enhanced voice and data networks, consumer electronics, components, electronic measuring and scientific instruments, and ITEC-related professional and technical services. This definition has been implemented as far as possible in each of the selected countries using national occupational classification systems. The articulation of this definition in the six countries, therefore, gives rise to a different ITEC sector map in each (see Appendix 1).

Defining ITEC employment

ITEC employment refers to occupations that involve the design and production of ITEC goods and services, for example, computer managers, electrical and electronic engineers and technicians, software engineers, and computer analysts and programmers. People in ITEC employment may work in ITEC jobs in the ITEC sector, in other non-ITEC sectors (such as, banking or travel and tourism) or across the whole economy (i.e. all sectors). The definition of ITEC employment that is adopted in this report has been created to include a wide range of relevant professional occupations. However, again, national sources of occupational data have been used, and these vary (see Appendix 1). As a result, the composition of ITEC jobs in the UK is different from those in other countries, and their analyses are not directly comparable.

ITEC-related courses

'ITEC-related courses' are defined to include those that could be expected to lead to an ITEC occupation. A broad range of subjects was selected to reflect the variety of fields of study that can prepare for the range of jobs in the ITEC occupational definition and to facilitate international comparisons. In the UK, for example, they include mathematical sciences, computer sciences, engineering and technology and business and administrative studies. In other countries, while the range of subjects is similar, the labels used are often different (see Appendix 1).

1.4 Structure of the report

The report is in two main parts: A and B.

Part A focuses on a comparative analysis in six countries (the UK, the US, Canada, Ireland, Taiwan, and Spain,) of:

- patterns and trends in the participation of women in ITEC-related courses
- the nature, scale and scope of women's employment in ITEC, both within the ITEC sector and in ITEC jobs in other, non-ITEC, sectors in the economy
- initiatives that have extended opportunities for women to embark on and remain in an ITEC career.

Part A is divided into two further chapters:

Part A, Chapter 2 provides a synthesis of the main findings from quantitative research in the six countries. With a particular focus on the situation in the UK, it compares and contrasts the participation of women in ITEC courses and careers in the six countries.

Part A, Chapter 3 presents an analysis of the main barriers in the six countries that have prevented women from entering, remaining, and progressing in an ITEC career, and highlights examples of initiatives that have proved effective in improving the situation for women other countries.

[24] The study examined the approaches used by the OECD to guide their forecasting studies, the 'Harvard Map' of users and producers of ITEC products and services, the UK Programme on Information and Communication Technology mapping and measuring exercises, the Australian Productivity Commission map, the Royal Institute of International Affairs (RIIA) map and the UK Office of Science and Technology (OST) Technology Foresight ITEC Panel map.

Part B is divided into six chapters. Each chapter gives a detailed analysis of quantitative evidence on the participation of men and women in ITEC-related courses and careers in each country in the following order: the UK, the US, Canada, Ireland, Taiwan and Spain.

Appendix 1 provides further methodological details and presents the research instrument used in the research.

Appendices 2-7 present detailed country-level data on the participation of women in ITEC courses and careers in the UK, the US, Canada, Ireland, Taiwan and Spain.

2. Examining the participation of women in ITEC courses and careers

This chapter brings together the evidence presented in Part B, Chapters 1-6 on the participation of women in ITEC courses and careers in six countries: the UK, the US, Canada, Ireland, Taiwan and Spain. It draws out patterns and trends in the proportion of women among graduates and in employment that relate to the capacity of these economies to respond to the challenges of the Information Society, for example, by enabling equitable access to participation in ITEC courses and careers. The chapter is divided into two main parts:

- the first focuses on the participation of women in ITEC-related courses, and
- the second examines the proportion of women in ITEC-related careers within the ITEC sector and/or the wider economy.

2.1 The participation of women in ITEC-related courses in six countries

Headlines:

- Women are generally under-represented among graduates in ITEC-related subjects and this is despite the fact that they form the majority and a growing proportion of university graduates generally.
- The proportion of women ITEC graduates is lower in the UK than in the other five countries in the study.
- Some women appear to move away from ITEC when beginning to structure their education towards a career. In the UK this starts before entry into higher education. Although similar proportions of males and females study ITEC-related subjects at school, smaller proportions of women qualify at GCE A' Level.
- There are more problems in the UK in attracting women onto ITEC-related courses such as computing, engineering and maths than courses like business and administration.
- Women represent a high and growing proportion of graduates in business and administration in all countries.
- The proportion graduating in engineering is beginning to rise in many countries; it remains stable in the UK, which is lower than in Canada, the US and Spain. Female computing graduates are in decline in all countries, with figures in the UK lower than in Ireland and the US.
- There are higher and rising proportions of female graduates in maths in the US, Canada and Taiwan but proportions in the UK are low and declining.

This section draws together country-specific data in order to compare and contrast the participation of women in ITEC-related courses in six countries: the UK, the US, Canada, Ireland, Taiwan and Spain.

With the exception of Taiwan, in all these countries women are in the majority among university graduates (Figure 1, Table 2) and the proportion of women among university graduates has risen.

Small but increasing numbers of women are graduating in courses that could be expected to lead to a career in ITEC. There is considerable variation in the proportion of women ITEC graduates between countries. For example, women are 42 per cent of ITEC graduates in Ireland but only 35 per cent in the UK. The proportion of women ITEC graduates is smaller in the UK than in the other countries. Problems in the relationship between women and ITEC seem to appear post GCSE level. Similar proportions of male and female 15-year-old students qualified in information systems and mathematics at GCSE level in 1998/99, while slightly lower proportions of females qualified in computer studies (43 per cent). However, fewer women than men qualified in ITEC-related subjects such as maths (36 per cent) and computer science (20 per cent) at GCE A level.

There is also variation in the participation of women in different ITEC-related courses. High and growing proportions of women graduate in business and administrations – the category includes courses that relate to traditionally female employment, such as secretarial work. Greater proportions of women graduate in business and administrations than in other ITEC-related courses.

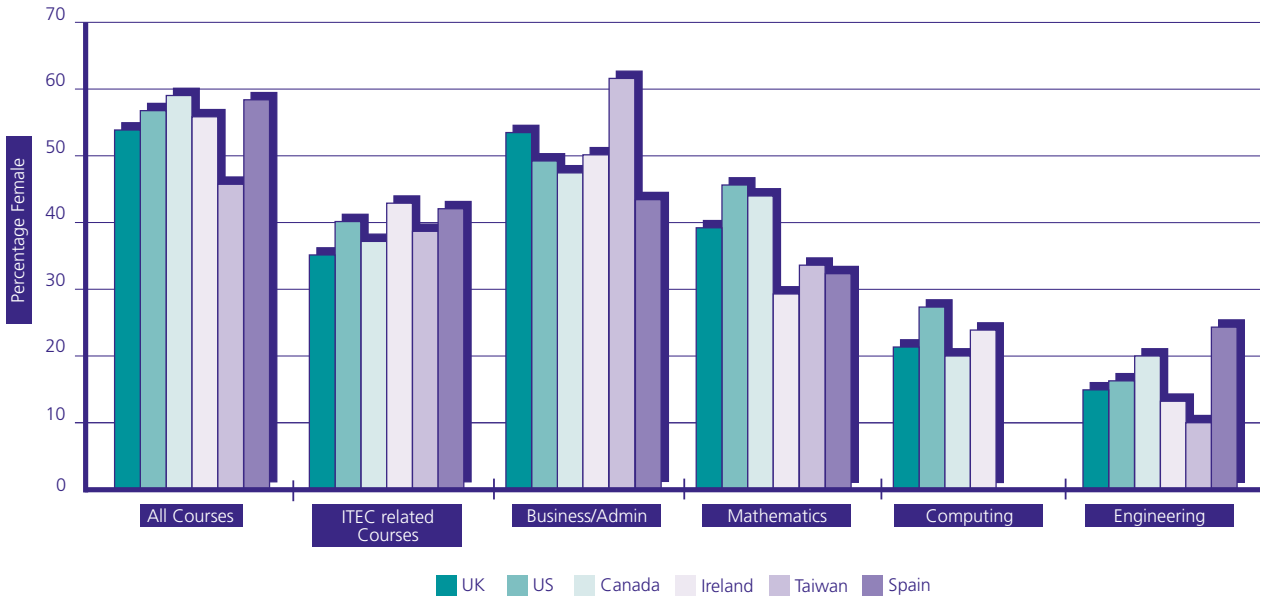
Table 2: Women graduates in ITEC-related subjects

Country	All courses (% female)	ITEC-related courses (% female)	Business/Admin (% female)	Mathematics (% female)	Computing (% female)	Engineering (% female)
UK	54 (1998/99)↑	35 (1998/99)↑	53 (1998/99)↑	39 (1998/99)↓	21 (1998/99)↓	15 (1998/99)(st)
US	56 (1996/7)↑	40 (1996/7)↑	49 (1996/7)↑	46 (1996/7)↑	27 (1996/7)↓	16 (1996/7)↑
Canada	59 (1997)↑	36 (1997)↑	48 (1997)↑	44 (1997)↑	20 (1997)↓	20 (1997)↑
Ireland	55 (1998)↑	42 (1998)↑	50 (1998)↑	29 (1998)	23 (1998)	13 (1998)
Taiwan	47 (1998)↑	37 (1998)↑	61 (1998)↑	34 (1998)↑	Combined with maths.	10 (1998)↑
Spain	58 (1996/97)↑	41 (1990/91)↑	44 (1990/91)↑	33 (1996/97)↓	Combined with maths.	25 (1996/97)↑

(date) ↑ = proportion of women has increased to this date
(date) ↓ = proportion of women decreased to this date
(st.) = proportion of women is relatively stable
Note: See Part B country chapters for details.

In Taiwan and the UK, women are the majority of business and administrations graduates. The high proportion (61 per cent) of women graduates in business and administrations in Taiwan is outstanding (Table 2).

Figure 1: The proportion of women among ITEC graduates



Source: Table 2. Note: In Taiwan and Spain, data on mathematics are combined with computing. Note also that the data refer to various years. See Table 2 and Part B country chapters for further details.

In other countries, with the exception of Spain,[25] the participation of male and female graduates in business and administrations is almost equal.

[25] The relatively low proportion of women among graduates in business and administrations in Spain may be due to the use of data from 1990/91 to construct this analysis of the participation of women in ITEC-related courses in Spain

The proportion of women mathematical science graduates varies considerably between countries. For example, in the US and Canada there are high and rising proportions of women graduates in mathematics but these proportions are low and in decline in the UK. The percentages of women mathematics graduates are lowest in Taiwan, Spain and Ireland. In Taiwan and Spain the data on mathematics includes computing.

There are proportionally few women computing graduates and their numbers are declining. The US has the greatest proportion of female computing graduates followed by Ireland. The smallest proportions of women computing graduates occur in Canada and the UK. In Taiwan and Spain, data on female computing graduates includes mathematics.

In all countries, women make up a small minority of engineering graduates. Penetration into the graduate community in engineering appears to have posed particular problems for women in Taiwan and Ireland. However, where historical data enable the analysis of trends, the proportion of women engineering graduates appears to have been rising in all countries except the UK. The proportion of women graduates in engineering-related subjects is highest in Spain – 25 per cent, followed by Canada (20 per cent), the US (16 per cent), the UK (15 per cent), Ireland (13 per cent) and Taiwan (10 per cent).

2.2 The participation of women in ITEC occupations in six countries

Headlines:

- The participation of women in the ITEC sector is lower in the UK than in all the other countries except Spain.
- Women are severely under-represented in ITEC occupations, and their participation in ITEC jobs has been declining.
- In the UK, the proportion of women in ITEC occupations is much lower than in the US, Canada and Ireland.
- Women's employment in ITEC sub-sectors in the UK is skewed towards broadcasting services. They are very poorly represented in the IT services, telecommunication services and electronics manufacturing. The US, Canada and Ireland perform better in electronics and IT services.
- Women in ITEC jobs generally appear to have lower status and in the UK and the US women are paid less than men and the pay differential appears to increase with occupation status.
- In the UK, women in ITEC jobs are better educated than men.
- There are more opportunities for part time work in the US than in the UK. The proportion of men and women working part time are more similar in the US than in the UK. This may be having a more positive impact on the acceptance of flexible forms of working in this country than in the UK.
- Women in ITEC jobs are on average 4 years younger than the men so age may also be discriminating against women in ITEC employment in the UK who delay entry into an ITEC career for example because of care for children and/or dependants.

This section compares and contrasts the participation of women in employment in different countries. It focuses on women in ITEC occupations in the ITEC sector, as well as in other, non-ITEC sectors in the six different economies.

Women's employment in the ITEC sector

Table 3 (and Figure 2) show that women are well represented in employment generally but are under-represented in the ITEC sector in countries where there is a broad range of economic activities, such as Canada, the US and the UK. In these countries the participation of women in the ITEC sector is lower than would be expected given their participation in other, non-ITEC sectors or in the wider economy (i.e. all sectors). For example, in 2000 in the US, almost equal proportions of men and women were employed yet

women accounted for only 37 per cent of those in the ITEC sector. In the UK in 2000, and in Canada in 1996, women made up 45 per cent of all employees but only 28 and 38 per cent respectively of ITEC sector employees. The participation of women in the ITEC sector is lower in the UK than in all the other countries except Spain.

Table 3: The participation of women in ITEC employment

Country	Employed in all sectors (all occupations) (% female)	Employed in ITEC sector (all occupations (% female)	ITEC-related jobs in ITEC sector (% female)	ITEC-related jobs (all sectors) (% female)	ITEC-related jobs non-ITEC sector (% female)
UK	45 (2000)	28 (2000)	9 (2000)	13 (2000)↓	18 (2000)
US	47 (2000)	37 (2000)	21 (2000)	28 (2000)↓	34 (2000)
Canada	45 (1999)↑	38 (1996)	–	21 (1996)↓	–
Ireland	41 (1999)	35 (1999)	–	19 (2000)↓ (est.)	–
Taiwan	43 (1999)	51 (1999) (st)	–	–	–
Spain	36 (1999)	27 (1999)	–	7 (1999)↓	–

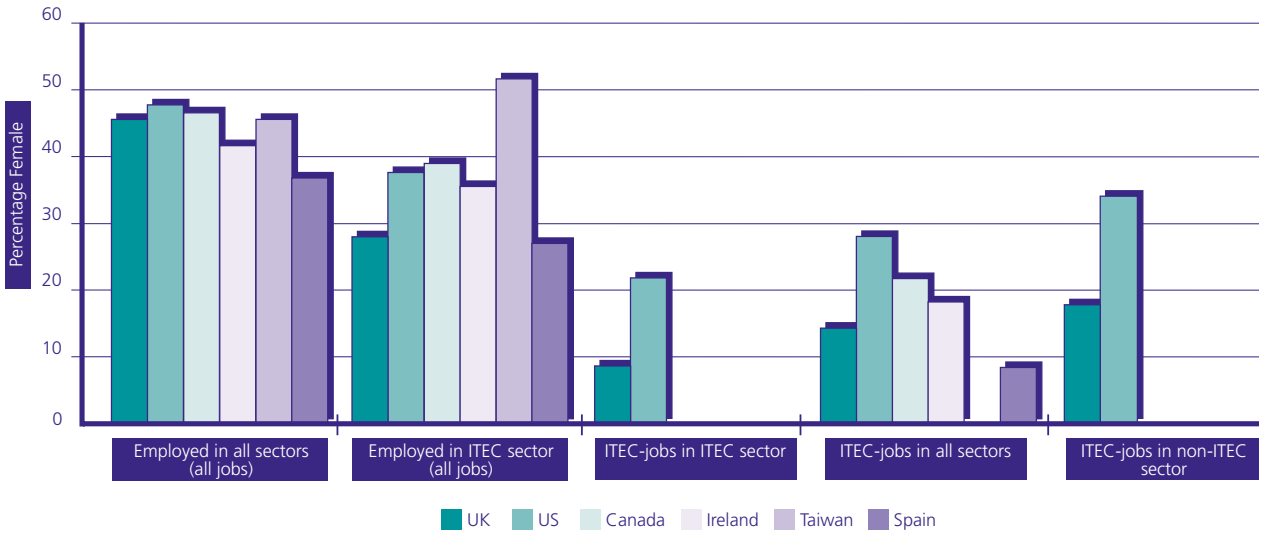
Notes:
(date)↑ = proportion of women has increased to this date
(date)↓ = proportion of women decreased to this date
(date) = latest data included in the analysis
(st.) = proportion of women is relatively stable
Limited data are available on the relationship between occupation and sector

Smaller proportions of women were employed in 1999 in Ireland and Spain, where women represented 41 per cent and 36 per cent of the workforce respectively. These two countries have a more limited range of economic activity[26] than the UK and the US, for example, and they are historically Catholic. In Spain these factors, together with high unemployment, reduce the employment prospects for women, reinforce the general trend towards the under-representation of women in the ITEC sector and depress the proportion of women in ITEC jobs to a mere 7 per cent.

In Ireland, which is approaching full employment, the ITEC sector is a major employer of women. The proportion of women in the ITEC sector in Ireland is only marginally lower than in the whole economy. In Taiwan, a tiger economy specialising in microelectronics manufacture and with abundant assembly work – typically lower status, low skilled and non-professional work with limited career prospects, women are the majority of ITEC sector employees.

[26] In the Spanish economy, for example, there are a large number of small and medium sized enterprises (SMEs) in traditional industrial sectors. These firms make more limited use of ITEC technology and ITEC skills than large enterprises and firms in technology intensive sectors.

Figure 2: Women in ITEC employment



Source: Table 3 (see Table 3 notes above).

Women in sub-ITEC sector industries

Comparisons between the industrial distribution of women's employment (all occupations) within the ITEC sector (Figure 2, Table 4) show the relatively high proportions[27] of women employed:

- in broadcasting services in the UK, Canada and Ireland
- in electronics manufacturing in Taiwan, Ireland and the US
- in telecommunication services in the US and Canada
- in IT services in Taiwan, Ireland and Canada.

Table 4: Women in ITEC sub-sector industries (all occupations)

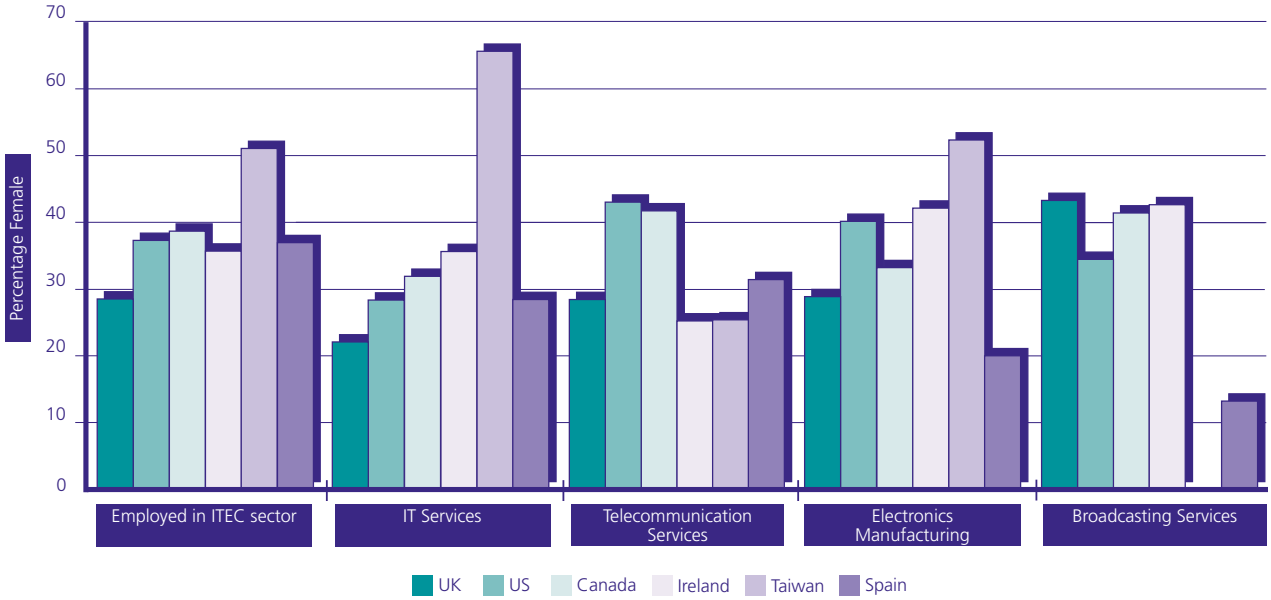
Country	Employed in ITEC sector (all occupations) (% female)	IT Services (all occupations) (% female)	Telecommunication Services (all occupations) (% female)	Electronics Manufacturing (all occupations) (% female)	Broadcasting Services (all occupations) (% female)
UK	28 (2000)	23 (2000)	28 (2000)	29 (2000)	44 (2000)
US	37 (2000)	29 (2000)	43 (2000)	40 (2000)	35 (2000)
Canada	38 (1996)	32 (1996)	42 (1996)	34 (1996)	41 (1996)
Ireland	35 (1999)	34 (1999)	25 (1999)	44 (1999)	42 (1999)
Taiwan	51 (1999) (st)	66 (1999)	25 (1999)	52 (1999	-
Spain	27 (1999)	21 (1999)	34 (1999)	21 (1999)	19 (1999)

Note: See Part B country chapters for further details.

Focusing on the UK (and excluding Spain where there is very high unemployment) the low proportion of women employed in the ITEC sector and in IT Services in particular, is outstanding within the group (Figure 2, Table 4). The proportion of women employed in telecommunication services and electronics manufacturing in the UK is also among the lowest in the cluster of countries studied (Figure 3, Table 4). Very few of these women are engaged in ITEC jobs (Figure 2, Table 3).

[27] Higher than the average proportion of women employed in the ITEC sector in the country.

Figure 3: Percentage female in ITEC sub-sector industries



Source: Table 4
See Table 4 and Part B country chapters for further details.

The high proportion of women in telecommunication services in the US and especially in the US Postal Service (44 per cent) merits special attention. In the US, the postal service has been a major progressive force for minority employment. Given that there is male bias in the recruitment process it is all the more remarkable that women do so well.

Women in ITEC occupations

Women are severely under-represented in ITEC occupations in all six countries. With the exception of Spain (where there is little industry and high unemployment) and Taiwan (for which data are not available) the proportion of women in ITEC jobs is much smaller in the UK than in the other three countries (Table 3, Figure 2). In all countries, including those where there has been long term concern about the relationship between women, ITEC and employment such as Canada and the US, the proportion of women in ITEC occupations has been declining.

In the UK and the US it is possible to separate and compare the proportions of women in ITEC occupations inside and outside of the ITEC sector. In both countries, there are smaller percentages of women in ITEC occupations inside the ITEC sector than there are outside the ITEC sector.

In the UK, a mere 9 per cent of those in ITEC jobs within the ITEC sector are women – the large majority of women in the ITEC sector in the UK are not in ITEC occupations but work in lower skilled, non-professional occupations that have limited career opportunities, such as, clerical jobs, as assemblers or in sales. Compared with the UK, women in the US are well represented in the ITEC sector where they account for about a fifth of ITEC occupations.

In other, non-ITEC sectors there are higher proportions of women in ITEC jobs than in the ITEC sector. For example in the UK, 18 per cent of those in ITEC occupations outside the ITEC sector are women and in the US, 34 per cent (Table 3). Women in the US seem to have been considerably more successful than women in the UK in engaging with ITEC and penetrating into ITEC occupations – both in the ITEC sector and outside the ITEC sector.

The chronic under-representation of women in ITEC employment and the relative absence of women in certain ITEC industries and ITEC occupations – notably those that involve engineering – appear to be

common features of ITEC work across all countries. In general, the situation appears to be better for women in the US, Canada and Ireland than it is in the UK and more women have been able to penetrate ITEC occupations in these other economies.

Focus on the US and the UK, where additional data analysis has been possible, reveals further inter-country differences. There are more opportunities for part-time employment in the US than in the UK, both in the ITEC sector (12.2 per cent in the US, 10.7 per cent in the UK) and in ITEC occupations (13.9 per cent in the US, 4.1 per cent in the UK).

Further, in the US there is a more egalitarian distribution of part-time work. In the US, 9.8 per cent of men and 16.4 per cent of women work part-time in the ITEC sector against 4.9 per cent of men and 25.8 per cent of women in the UK. Similarly, in the US 12.2 per cent of men and 18.3 per cent of women in ITEC occupations work part-time, whereas in the UK the figures are 2.3 per cent for men and 15.7 per cent for women. The more balanced dispersion of part-time work between men and women in the US may have a positive impact on the acceptance of non-standard forms of employment among the workforce and this might contribute towards raising women's participation in the ITEC sector and in ITEC jobs.

Women account for the majority of those in relatively low status ITEC jobs in the US and the UK, such as telephone operators or data processing equipment installers and repairers (where data are available for other countries, they tend to support this finding). Even though there are relatively more women in some professions, such as computer programmers and computer systems managers, women are chronically under-represented in ITEC jobs that are key to the creation and design of technical systems.

The ITEC sectors in the UK and the US employ much higher proportions of graduates – particularly male graduates – than other sectors.[28] However, not all employment in the ITEC sector requires a degree – there is intensive employment of women without a college education in the ITEC sector in both countries.

Women in ITEC jobs in the UK and the US[29] are paid less than men and the differential between their salaries appears to increase with professional status in the UK and with experience/time in ITEC jobs in the US.[30] For example, in the UK in the two ITEC occupational categories[31] where women are relatively well represented – computer system managers and computer analysts/programmers – the median gross hourly salaries[32] of the women are between 86 and 79 per cent of those of the men.

In the UK and the US, the low status of women in ITEC jobs is paradoxical because women in ITEC jobs are slightly better educated than men.[33] Most graduates (62 per cent) in ITEC jobs in the UK have not graduated in an ITEC-related subject. It would seem that there are many more routes for women to enter an ITEC career than through graduation in an ITEC-related subject.

In addition, age appears to be discriminating against women in ITEC occupations in the UK. Women in ITEC jobs are, on average, four years younger than men, three years younger than employees in the ITEC sector and five years younger than people working in other, non-ITEC occupations. This might have a negative impact on women who delay entry into an ITEC career, for example because of care for children and/or other dependants, migration into ITEC from another, non-ITEC, occupation or efforts to re-skill in an ITEC area.

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[28] In the UK, 27 per cent of the men and 20 per cent of the women in the ITEC sector are graduates, whereas in other sectors 16 per cent of males and 14 per cent of females are graduates. In the US, 43 per cent of the men and 29 per cent of the women in the ITEC sector are graduates compared to 26 per cent in other, non-ITEC sectors.

[29] The Internet Workforce Compensation Study 2000, observed a 24 per cent discrepancy between men's and women's salaries in 'new economy jobs' in the US, and that women receive only a proportion of the bonuses that are awarded to men. A techies.com survey of more than 100,000 technology professionals found that the wage gap increased with experience.

[30] It might be expected that there would be a relationship between time/experience in an occupation and occupational status.

[31] Reliable Labour Force Survey data on salaries by gender are only available for these two occupational categories.

[32] Data on median salaries are used in order to counter the tendency for the results to be skewed by a few very highly paid individuals. In addition, the data relate to gross hourly wages, rather than monthly or yearly salaries in order to account for differing work patterns, e.g. part-time work.

[33] More women than men in ITEC occupations in the UK are graduates (45 per cent, compared to 39 per cent for men) and the US (44 per cent for women, 42 per cent for men).

3. Encouraging the participation of women in ITEC courses and careers

This chapter provides insights into the factors that appear to combine together negatively to influence the propensity for women to embark on and progress within ITEC careers and to affect the status of women in ITEC jobs. It also highlights some of the practical initiatives that have been implemented in the UK and elsewhere in order to try to improve the situation for women. Particular attention is directed towards initiatives in Canada, Ireland and the US where the situation for women in ITEC courses and careers appears to be better than in the UK.[34] In Spain there is high unemployment and the strong female participation in ITEC-related courses has not been translated into ITEC careers.

However, the participation of women in ITEC occupations has been declining in all the countries in the study (excluding Taiwan for which data are not available) – even in those where there has been active intervention to counter this trend. Many of the initiatives to stimulate female participation in ITEC courses and careers are fragmented, uncoordinated and lack focus; often they seem to be 'old wine in new bottles'.

The chapter is based on information derived from interviews with a small number of key respondents (for example, subject matter experts, employer representatives, members of industry-specific professional bodies). This is coupled with a review and analysis of the literature from government, professional[35] and academic sources[36] that relates to the gender and employment relationship in ITEC.

These two main streams of information are pooled here to inform suggestions for policy and practice that might have a positive impact on women's participation in ITEC jobs. This synthesis is necessary because most of the literature in the area has only a partial focus. For example, it typically concentrates only on particular parts of the ITEC sector and selected ITEC occupations such as computing, information technology (IT), or information and communication technology (ICT) related work. This focus is often at the expense of electronics manufacturing where, in the UK, women's participation has been shown to be small and broadcasting services where the level of women's participation in employment (although not in ITEC occupations) in the UK is particularly high (Part A, Chapter 2). In addition the literature typically fails to isolate factors that appear to discriminate against women and that are peculiar to ITEC-sector work, and there are few comparative studies of gender and technology relationships that span sectors and occupations.[37]

This chapter is organised in five sections. Section one provides contextual information on each of the countries included in the study. Sections 2-5 address the four overriding themes that are critical to improving the position of women in ITEC:

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[34] See Part A, Chapter 2.

[35] Government and professional literatures in this area tend to be very practical. Typically they address straightforward questions. For example: why do there appear to be so few women in technologically sophisticated jobs and, assuming that this is the case, what can be done about it?

[36] The academic literature is more diverse. Most of this literature can be divided into four streams (Faulkner, 2000). 1. 'Women in technology', where the focus is on gender equity in technology-related employment. 2. 'Women and technology' where the focus is on the gender-technology relationship, and consideration is given to women as users as well as designers of technology. 3. 'Men, masculinity and technology' which embraces feminist studies of masculine gender identity and its interaction with their use of technology. 4. 'Gender and technology', which provides feminist interpretations of the gender technology relationship that are premised on a) a need to understand relations between men and women, as well as those between women and men in order to understand the dynamics of gender and employment, and b) an understanding of technology and technology-gender-employment relationships as being socially constructed.

[37] Despite these limitations, the literature does make a critical contribution towards the development of a comprehensive understanding of the social and cultural nature of gender-technology-employment relationships in general, and of the gender/ITEC-education/ITEC-employment relationship in particular. Without such understanding, attempts to intervene and change those relationships in order to promote a more egalitarian distribution of opportunities for employment and career development in the sector are likely to be ineffective.

- Access and education
- Education and recruitment
- Recruitment and employment
- Employment and retention.

Each of these sections discusses the main factors that appear to have an impact on women in ITEC jobs, and provides examples of initiatives that have been put in place in order to tap women's skills more appropriately within the labour market.

3.1 Contextual information on the countries included in the study

Some understanding of the different socio-political and economic contexts in the countries involved in this study is critical to appreciating variations between them in terms of:

- the pattern, scope and scale of women's participation in ITEC, and
- their various priorities for the development of initiatives to improve women's access to ITEC skills and employment.

The UK

The UK economy exhibits a range of industrial and commercial activities. As a result, the impact of ITEC technologies may be expected to span a variety of sectors.

Education in the UK is compulsory between the ages of 5 and 16, although opportunities for full- and part-time further and higher education extend beyond this. School and further education is either publicly funded or fee-paying. Higher education (study above GCE A Level) is provided through the universities and colleges and institutions of higher education.

The years spent in schooling in the UK are about average among OECD countries, as is the proportion of adults in tertiary education (OECD, 1998). However, participation in upper secondary education is above the OECD average.

The relative significance of the ITEC sector in the UK economy increased from 5 to about 7 per cent of GDP between 1993 and 1997 (OECD, 2000a). The main driver of this growth was the wholesale of ITEC products. Employment was high and growing in the IT Services industries and was high too in manufacturing related sub-sector industries. Use of ITEC technologies rose substantially between 1996 and 1998: in 1998 44 per cent of the population had a home PC. However, in 1998 only 28 per cent of the population had used the Internet and only 16 per cent had Internet access from home.

There has been some increase in the support provided by the state for women in employment. For example, the 'New Deal' for lone parents. However, the high cost and lack of tax-deductible childcare are typically cited impediments to the participation of women in employment and employment-related training.

While skill shortages are declining, there is still a critical scarcity of particular ITEC skills in the UK economy. These are believed to be in technical areas that are associated with the development of e-commerce and the Internet and in more generic areas such as those related to problem-solving and inter-personal communications.

The US

In most US states, education is compulsory between the ages of 6 and 16, following which there are opportunities for further (high school) and higher (university/college) education. Both state and private options are available.

Opportunities for adult education have expanded rapidly in the past 15 years – partly to meet additional certification requirements in particular fields such as health and education. Among OECD countries, a high

proportion of the population in the US spends above average lengths of time in education – and participation in upper secondary and tertiary education in the US is among the highest (OECD, 1998).

ITEC is generally considered to be one of the most important sources of growth in the US economy. However, the contribution of ITEC to GDP in 1998 was modest (7.8 per cent) but had grown since 1993 (6.1 per cent). Nevertheless, in the 4 years between 1995 and 1998, output growth among ITEC-related industries accounted for over a third of growth of real output in the US economy (OECD, 2000a). Between 1990 and 1998, ITEC-related industries accounted for more than 1.1 million new jobs – especially in IT services. In 1996, ITEC-related occupations accounted for 7.3 per cent of total employment (OECD, 2000a). Computer use (including Internet access) is widespread at work, at school and in the home and the community.

The US has longstanding policies to protect and encourage the participation of women in education and employment.[38] Concern that ITEC skills were becoming scarce within the US economy (Department of Commerce, 2000; Information Technology Association of America, 2000b) fuelled a range of initiatives, for example, to improve the responsiveness between higher education and industry and to increase the participation of men and women in ITEC careers.

However, the socio-political and economic situation in the US has recently changed. Economic downturn has accompanied the failure of many high technology (e.g. dot.com) companies. According to one respondent, in the current environment small companies that had made big promises to women in order to entice them into employment when skills were scarce are now clawing back these benefits.

Canada

In Canada, compulsory education extends from 6 or 7 until 15 or 16 years of age and from there students may enter into further and higher education. There is considerable variation in the structure of the education system among provinces and territories. A high proportion of the Canadian population spends above average (among OECD countries) time in schooling, and the percentage in tertiary education, in Canada, is substantially higher than elsewhere (OECD, 1998).

The expanding significance of the ITEC sector in Canada in terms of its contribution to GDP (4.6 per cent in 1993, 5.9 per cent in 1997) has not been matched by its share of employment. Employment in the ICT sector, while it is growing – driven mainly by expansion in computer and software services – accounts for 3.5 per cent of total employment (OECD, 2000a). Employment in telecommunication services and in ICT manufacturing has declined (OECD, 2000a). There are high levels of penetration and use of ICT (including the Internet) in industry, education, the home and the community.

Women have been high on the political agenda in Canada for a number of years, and the policy environment surrounding the need to advance the status and economic autonomy of women in society is relatively well developed (Status of Women Canada, 1995). Pro-women initiatives that have been targeted towards employment, for example, include schemes to promote pay equity, employment equity, comparable worth, flexibility and diversity in the workforce (including for example, in some provinces the provision of low cost ($5 a day) childcare) and participation in the cultural industries and broadcasting.[39] Despite these interventions, the proportion of women in ITEC occupations declined between 1991 and 1996.

Women are the majority (59 per cent) of students at university and they are considered by some to be relatively well represented on ITEC courses (36 per cent) and in careers in the ITEC sector (38 per cent). According to a recent Status of Women Canada discussion paper 'one thing seems clear: basic computer literacy is not a problem' [emphasis removed] (Menzies, 1998).[40]

[38] For further details about the participation of women in ITEC education and employment in the US, see Part B, Chapter 2.

[39] This is developed though agencies such as Telefilm and the National Film Board (NFB). The NFB is home to the forum for women film makers and the Federal Women's Film Program (FWFP). The proportion of women in the broadcasting services sector in Canada is 41 per cent (Part B, Chapter 3).

[40] Although this interpretation is contested. See, for example, (Balka et al., 2000)

Although there is a groundswell of concern regarding the low proportion of women in ITEC occupations [41] and gender imbalances on the internet (Balka *et al.*, 2000; Kaplan *et al.*, 1994), considerably more attention is being directed towards understanding the recent 2.7 per cent decline in aggregate labour force participation, and particularly among men (Fortin *et al.*, 1999).

Ireland

The ITEC sector and ITEC occupations (especially those within the ITEC sector) in Ireland are expanding at a rapid rate. Expansion has been driven by national policies for building the industry, including encouraging foreign direct investment and the provision of favourable corporate locations (low inflation, tax concessions, low costs) (OECD, 2000a).

Low levels of unemployment (around 5 per cent), and a high and rising demand for ITEC skills (especially software development, project management and multi-media skills) have led to a range of initiatives that are designed to attract people, including women, into ITEC careers and to remove disincentives[42] to women's participation in employment. For example, the government has developed policy initiatives to enhance the provision of childcare in order to encourage women returnees to employment and has used taxation policy to improve women's access to the labour market. The proportion of women in the ITEC sector is almost the same as the proportion in employment.[43]

The focus then, given the tight labour market for ITEC skills in Ireland, is on stimulating participation in ITEC education,[44] for example, by increasing awareness of ITEC among the school and college population, widening participation in ITEC at university level and encouraging the migration of skills from other subject areas into ITEC, for instance, through the provision of transition courses.

Attention is also directed towards assisting the immigration of ITEC skills into the economy. Ireland has implemented a three-pronged approach. It has a working visa system, a work permit system and a system by which representatives proactively seek trade in skills with firms in countries such as Australia, Africa, the UK, and Central and the countries of Eastern Europe.

The links between education and employment in Ireland are fairly direct. A high proportion of graduates in ITEC-related courses go on to employment in ITEC and so it has been possible to effectively target courses to particular jobs. However, it has been difficult to locate and educate sufficient numbers of students.

Ireland lags behind other European countries in the integration of ICTs into teaching and education and the education system has been the focus for recent reform. There is an absence of science education at primary level and the proportion of women among students taking science-related subjects at secondary level is very low and has been declining. However, there is concern that it is the efforts to stimulate participation in IT among school leavers that have reduced, and are therefore weakening, participation in science and engineering.

Taiwan

The Taiwanese economy is divided between a dynamic electronics sector and a more 'sluggish' traditional industries and services. The position of women in employment is similarly divided. Traditional ideologies about women, stereotyping, and gender discrimination in education[45] and the labour market have played roles in the location of women in employment in Taiwan (Taiwan Women Web, 2000). More recently, however, growth of the 'new knowledge noblesse' and shortages of key skills in the economy have been stimulating change.

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[41] Women make up 21 per cent of the ITEC workforce in Canada. While women represent 47 per cent of computer operators and 30 per cent of computer systems analysts, their participation in some jobs is almost negligible. See Part B, Chapter 3 for further details.

[42] Including political and religious disincentives, for example, notions of appropriate courses, careers and futures for Irish women and girls.

[43] See Part B, Chapter 4.

[44] Women represent 42 per cent of graduates in ITEC-related subjects in Ireland.

[45] Some elements of this can be observed in the pattern of women's participation in ITEC education and employment. See Part B, Chapter 5.

According to a recent Financial Times Survey, 'High-tech products account for more than 30 per cent of Taiwanese exports and output from the electronics and information technology sector climbed more than 22 per cent year-on-year in the first seven months of 2000, double the increase in overall industrial output' (Dickie, 2000). However, in these sectors shortages of skilled labour are forcing production offshore.

In this context, the government has implemented a new programme to promote the well-being of women, including school subsidies for parents and assistance with domestic responsibilities, in order to increase the labour participation rate of women by enabling them to pursue careers after marriage and parenthood (Hsu, 2000).

Spain

The economy in Spain has undergone a transformation in recent years. Economic growth (especially growth in the telecommunications industry following market liberalisation and de-regulation, and participation in the EU) and employment have increased along with business confidence and investment. Industry in Spain is characterised by a high proportion of small and medium sized enterprises (SMEs) in areas that are less dependent on ICTs than larger firms. As a result, the demand for ITEC skills has been relatively low in comparison to other European countries (EITO, 2001).

Nevertheless, unemployment is still the highest among OECD countries (15.9 per cent) [46] (Joumard, 2000). Limited opportunities for employment generally and the impact of traditional cultural and religious values and segmentation of the labour force[47] are the main barriers to women's participation in ITEC employment in Spain.[48]

3.2 Access and education

In all of the countries included in this study, there is a discernible trend towards low participation that pervades further education, higher education and employment in ITEC. Achieving the engagement of women with ITEC, at all stages of transition from early education to employment, is clearly problematic. Yet, developing ITEC literacy among girls and women is critical to their ability to play a productive role in the emerging economy. Increasing attention is being directed towards:

- understanding the early roots of gender differences in computer use
- developing initiatives to build ITEC literacy among women and girls.

This section reviews some of the evidence about the roots of gender differences in computer use and highlights some practical initiatives that are in place to strengthen interest in ITEC among women and girls.

Understanding the early roots of gender differences in computer use

Evidence shows that people form attitudes towards ITEC early in life, and experiences in the home, for example with computer games that are designed primarily for the male market, or through exposure to magazine adverts for technology that show women in secretarial, or merely decorative roles, are critical in determining women's later reactions to and interactions with technology (Miller *et al.*, 2000).

Other studies confirm that many computer games portray a 'macho'[49] culture that may be alienating to girls (Provenzo, 1991), and also that sex stereotyping is observable in a large proportion of educational software (Cooper *et al.*, 1990).

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[46] The average among OECD countries is 6.7 per cent.

[47] Most women are employed in low paid 'ghettos' in the manufacturing and services sectors. They are under-represented in higher status occupations. This is not attributable to educational differences, women are at least as well qualified as men (Lawlor et al., 1998).

[48] Only 7 per cent of those in ITEC occupations are women. For further details, see Part B, Chapter 6.

[49] Properly, the term 'macho' has to do with a code of honour that is socially constructed and reinforced so that individuals do crazy things in response to challenges rather than suffer a loss of self-esteem. More commonly, it is the fascination with power and control that underlies the programmer culture that women may negatively respond to.

In school, particularly by the time students reach secondary level, computing is seen as a 'male preserve' and boys assume ownership over the technology. This has a negative impact on women's and girl's 'psychological access' to ITEC technology and on their attitudes and beliefs regarding computers and information systems in general (Miller *et al.*, 2000).

Across the school age range, girls (and female teachers) are less likely to engage with computers than boys, not only at school but in other settings too, including the voluntary use of computers.

> 'Certainly girls often seem to be a good deal less enthusiastic about computer use than boys. Surveys suggest that more girls than boys have negative attitudes towards computers right across the school age range ... A substantial proportion of both boys and girls seem to regard use of the computer as being 'more appropriate' for boys than for girls, and believe that boys like and use computers more than girls do.' (Light *et al.*, 1999).

In the home, evidence suggests that women and girls are less likely than men to use a computer and are generally less aware of its potential usefulness to them. Lack of technology use, together with the ownership that males assume over the technology and its impact on women's and girl's psychological experiences of access to technology, combine to depress their inclination to exploit opportunities to engage with ITEC. Negative reinforcement through media and advertising channels regarding the relationship between females and ITEC aggravates the situation.

One implication is that young women may be excluded from opportunities for lifelong learning that might be provided, for example, through the Internet, and from opportunities for sustainable participation in the emerging Information Society.

Another is that women may be under-represented among the group of 'advanced domestic users' that is created through the widespread domestic use of ITEC, and that is considered to feed into the design and innovation of new technological systems (Fagerberg, 1998). The absence of women from activities that are integral to the design of ITEC systems is cause for concern. It has negative implications for the structure and design of those technologies (Green *et al.*, 1993), and may be expected to have contributed towards reducing women's propensity to interact with them.[50]

Building ITEC capabilities among women and girls

A range of initiatives is being created and implemented in order to build ITEC literacy among women and girls so that they might be better placed to exploit opportunities for engagement with ITEC technologies in later life. This section highlights three examples of initiatives in Ireland, Canada and the US.

In Ireland, education has traditionally been segregated by gender, and science as a compulsory subject has been removed from the curriculum in order to make room for Irish language. Religious influence over the education of girls in Ireland is still strong. Many girls' schools do not teach 'hard science' – mathematics and science are considered to be subjects appropriate for boys. Even when these subjects are available to girls, for example, in mixed schools, girls may not select them because of the influence of parents and peers. About a quarter of girls never do science at school, and 'Ireland lags significantly behind its European partners in the integration of information and communication technologies (ICTs) into first and second-level education' (Ireland, 2000). One initiative that is attempting to improve this situation is the School IT 2000 project that is directed towards all students in school and their teachers.

[50] The view here is that the design of software provides an architecture for participation that has consequences for learning and identity, performance with software is a response to this design, and change in design can alter performance. This view is not new (e.g. see Wenger, 1998) and it has been used to refute claims that gender differences in performance with software reflect immutable differences in the cognitive capabilities of men and women and boys and girls (Light et al., 1999).

The Irish government in partnership for learning: School IT 2000

The government has devoted £40million to develop a national partnership for learning that involves schools, parents, local communities, third-level colleges, and public and private sector organisations. There are four main strands of the School IT 2000 programme:

- the Technology Integration Initiative – to develop technology infrastructure in Irish schools, connect every Irish school to the internet
- the Teaching Skills Initiative – that aims to increase the ICT capabilities of teachers,
- the Schools Support Initiative – to assist in the development and use of effective ICT-based tools in the curriculum and enhance learning through the use of ICTs in class
- the School Integration Project – to assist with the identification of additional and complementary policy, training and support models.

A similar initiative funded by the Social Sciences and Humanities Research Council (SSHRC) in Canada, the GenTech Project, has the explicit aim to promote gender equity, in particular public school contexts, within the 'new information technologies' domain. The initiative was informed by the results of research into gender, access to and uses of ICTs which indicated that in public schools, female staff and students were more likely than their male counterparts:

- to be disenfranchised regarding access and use
- not to acquire technical competence
- to be discouraged from assuming a leadership role in relation to ICTs.

Public-private partnerships for women's education in Canada – The GenTech Project (1996-1999)

The GenTech Project is a collaborative research initiative at the University of British Columbia and Simon Fraser University that also involves the Richmond School District and Hewlett-Packard (Canada). The project studies non-school based environments in which women experience unusual levels of success with ICTs. The results of this are fed into the development of a model for the implementation of 'micro-climates' within schools that is encouraging and supportive for girls and their female teachers in their technology-based work. So far, the project has

- established a 'Girls First' computer centre at one elementary school site
- provided students and staff in three schools with basic computer literacy skills, including web page design and multi-media authoring
- developed an on-line instructional resource for GenTech teachers, with assistance from government
- created an extensive project website (http://www.educ.sfu.ca/gentech)

In both of these examples the focus is on the dynamics of the relationship between technology, teaching and education. They embrace the need to:

- develop the skills and capabilities of teachers alongside those of pupils
- devise new pedagogies and educational materials that are associated with ITEC use
- support, sustain and develop the initiative through providing access to a wider networked community of users.

However, the GenTech Project addresses this relationship from a gender and a pro-female perspective.

In the US, the AAUW Educational Foundation Commission on Technology, Gender, and Teacher Education's report *'Tech Savvy: Educating Girls in the New Computer Age'* has produced a series of recommendations to counteract the problems that they believe begin in the home and classroom and are turning girls away from computer science. The report argues that 'instead of trying to make girls fit into the existing computer culture, the computer culture must become more inviting for girls' (AAUW, 2000). It has put forward a series of recommendations for ITEC education among girls.

Policy recommendations for girls in ITEC education in the US

- Integrate computing into the curriculum
- Re-define computer literacy in ways that make it more relevant to girls
- Respect multiple points of entry – through art and design, through mathematics – into computing
- Change the public face of women in computing to make it correspond with reality rather than stereotype
- Train 'tech-savvy' teachers
- Begin a discussion on equity for educational stakeholders
- Educate students about technology and the future
- Rethink educational software and computer games

The next section identifies the main barriers to women embarking on an ITEC career and highlights initiatives that are in place to overcome them.

3.3 Education and employment

In the UK the majority of women elect not to extend their education in ITEC-related subjects when they come to build their education profiles (post GCSE) towards a career. Evidence of the general under-representation of women among graduates in ITEC-related subjects, of the very low proportions of women engineering graduates and the low and declining percentages of women computing graduates emphasises the general trend. However, higher proportions of graduates in ITEC-related subjects – and more of the women than the men – than graduates generally (all subjects) enter employment directly after graduating. This section addresses the main barriers that prevent women pursuing a career in ITEC.

Changing the image of ITEC employment

The dominant image of ITEC in the UK is that the industry is populated by social misfits, compulsive 'bums', game-playing wizards, 'nerds', and geniuses who are almost exclusively white and male and who thrive in an environment that is alien, and alienating, to women (Department for Education and Employment, 1999b).

The intimate relationship that has grown up between computing and masculinity, and consequent perceptions of the insignificance of feminine knowledge, are considered to reinforce the exclusion of women from participation in the creation of new technology.

Many people in the ITEC industry and representatives of related professional bodies consider the image of ITEC employment to be a historical construction, a stereotype based on employment in computing that, while it may have been appropriate once, does not now reflect the reality and the diversity of ITEC occupations. For these people, dis-aggregating and updating the image of sub-sector employment is considered to be the key to promoting the participation of women and girls in ITEC courses and careers. According to one UK respondent, the negative image of the ITEC industry explains the low numbers of women in ITEC jobs:

> 'This is not traditional sex discrimination by male chauvinist pig managers. Now women are discriminating against the industry. The industry projects a poor image.' (from interview)

In support of this argument, in other countries the image of ITEC is less uniform than it is in the UK. For example in Ireland, where the participation of women in the ITEC sector and in ITEC-related occupations is higher than in the UK, the perception of electronics engineering, a key industrial activity, is that of the 'greasy engineer', a dirty job and not appropriate for women.

Initiatives are underway in the UK that aim to refine and refresh the public image of ITEC in order to assist women in their efforts to identify pathways to ITEC occupations. For example, the Equal Opportunities Commission is undertaking research to understand the impact of gender stereotyping on subject and career choices among women. Private firms and other professional institutions are using non-standard means (multimedia and targeted advertising, for example) to stimulate the interest of young women in ITEC careers. To the extent that these initiatives are successful, increasing numbers of women are expected to enrol on ITEC courses, and embark on ITEC careers.

'From a Microsoft perspective, within our marketing ... we have actively taken steps to use female models, and non-gender imagery. This is tricky, as the market we are selling in is heavily male dominated, so we tend to have to include both male and female to avoid alienating people. Where we have had people in recent campaigns, the ratio has been 50:50 and with a female lead. For example, an image of two surgeons, a female one in front of a male, promoting the concept of only using qualified people to work on your critical IT systems'. (from interview)

Identifying pathways into specific ITEC jobs

Contrary to the popular belief that ITEC occupations demand graduate skills in ITEC-related subjects, there are high proportions of people (especially women) in ITEC jobs in the US and the UK who have not received a college education and the majority of graduates in ITEC occupations in the UK have not qualified in an ITEC-related subject. Clearly, there is a range of alternative pathways into an ITEC career.

There is a general perception that women are not sufficiently aware of the benefits of ITEC employment, that they do not have realistic views of the variety of jobs on offer and have limited understanding of the skill requirements for entry into particular occupations – especially when these jobs are undergoing rapid change. Moreover, as the ITEC-related skill requirements of industry change, so do the pathways into ITEC occupations. For example, if the skills provided through the education system do not map onto the skills supplied through ITEC-related courses, the relative balance between the contributions of education, training and experience in employment to the development of ITEC skills will change.

A range of practical initiatives has been designed to improve women's perceptions about the relevance of an ITEC career that are felt to have made a positive difference to the participation of women in ITEC occupations. They include:

Publicity and Marketing initiatives

- the distribution of literature designed to provide information about ITEC careers to girls
- re-marketing of courses at university level, including the revision of course titles and descriptions in college prospectuses and their translation into natural language (avoiding the excessive use of jargon, for example)
- the development of programmes to attract people, including women, into electronics in Ireland and the UK.

Changes to the structure and content of university courses

- For example, in Ireland the removal of computer science courses from engineering departments in universities.[51]

[51] This was the result of research in the US into the factors that influenced a drop in the level of participation of women in computer science. The research found that the participation of women in computer science was worse in universities that located computing courses in their engineering departments.

Developing relationships with ITEC firms

- visits by local firms to schools and colleges. For example, the National Software Directorate in Ireland has implemented a campaign in Dublin to recruit about 50 women from local ITEC firms to speak to girls in single sex schools about their careers.[52]

Creating opportunities to integrate women into an ITEC community

- the creation of on-line forums for women in ITEC to share and exchange knowledge and experience (e.g. busygirl.com in the UK)
- mentoring programmes to encourage young women to stay on at school and continue studies in science, engineering and technology in order to pursue an ITEC career, for example, the 'Pathmakers' program in Canada
- the provision of opportunities for women to visit universities in order to get a feel for participation in ITEC courses, for example the 'Insight' programme that was initiated by the Engineering Industry Training Board (EITB) in 1979 and the Women into Science and Engineering (WISE) and WISE Outlook (for younger girls) initiatives (both now supported by the Engineering Employers Federation and EMTA, the national training organisation for engineering) in the UK
- the creation of female chairs in science and engineering in Canadian universities
- the creation of opportunities for work placements in ITEC firms (see the example below).

The **WTN (Women's Television Network) Foundation[53] in Canada** offers opportunities for girls and women to engage with careers in broadcasting through a range of education and training programmes. These include:

- **The Women's Technical Internship (WTNI) for recent post-secondary graduates – this is a programme that places graduates in technical apprenticeships and pays 50 per cent of their salary for the first six months (according to the Foundation website, in the second year of the programme, 100 per cent of the apprentices** were hired by their sponsoring employers at the end of the programme)
- The wtndowment fund to provide technology training for 'veteran' women with at least five years experience in the industry
- The Girls TV camp gives teenage girls considering a future in television experience in producing video
- Lesson plans for teachers 'who want to go high-tech'
- Teaching resources for creating learning opportunities for girls

Creating opportunities for skill conversion

The provision through the education system of opportunities for women to convert from one skill set to another are important when so few leave formal education with ITEC-related skills. In Ireland and Canada, for example, there is a more direct relationship than in the UK between the ITEC skills that are provided through education and the take up of those skills in ITEC employment. As a result, education initiatives to stimulate the supply of ITEC skills impact on participation in ITEC jobs.

In Ireland and Canada the participation of women in ITEC-related courses has been raised through the provision of joint/combined university courses that include an ITEC-related subject. These have enabled women to engage with ITEC while pursuing more familiar course options and have introduced elements of other disciplines into pure ITEC courses.

[52] There has been some criticism of this initiative with has grown out of the feeling that girls are more severely disadvantaged in mixed education.

[53] The WTN Foundation was awarded its broadcast licence in 1994.

The availability of conversion courses that enable graduates to migrate to an unrelated course (for instance, ITEC) offer the potential for women to embark on an ITEC career path. However, skill conversion delays participation in the labour market. The provision of opportunities for skill conversion, therefore, are unlikely to have a major impact on the participation of women in ITEC occupations in the UK unless complementary initiatives are developed to combat any discrimination against women in ITEC jobs on the basis of age.

Creating multiple points of access to ITEC literacy

Technological change and lifelong learning go hand in hand in the emerging digital economy. It is estimated that 80 per cent of the European labour force will require re-training in order to sustain their employment in the near future (Mercer, 1999).

Better co-ordination and integration between the supply of skills, especially ITEC-related skills, through education and training services and the needs of employers is being promoted in order to maximise the positive effects of the relationship between employment growth and the 'knowledge triangle' (education, innovation, technology) that is strongly linked to employment and growth (European Commission, 2000).

However, the availability of opportunities for, and the high costs of, skill acquisition in ITEC (Department for Education and Employment, 1999b) and the responsibility for meeting these costs, are often cited as barriers to women's participation. They draw attention to the impact of women's dominance in non-standard employment and their concentration among low status and less well paid occupations on their access to training (Compton, 1997).

International research has shown participation in job-related training across all sectors is higher than participation in training and education that is undertaken for other, non-employment related, reasons. Moreover, while there are no substantial gender differences in participation in education and training *per se,* especially between people who already have high levels of educational attainment, men are more likely to receive financial sponsorship from their employers for undertaking job-related training than women (OECD, 1999a).

Women's exclusion from opportunities for training and their lack of participation in ITEC employment potentially could create a vicious circle as new dynamics of inclusion and exclusion in the economy continue to be divided by gender. Widening opportunities for women in all age groups to access ITEC technologies in the home and elsewhere in the community can provide women with opportunities to build key ITEC skills and also enable women in ITEC employment to refresh and upgrade their capabilities in order to sustain their employment.

This broadening of education and training and their integration with employment has stimulated the creation of a range of new partnerships for learning, for example, between education providers, private enterprise and government. These provide certification in computer literacy (the European Computer Driving Licence) and professional qualifications (such as the Cisco Certified Networking Professional, and the Microsoft Certified Systems Engineer). Very few providers record and track participation on their courses by gender, and the information that is available suggests that very few women take advantage of these opportunities for skill development.

Cisco Systems Network Academy Program is one example where the conventional boundaries between education, training and learning and work are increasingly blurred. The networking firm has become one of the largest education providers in the world and, at the same time, has used ITEC education to reinforce its brand image[54] Cisco has entered into a set of learning partnerships with non-profit companies, international organisations like the United Nations Development Programme, unions, government agencies and other firms including Sun, Microsoft and Oracle in implementing and developing its full-time, eight term, online training program. Yet, according to a Cisco representative, only about 8-10 per cent of those who pass through the program in the UK are women.

[54] Two Internet networking certifications currently bear the company name, the Cisco Certified Networking Associate and the Cisco Certified Network Professional.

Such initiatives are seen in Europe to be one solution 'to ... problems of the competitiveness of business, the employment crisis and the tragedy of social exclusion and marginality ... they are expected to help society to overcome its present difficulties and to control the profound changes which it is currently undergoing' (European Commission, 1993).

Creating opportunities for career migration

Alternatives to the traditional paths from formal education into ITEC employment are valuable, not least because they enable women in employment to migrate from one occupation into another; help women to re-enter the workplace in new occupations; and assist women that are threatened by unemployment to revise their careers.

Non-formal routes between careers have always been important for women and they remain so, as women are clustered into low status, non-ITEC jobs that involve clerical work and assembly work in the ITEC sector. Many women may not have the qualifications at school leaving age that provide access to a professional ITEC career and they may not be aware of the employment opportunities that ITEC offers.

For example, a woman might progress from being a data entry clerk, to having a supervisory position in her group. This promotion may have required her to interface with a computer centre and, from her experience in this role, she may then have been motivated to pursue a career as a systems programmer. Alternatively, a woman employed in sales may have been required to book-keep on computer, she would have been exposed to computer operations and then may have elected to become a programmer.

However, with the introduction of PCs, time accounting, and ever-shorter project life cycles, there are now fewer opportunities for women to explore and experiment with participation in tasks other than those for which they are directly responsible.

There have been attempts to formalise this migration path, for instance through the development of 'springboard courses' that enable people, including a high proportion of women, to leapfrog in electronics engineering from clerical work into management. In one UK firm, such initiatives have not always met with success from a corporate viewpoint.

> We did have an initiative about 10 years ago – a course called Strategic Skills for Women Managers ... it covered all kinds of things, style, politics, how to impress people, why do we make certain decisions, what is important to you ... it was stopped because it was so successful, a lot of women got very confident and realised they could do all sorts of things, and they left [the company] (from interview)

In addition, initiatives to promote career migration are unlikely to meet with success unless complementary actions are taken to combat the discriminatory effects of age that appear to militate against women's participation in ITEC occupations.

3.4 Recruitment and employment

Women are shown to be under-represented in employment in the ITEC sector and in ITEC occupations in all countries included in this study, except Taiwan, where data are not available. Evidence from the UK and the US shows that the participation of women in ITEC occupations declines still further when these occupations are located in the ITEC sector. This section focuses on the barriers to entry into ITEC employment that confront women and initiatives to reduce these obstacles.

Overcoming barriers to entry into the culture of ITEC employment

The traditional culture of ITEC-related work has been briefly characterised earlier in this section as being predominantly male and populated by a generation of technical specialists. Over time, pressures for change have demanded a different genus of ITEC specialists who, alongside their technical skills

- possess strong communications skills
- are able to share their knowledge with specialists and non-specialists through participation in teamwork
- are flexible and adaptive and are able to build and maintain productive relationships with users of the technological systems that they create.

This redefinition of the key skills and abilities that are required for ITEC-related work has opened up new opportunities for women, who generally excel in these critical, non-technical areas, to enter into ITEC careers. In the context of severe shortages of skills and talent in ITEC, the rhetoric of professional discourse has declared that there has never been a better time for women to enter and prosper in ITEC employment. Firms are directing attention to the language used, and the image portrayed in their recruitment drives in order to encourage women to apply for vacancies.

Yet according to several interviewees the image of ITEC work – the long-hours and the lack of alternatives to standard working practices (part-time work and flexible work) – accurately reflect notions of professionalism that are integral to the culture.

> The industry is not women friendly. There are long hours, early starts, late nights and a lot of travel. It's not family friendly, not socially friendly. There's still a macho thing about it. (from interview)

On the one hand, the need to change working practices and recruitment and career development strategies may increase as the levels of women's participation in ITEC occupations rise and it becomes imperative to attract even more women into ITEC jobs in response to skills shortages. On the other hand, as experience in the US has shown, there is every chance that economic change will render such changes unnecessary.

> The 'ideal IT Manager' is young, male, he lives and works in the South East, has a team of about half a dozen and there's one female in it, he's possibly reluctant to bring in a second because he worries about their commitment, and he won't recruit older than himself. ... The IT manager recruits in his own image. Issues of women and age sit alongside each other. (from interview)

One strategy that has proved effective in the US postal service in recruiting women into employment despite explicit discrimination towards veterans (generally male), has been the use of examination-based (i.e. gender-blind) recruitment.

Age and opportunity

Other factors that may militate against women's inclusion in ITEC-related work depend for their impact on how they are interpreted within employment, and whether their interpretation is the same for women as it is for men. For example, some studies have drawn attention to 'ageism' in the sector within the UK, and the youth of those in ITEC employment. The research presented in this report has revealed a relationship between age, gender and ITEC employment.[55] According to one recent survey,

> Ageism is rife in information technology despite severe skill shortages ... A quarter [of the 1400 respondents to the survey who work in the sector] said IT people became classified as 'older workers' at 40 and more than one in five said that the defining age was 35. (Maitland, 2000)

There would appear to be a relationship between youth and the ability (and willingness) to work long and non-standard hours that has been associated with ITEC occupations. Nevertheless, most of the 37 per cent of respondents to this survey who had recruitment responsibilities reported that age was less important than skills, experience and flexibility.

[55] See, Part B, Chapter 1, for details of the relationship between age, gender and ITEC employment in the UK.

3.5 Employment and retention

The women in ITEC occupations in the UK and the US are better educated than the men, yet they appear to be under-valued at work – they are clustered into low value-added occupations and are not rewarded equally with the men for the work. This section addresses this paradox.

Enabling progression and achieving retention in ITEC careers

Increasingly, research is finding out that although they may not recognise it, women and girls do have the necessary skills to pursue and profit from a career in ITEC. Women are more likely to be motivated by the relevance of ITEC to 'real world' problems than by the challenge of getting the technology to do spectacular things. This might explain the high proportion of women that work outside the ITEC sector in the UK and the US.

> Most women are employed in user companies because they are interested in the application of computing and because their business interests are stronger and their knowledge of IT is secondary. (from interview)

A range of research in work and education settings has drawn attention to the existence of gender differences in preferred 'styles' of working that emphasise the desirability of women being employed in ITEC occupations.

Workplace research has indicated that men and women react differently to particular learning experiences. For example, women appear to adopt a bricoleur approach to problem solving in order to try to piece together a solution from various sub-components. In contrast, men tend to adopt a linear, hierarchical and planned approach to problem solving (Geppert, 1999; Woodfield, 2000).

The assembly approach to problem solving that is associated with women is also characteristic of excellent programming skills. Good programmers prefer to devise generic solutions that can be tailored to different purposes and to re-use elements of code rather than to create each program from scratch. This may be one reason why women are relatively well represented in ITEC professions among computer analysts/programmers and computer systems managers. Placing emphasis on the affinity between the problem solving characteristics of women and good programmers may be more acceptable to women as a way to encourage them into ITEC careers than is the current stress on their communication skills.

Other studies in educational settings have indicated that girls prefer to work collaboratively and view peer interactions as a source of mutual support and knowledge sharing, whereas boys tend to work alone, and consider peer interactions to be unnecessary diversions (Cooper *et al.*, 1990; Underwood *et al.*, 1999). Women are generally acknowledged to be better than men at teamwork and in working at the human-computer interface, and this is the basis for many proposals to encourage their inclusion in ITEC-related work.[56] These skills are currently highly valued in ITEC employment.

Yet few women achieve high status in ITEC occupations. The combined impacts of gender, age, opportunity, and experience (especially if one, or several, career breaks have occurred) appear to combine to negatively impact on women's chances of getting on and moving up in an ITEC career. According to Karen Reddy, head of membership at the National Computing Centre (NCC), commenting on the NCC/Computer Weekly IT Careers Tracking Survey

> 'This is the first systematic analysis of what it is to be a high flyer, and it confirms many people's fears that it helps to be a man.'

[56] When firms are under financial pressure, the practice of teamwork or group working is seen in a less positive light, for example, as being unable to reach closure and as expensive.

Confidence versus competence

Women need to take some responsibility for making sure that they are not overlooked. Lack of confidence among women is a recurring theme (Department for Education and Employment, 1999b; Information Technology Association of America, 2000b; Woodfield, 2000) in explanations of women's exclusion from ITEC, along with lack of encouragement (Information Technology Association of America, 2000b). Henwood (2000) makes special note of the 'contradiction between women's competence, as measured by assessments and the judgements of an outside observer, and their own subjective experience of technical competence.'

Achieving a balanced working life

Women in ITEC-employment often experience difficulty in attempting to achieve a balance between work and life because of the culture of long, non-standard hours and associated social and physical neglect.

While some firms offer flexible working alternatives, few women are employed on a non-standard, part-time basis in ITEC in the UK and the US. This might be because non-standard employment options are not available or because women are reluctant to embrace such options within a long-hours culture, where there is a belief that greater amounts of time spent at work demonstrate greater commitment and enhance productivity.

For example, women in engineering in the US have reported that they are not inclined to take advantage of opportunities for telework in case they are seen as being not committed to their careers (Geppert, 1999). Also, while teleworking does offer women freedom from the cultural stereotyping and rigidities that they may experience in traditional employment relationships, it is increasingly the case internationally that flexible work is becoming synonymous with precarious employment (Bryant, 2000; Mitter *et al.*, 2000).

However, there are more opportunities for part-time work in the ITEC sector and in ITEC occupations in the US than in the UK. Moreover, there is a more balanced distribution of these opportunities between men and women. It would be expected that this would generate a culture within which part-time work is perceived to be broadly acceptable and this, in turn, could raise the participation of women in ITEC jobs.

Pregnancy and childbearing are major disadvantages for women's career prospects in most countries, often for different reasons.[57] In the UK, it is because they are seen to reduce women's commitment to, and availability for, work (for example, due to maternity leave, often followed by a prolonged period when women may need to leave work early).

Recently, however, firms have been driven by the need to retain key and expensive skills and have been implementing a range of schemes to improve their responsiveness to the various needs of women, and men, at different periods in their working lives. These include:

- the provision of crèches and other facilities on site in order to reduce the negative impact of parenthood on employment and career prospects
- the development of women's mentoring programmes that enable 'networking with women at all levels ... *Building up a feel for how things mesh together is harder now for new recruits, and this helps'*
- the promotion of initiatives to encourage workplace diversity, for example, in one US firm business units are targeted towards diversity and supervisors pay is linked to the achievement of those targets
- opportunities for flexible home-based working that may include a budget allocation to establish the home as an operational base.

[57] For example, in the US because of a lack of affordable and reliable childcare, especially in the evening. In Spain, Ireland and Taiwan, parenthood is a disadvantage in employment because of the dominant ideologies in those countries.

Entrenching the 'new' image of ITEC employment

Initiatives to address women's experiences of the projected image of ITEC only tackle one aspect of image-related issues that intervene in the relationship between women and ITEC employment. Another facet is the image that the ITEC industry has of women and the appropriate location of their skills in ITEC work. The response of one interviewee provides further insight.

> 'Women are changing in their acceptance of IT. It used to be that women saw IT as a geeky, 'anorak' populated, macho, game-playing career, and image was not appealing to them. This is changing and IT is changing.' [in the next breath] 'Being customer focused is increasingly important in IT, there has been a rapid growth in the use of customer relationship management software, all about touchy-feely things like how do you love your customers. This requires traditional feminine skills. There is more in IT now that needs the female touch. Now there is a need to say to women 'there is a career here, and you don't need to be a male.' (from interview)

The ability of the industry to value, recruit, promote and retain women with ITEC skills in ITEC occupations, in effect, to entrench and sustain its revised image, is critical.

Main Report – Part B

1. Women in ITEC courses and careers in the UK

1.1 Chapter summary

Access/Education

- Similar proportions of 15-year-old male and female students qualified in information systems and mathematics at GCSE level in 1998/99, while slightly lower proportions of females qualified in computer studies (43 per cent)
- More women (54 per cent) than men obtained GCE A levels in 1998/9, but fewer women than men qualified in ITEC-related subjects (i.e. those that could be considered to lead to ITEC careers) such as maths (36 per cent) and computer science (20 per cent)
- In 1998/99 more women passed GCE A level mathematics than computer science
- Although in the past six years there has been massive growth in the numbers passing GCE A Level computer science, the proportion of women passing GCE A Level computer science was, until recently, in decline because the number of men passing rose faster than the number of women. In 1998/99, however, the proportion of women reached 20 per cent (from 14 per cent in 1997/98)
- Women draw on a wide variety of information sources when deciding to embark on university courses in ITEC-related subjects and they are particularly influenced by prospectuses
- In 1998/99 women applicants to computer science and mathematics degree courses were motivated by enjoyment, the perception that a place was achievable and interest as well as employment prospects whereas applicants to business management and electronics-related courses were motivated primarily by career prospects
- A greater proportion of women (53 per cent) received a degree in business and administrative studies than men in 1998/99
- After business and administration, the number of women graduates was highest in engineering and technology, computer science and mathematical science, respectively
- After business and administration, the ITEC-related subject that had the highest proportion of women graduates was mathematical sciences (39 per cent)
- In 1998/99 women represented 21 per cent of computer science graduates and 15 per cent of engineering and technology graduates
- The proportion of female computer science graduates declined between 1994/95 and 1998/99 because the number of men graduating during the period increased faster than the number of women

Education/ Recruitment

- The ITEC sector is a major employer of graduates. Higher proportions of both men and women with graduate level skills are employed in the ITEC sector than in other industrial sectors
- In 1998/99, graduates in ITEC-related subjects were more likely than graduates in all subjects to enter employment directly after graduating
- Higher proportions of female ITEC graduates (77.2 per cent) than male ITEC graduates (75.8 per cent) went directly into employment after graduating

- Only among computer science graduates were males more likely to enter employment directly after graduating than females – 82.5 per cent of male and 75.1 per cent of female, computer science graduates went into employment directly after graduating
- Higher proportions of male (52 per cent) than female (40 per cent) computer science graduates were recruited to the business services industry (which includes the IT services sector) after university
- A quarter of those in the ITEC sector in 2000 were graduates – 27 per cent of males and 20 per cent of females.
- Female graduates were particularly concentrated in the broadcasting services sector – 42 per cent of the women were graduates.
- In 2000, just over a third of graduates in ITEC occupations (38 per cent of the male graduates and 33 per cent of the female graduates) had ITEC-related degrees
- Almost two-thirds of the graduates in ITEC jobs (and more women than men) did not graduate in an ITEC-related subject
- Graduates in ITEC-related subjects were particularly concentrated within the IT services industry among professional-level occupations that involved computing.

Recruitment/Employment

- In 2000 ITEC-related employment extended far beyond the ITEC sector – only about half (49 per cent) of those in ITEC jobs worked in the ITEC sector per se
- Most women (68 per cent) in ITEC jobs worked outside the ITEC sector whereas most men (52 per cent) worked in it
- Women were vastly under-represented in the ITEC sector (28 per cent), and in ITEC jobs (13 per cent) – particularly those within the ITEC sector (9 per cent) – women represented 46 per cent of the labour force in other, non-ITEC, sectors
- The proportion of women in ITEC occupations declined from 16 per cent in 1999 to 13 per cent in 2000 due to a reduction in the number of women in ITEC jobs in the period
- The majority of women in ITEC jobs were either computer systems managers (20 per cent, and rising) or computer analysts/programmers (21 per cent, and falling).

Employment/retention

- Women in ITEC occupations have lower status and receive lower salaries for their work than men
- In 2000, the pay differential for men and women seems to have increased with status (for computer analysts/programmers it is 14 per cent, for computer systems managers it 21 per cent)
- Women in ITEC occupations were generally better educated than men
- Few people work non-standard hours in the ITEC sector (11 per cent) and in ITEC occupations (4 per cent), as most employment is full-time
- Women in ITEC jobs were, on average, four years younger than men, three years younger than the average age of people working in the ITEC sector, and five years younger than the average age of men and women in other occupations.

1.2 Introduction

This chapter uses existing quantitative data[58] to examine evidence of the participation of women in ITEC courses and careers in the UK.

- It highlights the pattern and scale of trends in women's education in subjects that might be expected to lead to careers in ITEC
- It presents information about the choices that women make when applying for ITEC-related degrees at university
- It shows the participation of men and women in ITEC employment within the core ITEC sector and more widely across the UK economy

1.3 Women in ITEC-related courses in the UK: the evidence base

This section presents data on the proportion of women and men who graduate in computer science, business studies, electronic engineering and mathematics, which are classed as ITEC-related courses because they could be expected to lead to an ITEC career. The data show:

- trends in ITEC-related GCSE Level and GCE A Level qualifications
- the choices that female school leavers make when opting for a university course in an ITEC-related subject and the factors that influence them
- the pattern of men's and women's graduation from ITEC-related courses
- the initial destinations of first degree graduates in ITEC-related subjects
- the formal educational qualifications of men and women who are employed in the ITEC sector.

Qualifications at GCSE Level in the UK

The majority of those with GCSE Level A* to C qualifications in information systems in 1998/99 were female (50.2 per cent) and this percentage has been rising since 1993/4. Slightly lower percentages of 15-year-old females qualified in mathematics (49.9 per cent) and computer studies (43.2) in the same year (Figure 4, Table 22).

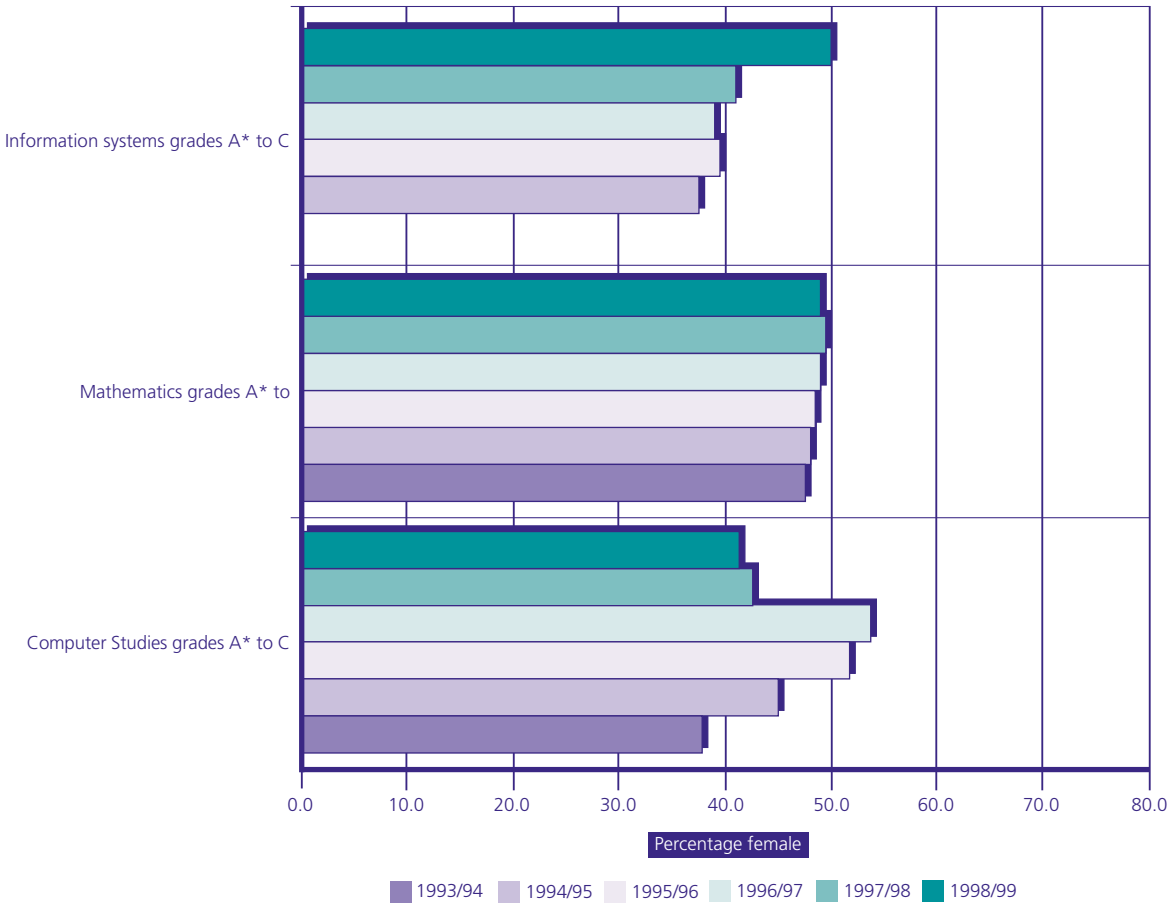
However, while the percentage of females with a GCSE qualification in mathematics, like those with GCSE in information systems, has risen since 1993/94, the proportion of women with a GCSE in computer studies has fallen since 1996/97 (Figure 4, Table 22).[59]

The number of people with GCSE mathematics has increased annually since 1993/94. However, the total number of those qualifying in information systems increased from 15,482 in 1993/94 to 25,691 in 1996/97 but dropped sharply to 13,255 in 1997/98 and to 2,546 in 1998/99. In contrast, the total number of those with GCSE in computer studies fell from 22,135 in 1993/94 to 5,089 in 1995/96 and then rose to 8,566 in 1996/97, to 24,141 in 1997/98 and 39,310 in 1998/99.

[58] The ITEC-related subjects, ITEC sectors and ITEC occupations that are covered in this analysis are described in Appendix 1.

[59] There was a historical distinction between GCSE courses in information systems and computer science that has now virtually disappeared.

Figure 4: GCSE level attainment of 15 year old pupils in the UK, 1993/94-1998/99



Source: DfEE (Annual) Statistics of Education: Public Examinations GCSE/GNVQ and GCE/AGNVQ in England

The decline in the number achieving GCSE level in information systems that appears to have begun in 1997/98 has been compensated for by the rise in the number with GCSE in computer studies. This suggests that the two qualifications (computer studies and information systems) may be substitutable and that they compete for candidates. A combination of the data on those attaining a GCSE qualification in information systems and in computer studies shows that the proportion of females qualifying at GCSE level in this combined 'computing and information systems' field has increased annually from 39.1 per cent in 1993/94 to 43.6 per cent in 1998/99.

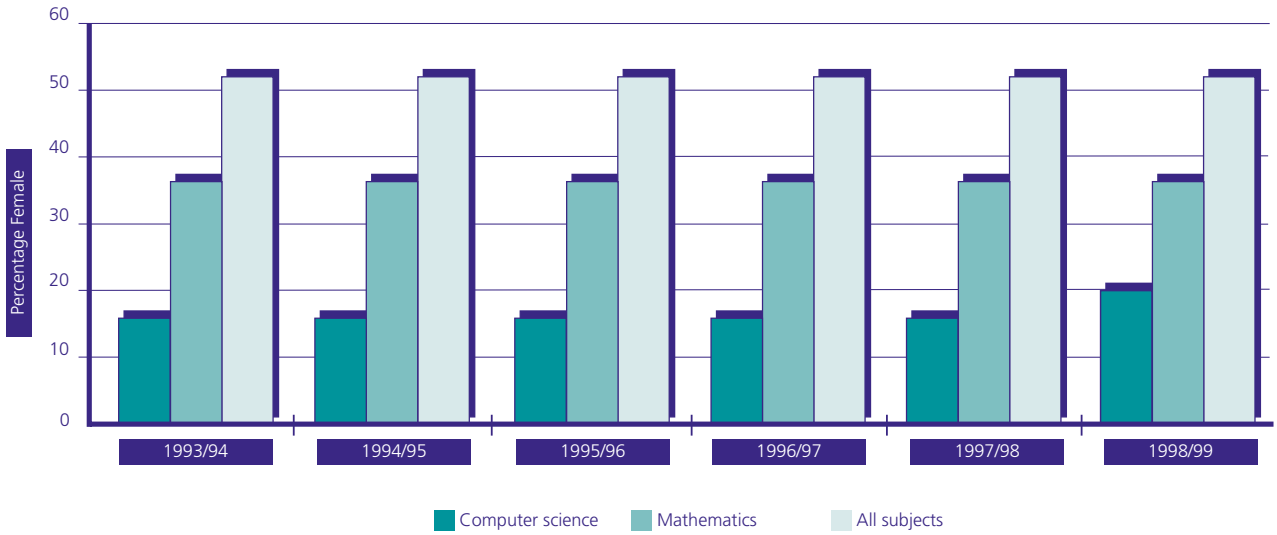
Qualifications at GCE A Level in the UK

This section examines men's and women's education in ITEC-related subjects[60] in school/colleges of further education in order to investigate a potential source of female skills to employment in ITEC.

More women (54 per cent) than men obtain GCE A Level qualifications and the relative proportions of men and women passing GCE A Level have remained more or less the same since 1993/94 (Figure 5, Table 23).

[60] This analysis focuses on mathematics and computer science. A level data on the other ITEC-related subject categories included in the definition of ITEC courses (see Appendix 1), namely business studies and engineering and technology, are not available.

Figure 5: The percentage of women with GCE 'A' Level in ITEC-related subjects in the UK, 1993/94-1998/99

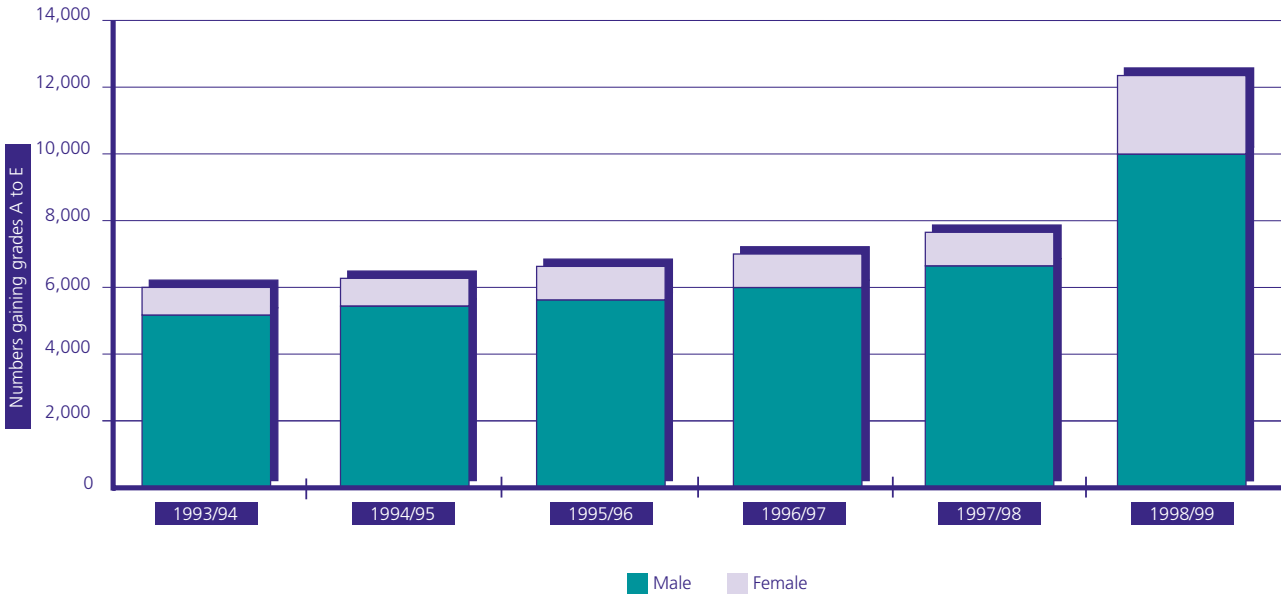


Sources: DfEE (various years) Statistics of Education: Public Examinations GCSE/GNVQ and GCE/GNVQ in England

However, in 1998/99, fewer women than men obtained GCE/A Level qualifications in mathematics and computer science. In 1998/99, women represented about 36 per cent of those with GCE/A Level mathematics and, although the total number of those (men and women) qualifying in mathematics rose from 48,974 in 1993/94 to 56,297, this percentage has remained fairly stable throughout the six-year period. The number of women attaining GCE A Level mathematics increased from 17,398 in 1993/94 to 20,453 in 1998/99.

Although the numbers of men and women achieving GCE A Level computer science doubled from 5,962 in 1993/94, to 12,317 in 1998/99, few women qualified in computer science and for several years until 1997/98 the proportion of women with A Level computer science was in decline. For example, in 1993/94, only 15 per cent of those obtaining GCE A Level in computer science[61] were women; by 1997/98 this proportion had reduced to 14 per cent.[62]

Figure 6: The number of men and women achieving GCE A Level in computer science in the UK, 1993/94-1998/99



Sources: DfEE (various years) Statistics of Education: Public Examinations GCSE/GNVQ and GCE/GNVQ in England

[61] The number of women qualifying in GCE A Level computer science in 1993/94 was 895.

[62] The number of women qualifying in GCE A Level computer science in 1997.98 was 1073.

However, there are signs of improvement. In 1998/99, the proportion of women passing A Level computer science rose to 20 per cent.[63]

Up to 1997/98, the decrease in the proportion of women being awarded GCE A Level in computer science was a result of the number of men qualifying being greater than the annual increase in the number of women qualifying (Figure 6, Table 23). This trend reversed between 1997/98 and 1998/99, when the number of women receiving GCSE A Level computer science doubled.

The transition from education to higher education

Limited data are available regarding the transition from further education into higher education because students enter higher education via a range of routes. This section is based on highlights taken from a special analysis of the responses from a subset of a survey of applicants to higher education who indicated a preference for ITEC subjects in 1998/99. This large UK-wide survey was undertaken by the Institute for Employment Studies and focused on the choices that students made when selecting a particular university or college.[64]

In deciding where to apply, women in particular were influenced by the information in the university prospectus and by their experience of visiting a university campus (Table 37). In addition to being heavily influenced by prospectus information, women applicants to ITEC-related university courses found the information in the UCAS handbook and from friends and school careers advisors was more useful than that provided by university/HE college staff, gained through campus visits or from the school careers library.

The search for the right course was the outstanding major factor influencing the choice of where to study. Next was the overall image of the institution, its teaching reputation, graduate employment prospects, entry requirements, location and academic facilities, safety and security, accommodation, distance from home and cost of living.

The ITEC female sub-sample was more interested in employment issues, including graduate employment prospects and work placements, than the sample of women choosing other courses of study.

Enjoyment, interest and future job/career prospects were the main reasons given by students for choosing an ITEC-related university course (Table 40). Women selecting an ITEC-related course were influenced almost equally by their perceptions of the enjoyment that a particular course would offer (35 per cent) and career-related reasons (36 per cent) whereas men were more likely to rate career prospects (40 per cent) over potential enjoyment (32 per cent).

There was some variation between the decisions made by students selecting different ITEC-related courses.

- More of those who chose maths/statistics (60 per cent) rated their enjoyment of the subject than its future employment prospects as an important influence on their choice
- Maths was seen to be 'achievable' (i.e. get entry qualifications, 34 per cent) (Table 42) by both men and women alike, and this had a positive influence on its selection as a course of study
- Female applicants to computer science/studies courses were far more likely than their male counterparts to cite enjoyment of the subject as influencing their choice, whereas males were slightly more likely than females to cite job/career related reasons (Table 43)
- Applicants to business/management studies courses, particularly the men, tended to give job/career reasons (40 per cent) for their choice (Table 44)
- Numbers of female applicants to courses in electrical/electronic engineering are too small (just 10) for any meaningful analysis but for men and women combined, career was the main reason given for this choice (by 47 per cent, the highest of all the subject groups).

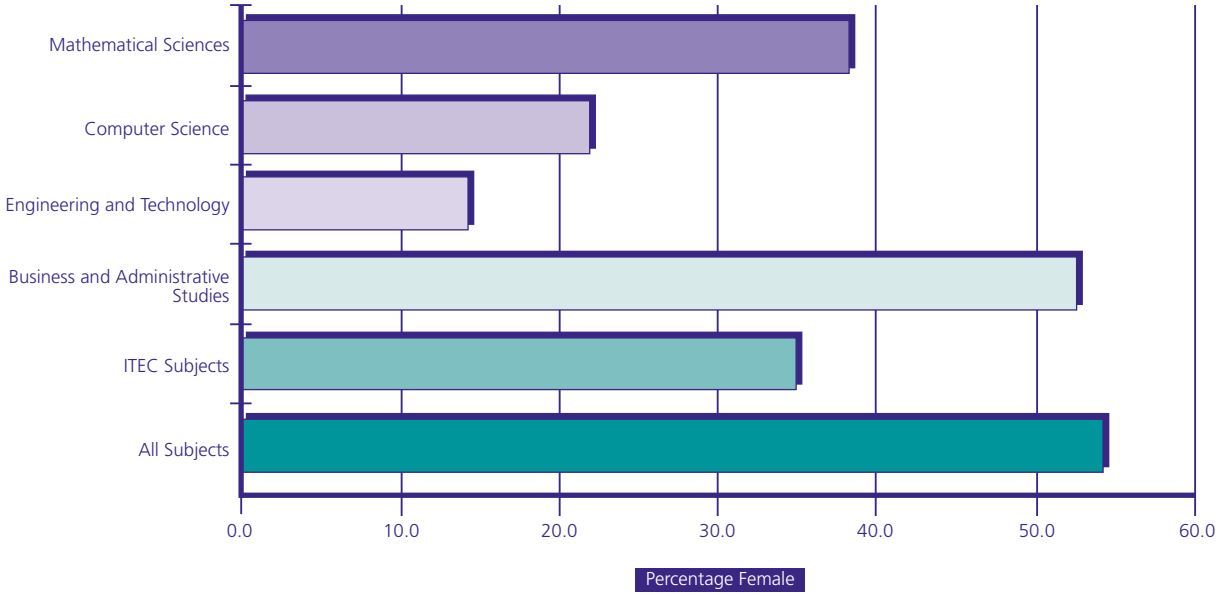
[63] The number of women qualifying in GCE A Level computer science in 1998/99 was 2,464.

[64] See 'Making the right choice: analysis of ITEC applicants' in Appendix 2 for the full report.

Graduation from university in ITEC-related subjects in the UK

Women represented the majority (54 per cent) of university graduates in the UK in 1998/99 (Figure 7) and, over time, there has been a steady upward trend in the proportion of women graduating from university (Figure 9).

Figure 7: The proportion of women graduating in ITEC-related subjects in the UK, 1998/99



Source: HESA Student Returns, July 1999.

In 1998/99, 26 per cent of all graduates were awarded degrees in an ITEC-related subject, and this proportion has not changed since 1995/96. The proportion of women graduates in ITEC-related subjects has increased from 32 per cent in 1994/95[65] to 35 per cent in 1998/99[66] (Table 24).

Graduates in business and administrative studies

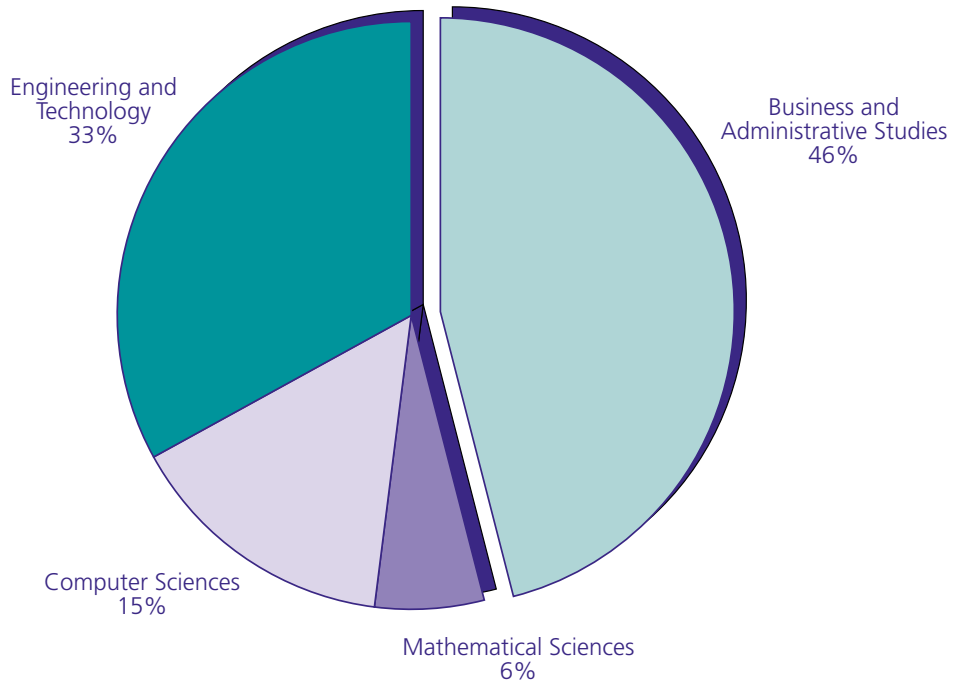
In 1998/99, there were more first degrees awarded in business and administrative studies than in any other ITEC-related subject (Figure 8, Table 24) and there was an upward trend in the numbers of students graduating in this subject. Business and administrative studies accounted for 43 and 46 per cent of all those who graduated in ITEC-related subjects in 1994/95 and 1998/99 respectively.

In 1998/99, business and administrative studies was the only ITEC-related degree level subject in which women were not in the minority in the university graduate population. The proportion of women awarded degrees in business and administrative studies rose by 4 per cent from 49 per cent in 1994/95 to 53 per cent in 1998/99 (Figure 9, Table 24).

[65] In 1994/95, 19,235 women graduated in an ITEC-related subject.

[66] In 1998/99, 23,541 women graduated in an ITEC-related subject.

Figure 8: University graduates in ITEC-related subjects in the UK, 1998/99



Source: HESA Student Returns, July 1999

The proportion of women graduates in business and administrative studies in 1998/9 was approaching the proportion of women graduates in all subjects (Figure 7).

Graduates in engineering and technology

Graduation levels in engineering and technology have remained almost the same over the five-years between 1994/95 and 1998/99 (Table 24). However, because the total number of students graduating in ITEC-related subjects has increased in the period, engineering and technology graduates have accounted for a declining proportion of those being awarded degrees in ITEC-related subjects from 37 per cent in 1994/95 to 33 per cent in 1998/99 (Figure 8).

Although, in 1998/99, greater numbers of men and women graduated in engineering and technology than in computer science or in mathematics, only 15 per cent of engineering and technology graduates were women (Figure 7) and this percentage has been stable over the last five years (Figure 9, Table 24).

Graduates in computer science

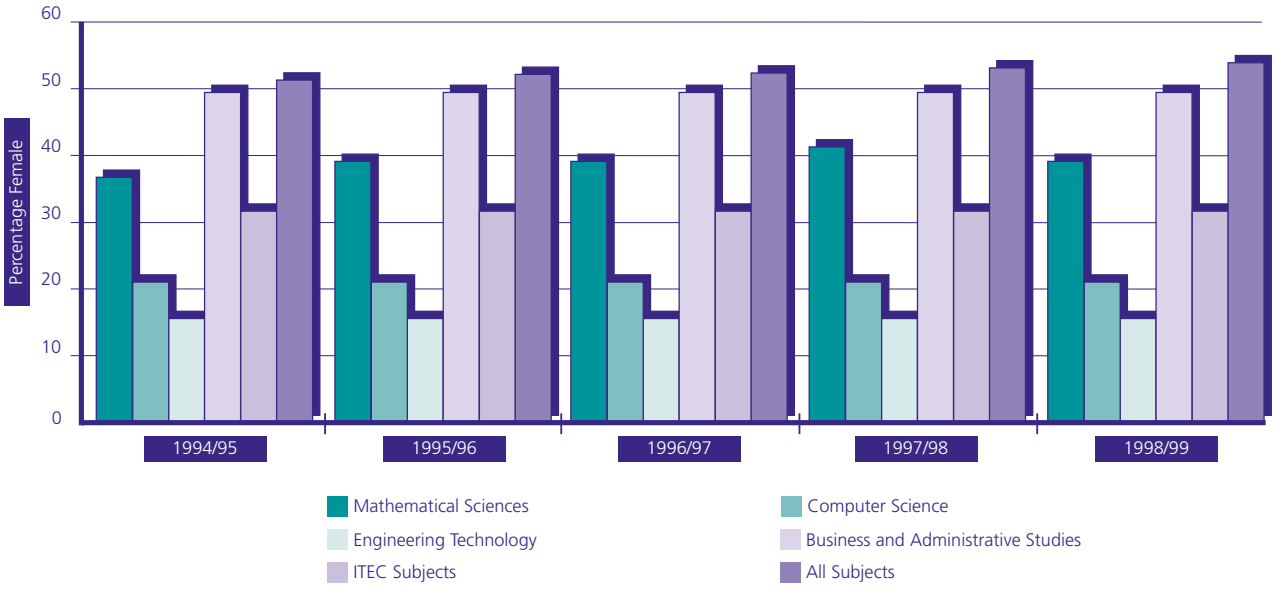
In total, there were more computer science than mathematical science graduates in 1998/99 and the proportion of women computer science graduates was smaller (Table 24). While the total number of computer science graduates increased annually from 8,274 in 1994/95 to 10,380 in 1998/99, the proportion of women graduating in this subject group declined almost annually from 22 per cent in 1994/9567 to 21 per cent in 1998/99[68] (Figure 7, Figure 9, Table 24). Increase in the computer science graduate population is mainly due to the number of men being awarded degrees in this subject group.

In 1998/99, 15 per cent of all graduates in ITEC-related subjects were awarded degrees in computer science (Figure 8), 1 per cent more than in 1994/95 (Table 24).

[67] In 1994/95, 1,805 women graduated in computer science.

[68] In 1998/99, 2,213 women graduated in computer science.

Figure 9: The proportion of women graduating in ITEC-related subjects in the UK, 1994/95-1998/99
Source: HESA Student Returns (various years).



Graduates in the mathematical sciences

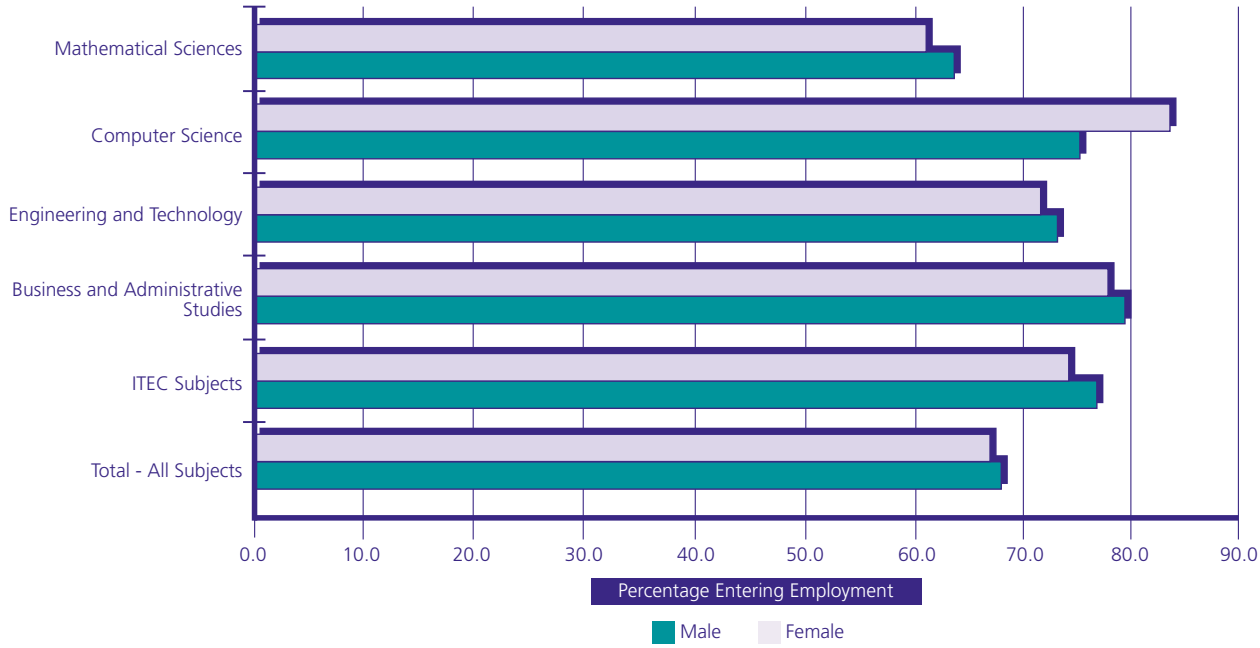
The proportion of mathematical science graduates is slightly declining. They accounted for 7 per cent of all graduates in ITEC-related subjects in 1994/95 and only 6 per cent in 1998/99 (Figure 8, Table 24). The proportion of women awarded degrees in mathematical sciences has increased almost annually between 1994/5 and 1997/98, from 38 per cent to 41 per cent. However, in 1998/99 it dropped to 39 per cent (Figure 7, Figure 9, Table 24).

The transition from university to employment

In 1998/99, higher proportions of graduates in ITEC-related subjects (both male and female) entered employment directly after graduation (75.8 per cent of male ITEC graduates and 77.2 per cent of female ITEC graduates) (Table 25). This compares with graduates in general where 68 per cent of male graduates and 68.8 of female graduates entered employment as their first destination after graduating.

There are clear differences between the first destinations of computer science Bachelor's graduates and graduates in other ITEC-related subjects (Table 25).

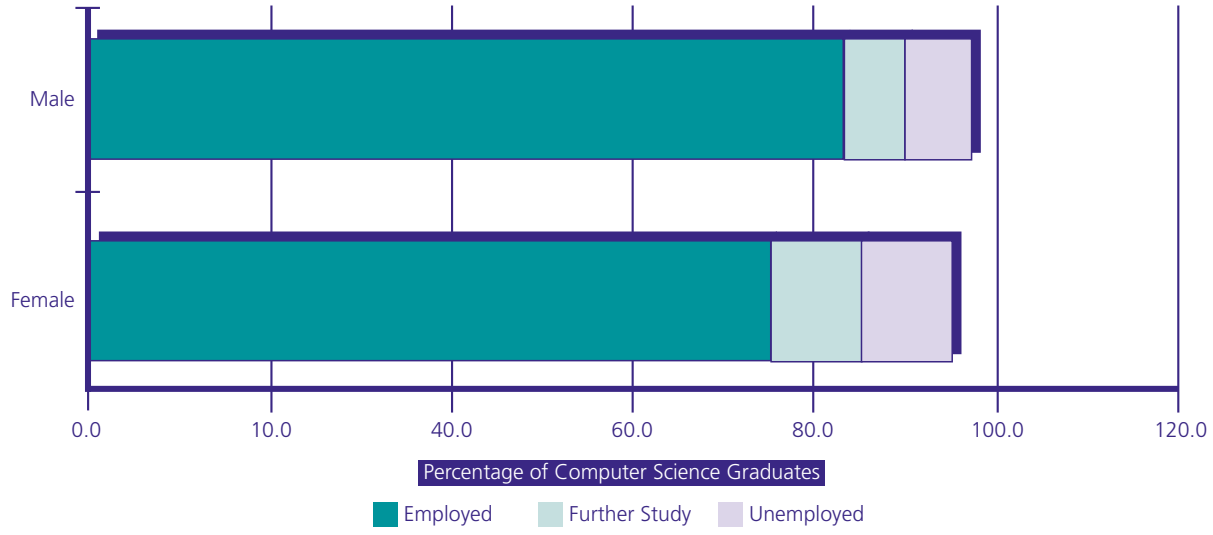
Figure 10: Percentage of first degree graduates in ITEC-related subjects entering employment in the UK, 1998/99



Source: HESA (2001) First Destinations of Students Leaving Higher Education Institutions 1998/99

Figure 10 (and Table 25) show that female graduates in all subjects except computer science were more likely to enter employment after graduation than male graduates. Higher proportions (82.5 per cent) of male computer science graduates than female computer science graduates (75.1 per cent) were employed directly after graduation. A smaller proportion of mathematical science graduates entered employment after graduating than graduates in other ITEC-related subjects.

Figure 11: First destination of computer science graduates in the UK, 1998/99

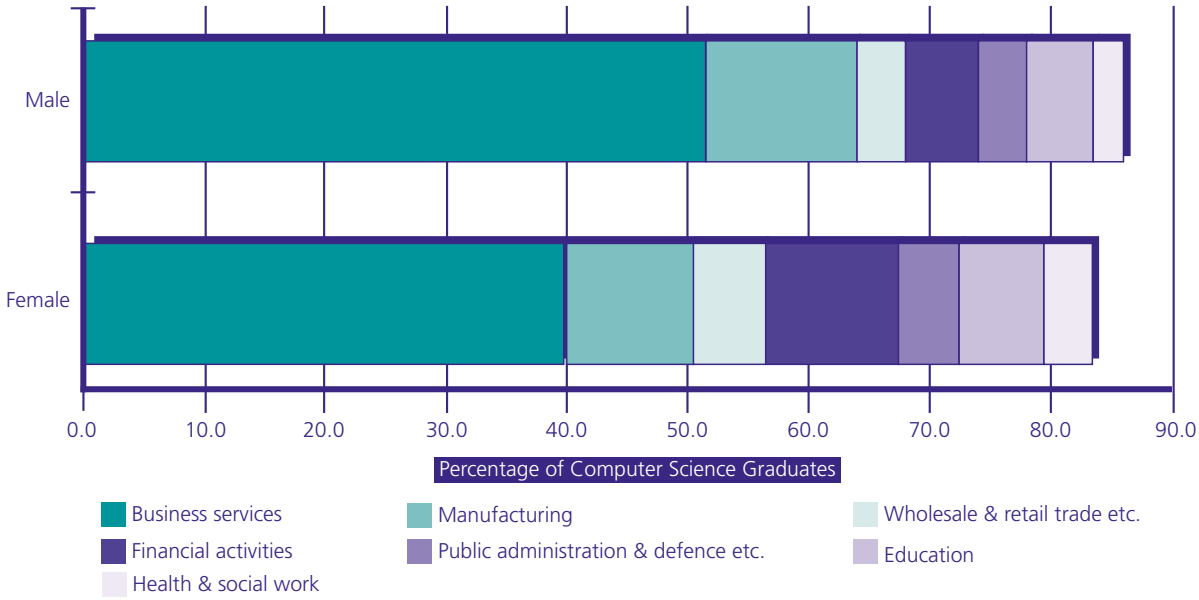


Source: HESA (2001) First Destinations of Students Leaving Higher Education Institutions 1998/99

Figure 11 (and Table 25) show the percentages of computer science students who graduated in 1998/99 and then went on to enter employment, further study, or became unemployed. Higher proportions of women computer science graduates either go on to further study or become unemployed after graduating than men.

Figure 12 (Table 26) show the initial employment destinations of graduates in ITEC-related subjects in the UK in 1998/9. Higher proportions of ITEC graduates and especially computer science graduates entered the business services sector (property development, renting, business – including IT services – and research activities). The business services sector was the largest employer of new male and female computer science graduates in 1998/9.

Figure 12: Initial employment of computer science graduates in the UK, 1998/9



Source: HESA (2001) First Destinations of Students Leaving Higher Education Institutions 1998/99

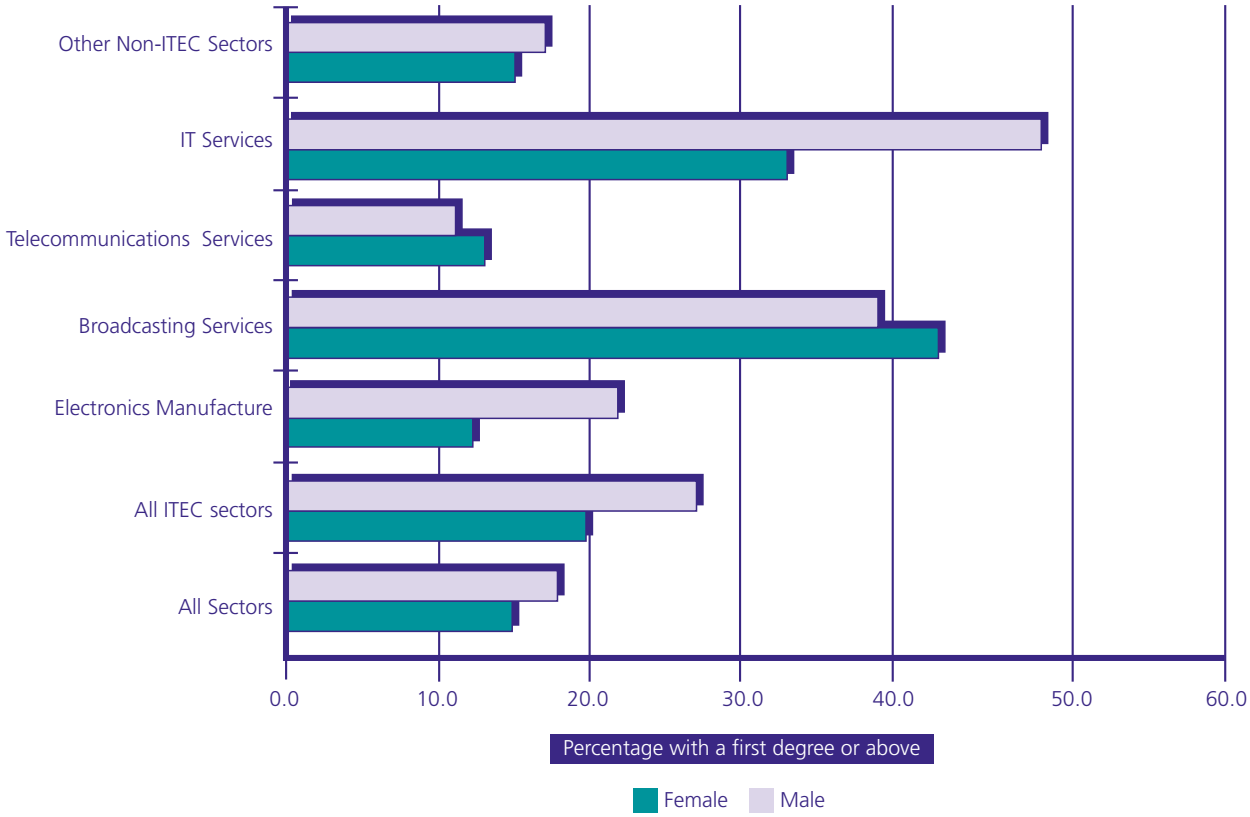
More male (52 per cent) than female (40 per cent) computer science graduates were recruited to the business services sector in 1998/9. Female computer science graduates were more likely than their male counterparts to be employed in the financial services, education, public services, wholesale and retail and health and social work sectors.

The educational base of employment in the ITEC sector in the UK

Employment of graduates – particularly male graduates – is intensive in the ITEC sector – in 2000 a quarter of those in the ITEC sector (27 per cent of the men and 20 per cent of the women) were graduates (Table 27). 16 per cent of men and 14 per cent of women in other, non-ITEC, sectors were graduates.

Within the ITEC sector, graduates were concentrated in the IT services industry – 44 per cent (48 per cent of men and 32 per cent of women) of the workforce in the IT Services industry were graduates. However, female graduates were clustered in the broadcasting services industry, where 41 per cent of employees (39.5 per cent of men, 41.9 per cent of women) were graduates. In contrast, only 18 per cent of those employed in electronics manufacturing (21 per cent or men and 12 per cent of women) and 11 per cent of those in telecommunication services (11 per cent of men and 12 per cent of women) were graduates (Figure 13, Table 27).

Figure 13: The graduate intensity of industries within the ITEC sector in the UK, 2000

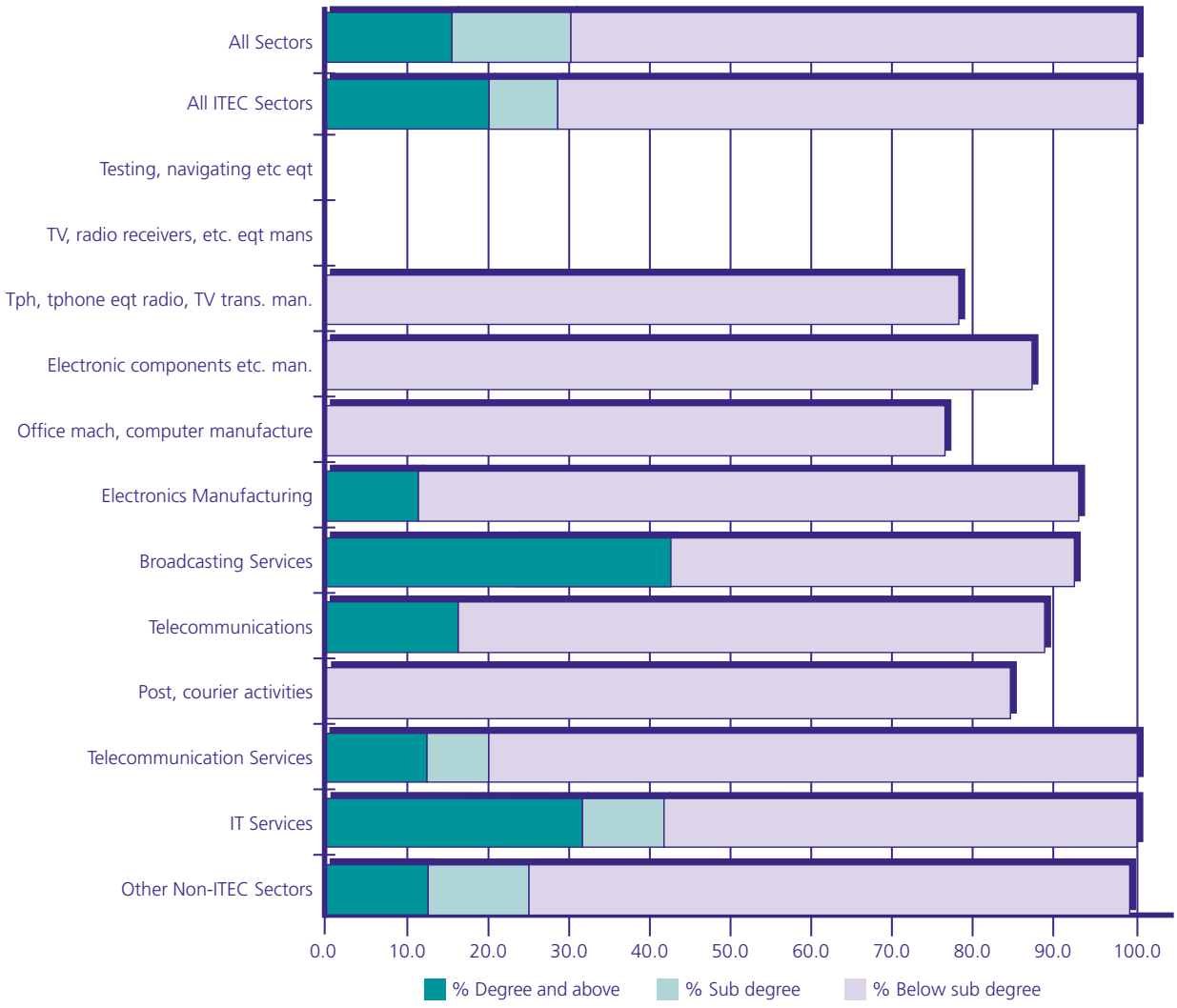


Source: Office of National Statistics (ONS) Labour Force Survey, March-May, 2000.

The majority of occupations in the ITEC sector, therefore, do not require higher or further education. Women with a college education[69] were under-represented in the ITEC sector, only 8.6 per cent were college educated whereas 12.3 per cent of the women in other, non-ITEC, sectors had received further education.

[69] Classified as 'sub-degree' level education.

Figure 14: The educational profile of women in the ITEC sector in the UK, 2000



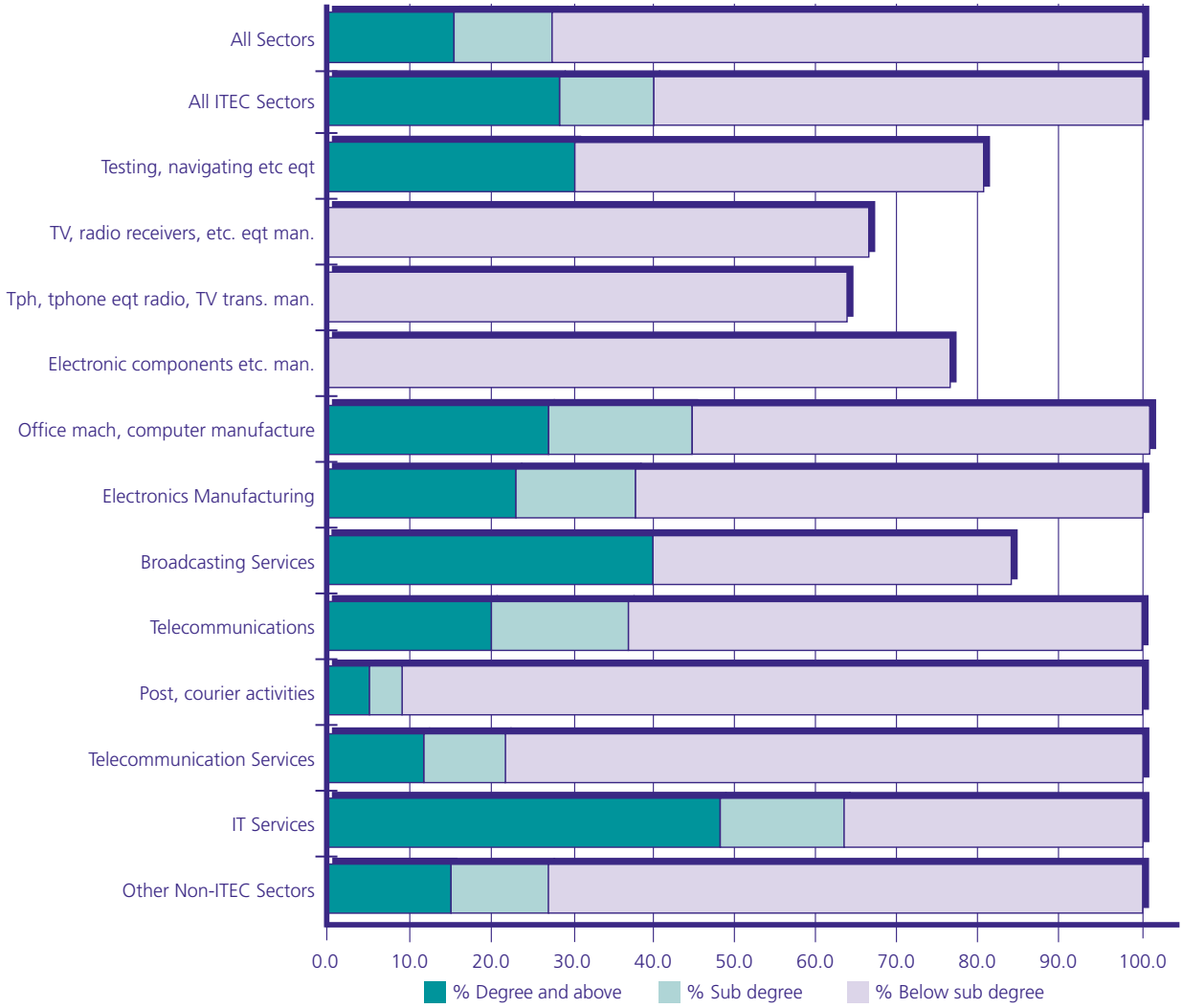
Source: Office of National Statistics (ONS) Labour Force Survey, March-May, 2000.
Note: where the total is below 100% this indicates that numbers are too small to be reliable.

The employment of women who are educated to below sub-degree level[70] was notably intensive in the sector (Figure 14). A greater majority of the women in the ITEC sector had below sub-degree level education than of the men (Table 27) – 72 per cent of the women and 60 per cent of the men in the ITEC sector had received below sub-degree level education.[71]

[70] ISCED levels 1-3.

[71] In other, non-ITEC sectors similar proportions (74 per cent) of the men and the women have not received a college education.

Figure 15: The educational profile of men in the ITEC sector in the UK, 2000



Source: Office of National Statistics (ONS) Labour Force Survey, March-May, 2000.
Note: where the total is below 100% this indicates that numbers are too small to be reliable.

A higher proportion of graduates (30 per cent) in the electronics manufacturing sector were in the, predominantly male, testing, navigating and equipment manufacturing industry (Figure 15, Table 27). In office machinery and computer manufacturing, also male dominated, over a quarter (28 per cent) of the men were graduates.

The graduate intensity of ITEC jobs in the UK

Figure 16 (and Table 28) show the graduate level[72] skills base of ITEC jobs in the UK economy in 2000. 40 per cent of those in ITEC jobs were graduates and, of these, 38 per cent (38 per cent of the male graduates in ITEC jobs and 33 per cent of the female graduates in ITEC jobs) were awarded degrees in an ITEC-related subject.

Almost two thirds of graduates in ITEC occupations had not graduated in an ITEC-related subject (Figure 16, Table 28). Most of the graduates with ITEC-related qualifications were computer analysts/programmers (46 per cent), software engineers (41 per cent), computer engineers (40 per cent) and computer systems managers (27 per cent).[73]

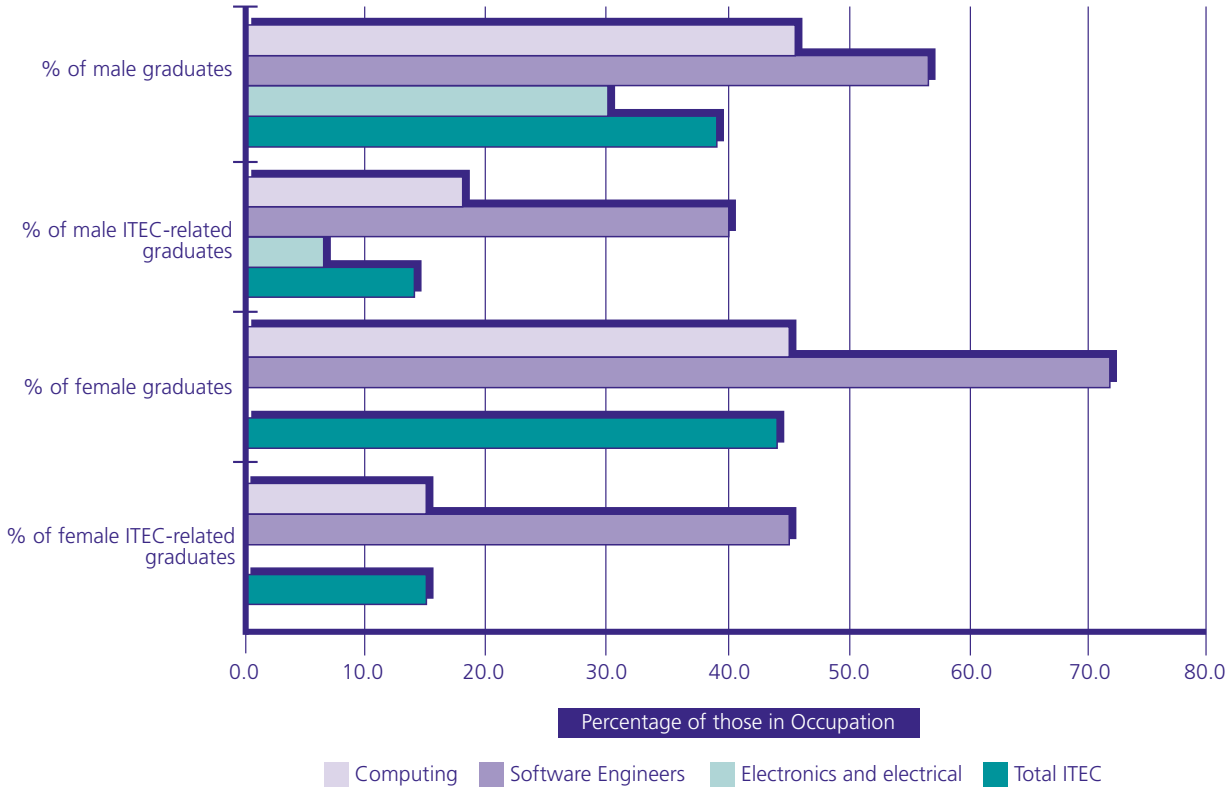
[72] Including first degree, higher degree and NVQ level 5 qualifications.

[73] It is not possible to provide a full analysis at an occupational level.

Women in ITEC occupations were better educated than are men, 45 per cent of the females but only 39 per cent of males had degrees.

Figure 16 shows the graduate intensity of particular types of ITEC jobs,[74] especially those in computing. In 2000, 46 per cent of males in computing jobs in the UK were graduates compared with 45 per cent of females. Of the males in computing jobs only 19 per cent had graduated in an ITEC-related subject and even fewer of the females (16 per cent) were qualified in an ITEC-related subject. 40 per cent of graduates (41 per cent of men and 35 per cent of women) in computing jobs had graduated in an ITEC-related subject.

Figure 16: The graduate base of ITEC jobs in the UK, 2000



Source: Office of National Statistics (ONS) Labour Force Survey, March-May, 2000.

Female software engineers in particular were better educated than male software engineers – more of the women software engineers were graduates (71 per cent women, 57 per cent men). Moreover, women software engineers were more likely than men to have graduated in an ITEC-related subject[75] – 33 per cent of female software engineers and 33 per cent of male software engineers had graduated in an ITEC-related subject. 40 per cent of the graduate male software engineers and 46 per cent of the graduate female software engineers were qualified in an ITEC-related subject. Over half of the graduate software engineers, and more men than women, had graduated in a non-ITEC related subject.

There appears to have been little variation in the proportions of male and female graduates in electronics and electrical jobs and in other ITEC jobs (where data are sufficiently robust to provide a basis for analysis).

[74] ITEC jobs have been clustered here into three main groups: computing jobs (spanning computer systems managers, software engineers, computer analysts/programmers and computer engineers), electronics and electrical jobs (comprising electrical and electronic engineers and technicians) and other ITEC jobs (made up of telephone fitters, cable jointers, line repairers and radio, TV and video engineers).

[75] In this instance, the classification of degree-level subjects into those that could be considered 'ITEC-related' in the UK has been based on the analysis of a wide range of disciplines, those that were used to construct this category (Table 29). The term 'ITEC-related subject' that is used in this section of the report, therefore, departs from its usage elsewhere to refer to courses in computer science, business studies, engineering and technology and mathematics.

Table 30 shows the subjects that those with degree level qualifications[76] in ITEC occupations in 2000 graduated in. Most (40 per cent) of the graduates in ITEC occupations had degrees in maths and computing. Next to maths and computing, the most common graduate qualifications were engineering and technology (21 per cent), physics and environmental sciences (11 per cent), and business and vocational studies (9 per cent).

Graduate computer analysts/programmers and computer systems managers (the two occupations where women tend to be concentrated) displayed the greatest range of graduate subject qualifications, followed by software engineers (where women represented the majority of the graduate population).

Gender differences in graduate-level qualifications among the ITEC workforce in the UK

There are some differences between the graduate qualifications of men and women in ITEC occupations.[77] The four most popular graduate qualifications for men in ITEC jobs were the same as those in the overall population:

- Maths and computing
- Engineering and technology
- Physics and environmental sciences
- Business and vocational studies.

Together, qualifications in these subjects accounted for 83 per cent of the total single subject qualifications of male graduates in ITEC jobs.

In contrast, the four most popular single subject graduate qualifications for women are:

- Maths and computing
- Business and vocational studies
- Social sciences
- Biological sciences.

Together, these four subjects accounted for 78 per cent of the total graduate qualifications of women in ITEC occupations. Slightly more women than men (42 per cent against 41 per cent) in ITEC jobs had graduated in maths and computing.

1.4 Women in ITEC jobs in the UK: the evidence base

The main focus of this section is on the participation of women in the ITEC sector and ITEC occupations in the UK. The analysis provides evidence relating to the scope, scale and pattern of women's work in ITEC.

Women in ITEC careers in the UK – trends over time

In 2000, women represented 45 per cent of employment in the UK. ITEC-related employment in the UK was not confined to the core ITEC sector, it was spread much more widely across the economy (Table 5). Only half (49 per cent) of ITEC occupations were in the ITEC sector. The majority of men in ITEC occupations (52 per cent) worked in the ITEC sector. In contrast, most of the women (68 per cent) in ITEC jobs were employed outside the ITEC sector. Only 32 per cent of the women in ITEC occupations were in the ITEC sector.

[76] These data include both single subject and combined subject degree level qualifications.

[77] Based on an analysis of single subject graduate qualifications only.

Table 5: The sector distribution of ITEC employment in the UK, 2000

	126 computer systems etc managers	212 electrical engineers	213 electr'nic engin'rs	214 software engineers	302 electrical, electronic tech's	320 computer analysts, pro-grammers	523 telephone fitters	524 cable jointers, lines repairers	525 radio, TV & video engineers	526 computer engineers etc	All ITEC Occupations
Male & Female											
Other Sectors	108,839	27,889	25,741	49,801	20,337	167,077	12,284	–	15,928	22,584	459,719
ITEC Sector	70,420	10,673	11,686	136,102	–	132,986	34,380	–	–	35,014	449,459
% in ITEC sector	39.3	27.	31.2	73.2	–	44.3	73.7	–	–	60.8	49.4
Males											
Other Sectors	81,368	27,372	25,344	45,827	20,073	119,103	12,284	–	15,928	21,774	378,312
ITEC Sector	62,825	10,305	10,577	125,049	–	117,638	33,201	–	–	34,037	410,407
% in ITEC sector	43.6	27.4	29.4	73.2	–	49.7	73.0	–	–	61.0	52.0
Females											
Other Sectors	27,471	–	–	–	–	47,974	–	–	–	–	81,407
ITEC Sector	–	–	–	11,053	–	15,348	–	–	–	–	39,052
% in ITEC sector	–	–	–	–	–	24.2	–	–	–	–	32.4

Source: Office of National Statistics (ONS) Labour Force Survey, March-May, 2000.

Some ITEC jobs were concentrated in the ITEC sector. For example, most software engineers, computer engineers and telephone fitters worked in the ITEC sector and, again, the majority of these were men. Other ITEC jobs, such as computer systems managers, electrical and electronic engineers, and computer analysts/programmers, are more widely spread across the economy, and most of these jobs were in other, non-ITEC, sectors.

Women were vastly under-represented in ITEC in 2000. They were the minority, 13 per cent, of ITEC occupations across the UK economy and represented a mere 9 per cent of ITEC jobs within the core ITEC sector.

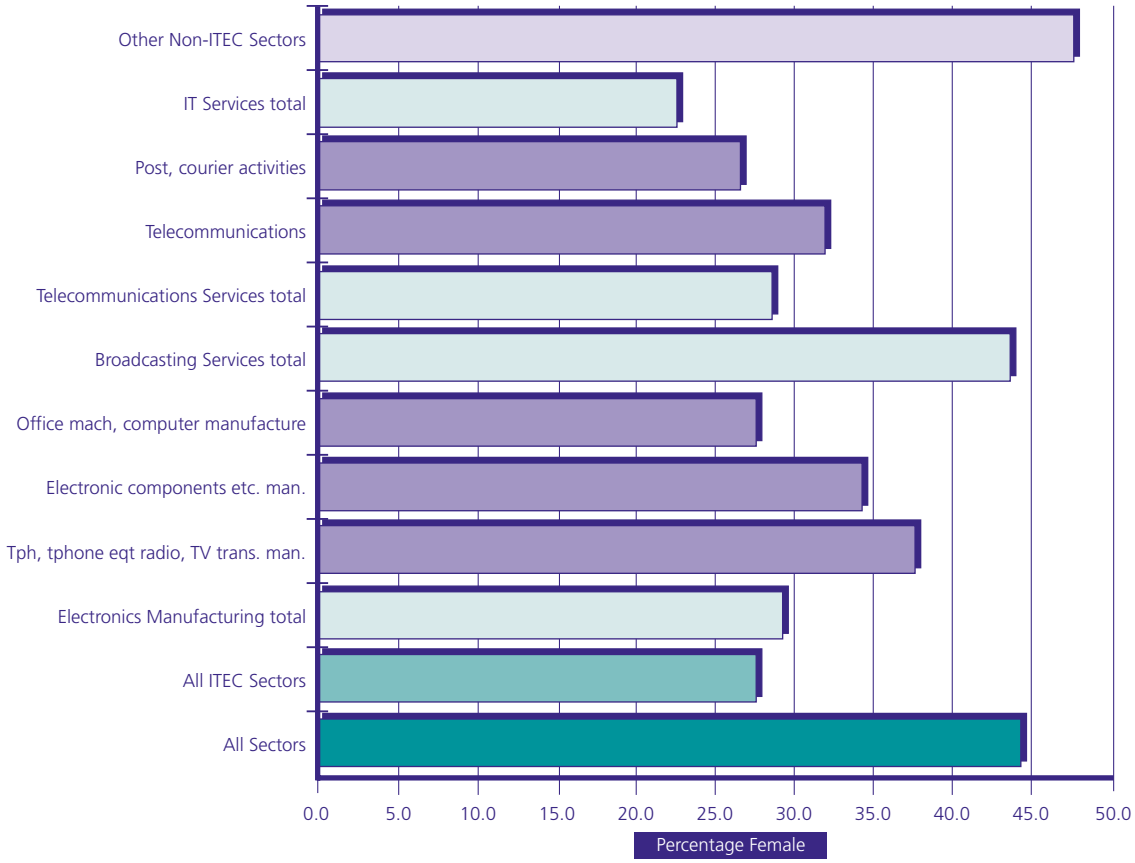
Women's participation in certain ITEC jobs, particularly engineering-related jobs, across all sectors of the economy, was minimal (Table 32). There were very few women radio, TV or video engineers, electrical engineers and electrical and electronic technicians, computer engineers and electronic engineers.

Most women were either employed as computer analysts/programmers or computer systems managers – where women were 21 per cent and 20 per cent of the workforce respectively (Table 32). However, even in these occupations, women were more severely under-represented in the ITEC sector than in other sectors. Only about 12 per cent of all computer systems managers and computer analysts/programmers in the ITEC sector were women. Most women were employed outside the ITEC sector, in other, non-ITEC, sectors and here they represented about 28 per cent of all computer analysts/programmers and 25 per cent of computer systems managers.

Women in the ITEC sector in the UK

Figure 17 (and Table 31) shows the pattern of women's employment within the ITEC sector in 2000. There were very few women employed in the ITEC sector (28 per cent) and the level of their participation (all occupations) fell considerably below that in other, non-ITEC, sectors (46 per cent). Women represented only 23 per cent of the workforce in IT services, about 28 per cent in telecommunications services, and 29 per in electronics manufacturing. Women were relatively well represented in the broadcasting services industry, where they made up 44 per cent of the workforce. However, most women who are employed in these ITEC sector industries do not work in ITEC occupations. About 21 per cent of women in the ITEC sector are in clerical occupations, a further 10 per cent are assemblers or inspectors and another 8 per cent are in sales related jobs.

Figure 17: Women's participation in the core ITEC sector in the UK, 2000

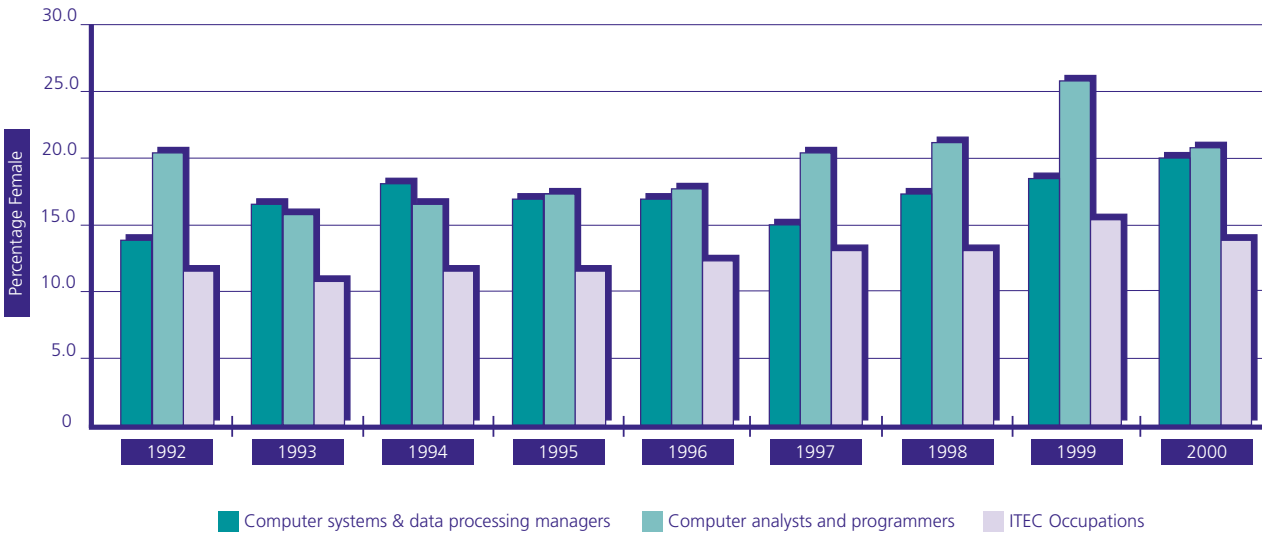


Source: Office of National Statistics (ONS), Labour Force Survey, March-May 2000.

Women in ITEC occupations in the UK

In 2000, women were vastly under-represented in ITEC jobs, both within the ITEC sector (9 per cent) and in other, non-ITEC, sectors (18 per cent) (Table 31). The level of women's participation in ITEC occupations was also well below the level of their participation in other occupations in the ITEC sector (28 per cent) and in other sectors (46 per cent) (Table 31). Within the ITEC sector, most women working in ITEC jobs were in the IT services industry.

Figure 18: Women's participation in selected ITEC occupations in the UK, 1992-2000



Source: Office of National Statistics (ONS), Labour Force Survey (various years)

Time series data show that about 13 per cent of all those in ITEC occupations across the UK economy in 2000 were women (Figure 18, Table 32) and that this was a recent decline from a peak (16 per cent) in 1999. The number of women in ITEC occupations in 2000, 120,459, had fallen from 140,580 in 1999.

While the proportion of women computer systems managers (20 per cent) has increased in recent years (since 1997)[78] the proportion of women computer analysts/programmers has recently declined from 26 per cent in 1999 to 21.1 per cent in 2000[79] (below the 1998 level of 21.3 per cent) (Figure 18). With the exception of software engineering where women accounted for about 8 per cent[80] the proportion of women working in other ITEC jobs between 1992 and 2000 was almost negligible.

Women's status in ITEC occupations in the UK

Women working in ITEC jobs earned less than men in 2000 (Table 6).[81] In the two ITEC occupational categories[82] where women were relatively well represented – computer system managers and computer analysts/programmers – the median gross hourly salaries of the women were between 86 and 79 per cent of those of the men.

Table 6: Median gross hourly salaries of men and women working in ITEC in the UK, 2000

ITEC Occupation	Male (£)	Female (£)	Differential
Computer systems managers	16.83	13.23	21%
Computer analysts & programmers	11.95	10.26	14%

Source: Office of National Statistics (ONS) Labour Force Survey, March-May, 2000.

Hence there was a pay differential of 14 per cent in the salaries of men and women computer analysts and programmers, and 21 per cent in the salaries of men and women computer systems managers. The salary differential between the genders increased with professional status.

Opportunities for non-standard work in ITEC in the UK

Part-time employment is increasingly common in the UK (Figure 19, Table 33, Table 34) in 2000, over a quarter (27 per cent) of all employment was part-time. However, within the ITEC sector part-time employment is relatively rare, only 11 per cent of employment is part-time. Women were more likely than men to work part-time in the ITEC sector (26 per cent female, 5 per cent male).

[78] In 1997 there were 21,181 women computer systems managers and in 2000 there were 36,066.

[79] In 1999 there were 78,429 women employed as computer analysts/programmers and in 2000 there were 63,322.

[80] In 2000, there were 15,027 women software engineers.

[81] Data on median salaries are used in order to counter the tendency for the results to be skewed by a few very highly paid individuals. In addition, the data relate to gross hourly wages, rather than monthly or yearly salaries in order to account for differing work patterns, e.g. part-time work.

[82] Reliable Labour Force Survey data on salaries by gender are only available for these two occupational categories.

Figure 19: Part-time employment in the UK ITEC sector, 2000

Source: Office of National Statistics (ONS), Labour Force Survey, March-May 2000.

An occupational analysis of full- and part-time work shows that almost all ITEC jobs in the economy were full-time, with the exception of a few computer analyst/programmer occupations (Table 7), where women's participation in ITEC employment was highest.

Table 7: Full- and part-time employment in ITEC occupations in the UK, 2000

	Full-time	Part-time	% Part-time
Other, non-ITEC, occupations	19,939,644	6,884,126	25.7
Computer systems etc managers	172,113	-	-
Electrical engineers	37,791	-	-
Electronic engineers	37,030	-	-
Software engineers	179,023	-	-
Electrical, electronic technicians	29,265	-	-
Computer analysts, programmers	283,464	16,599	5.5
Telephone fitters	45,759	-	-
Cable jointers, lines repairers	12,916	-	-
Radio, TV & video engineers	20,798	-	-
Computer engineers etc	53,847	-	-
All ITEC occupations	872,006	37,172	4.1
All occupations	25,599,932	9,389,283	26.8

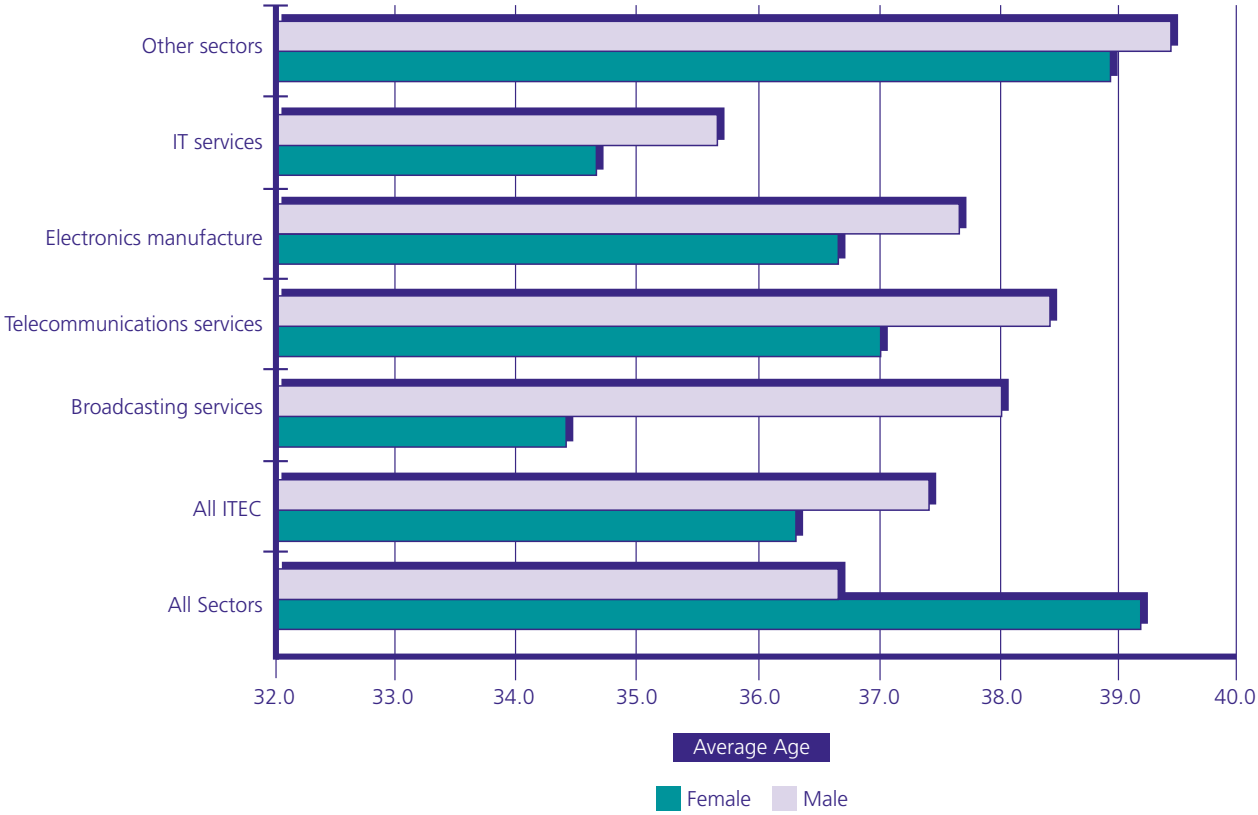
Source: Office of National Statistics (ONS) Labour Force Survey, March-May, 2000.

The proportion of those employed part-time in ITEC occupations (4 per cent) was far below the proportion of those employed part-time in other occupations (26 per cent).

The average age of ITEC-employment in the UK

The average age of people in the ITEC sector in the UK is 37 (37 for men and 36 for women). This is slightly younger than the average age of those in other, non-ITEC, sectors. Figure 20 (and Table 35) show the average ages of men and women in particular ITEC sector industries. With a few exceptions, women in ITEC sector industries are younger than men – this is most notable in broadcasting services, where the average age of women (34) is four years younger than men (38). This contrasts strongly with employment generally where, on average, women are older than men.

Figure 20: The average age of people working in the core ITEC sector in the UK, 2000

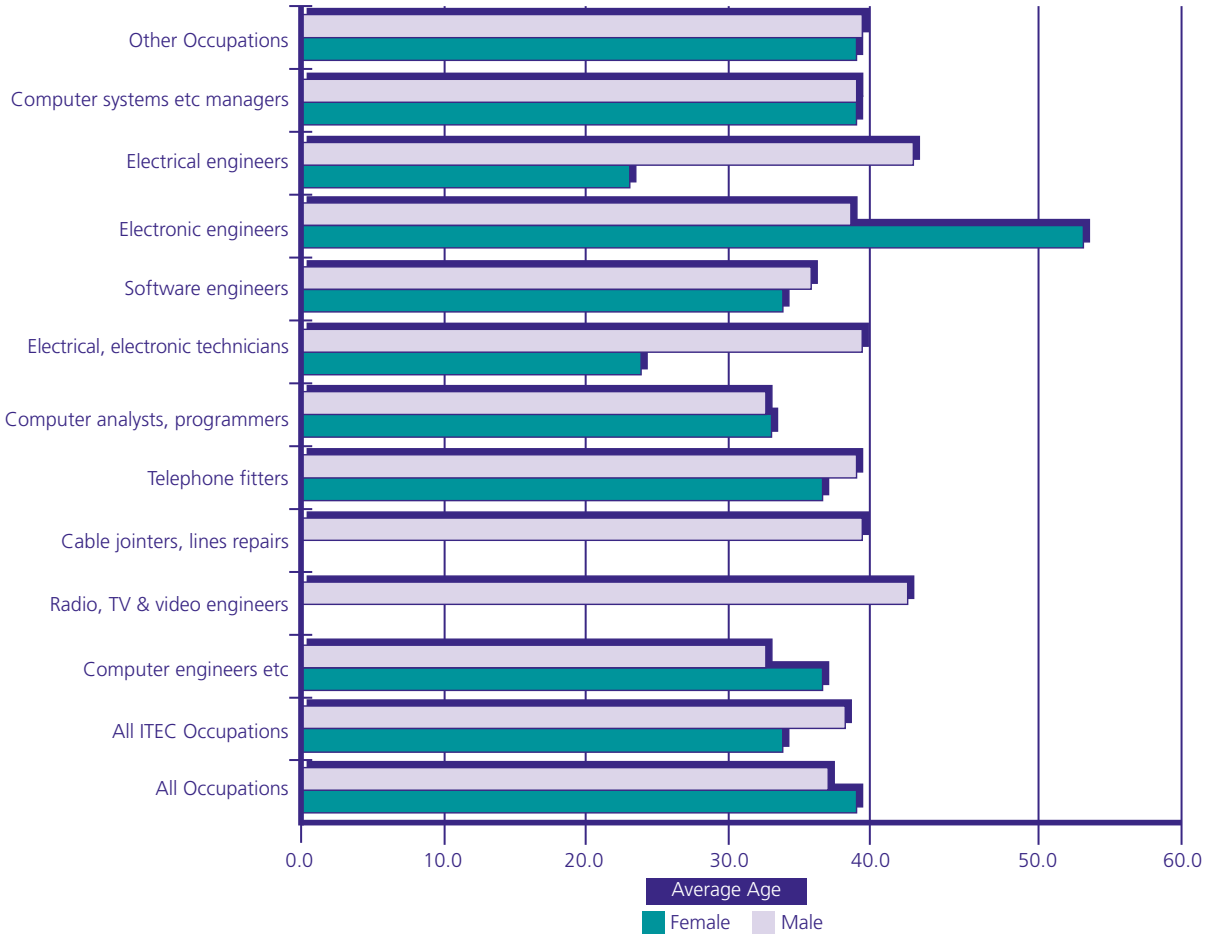


Source: Office of National Statistics (ONS), Labour Force Survey, March-May 2000.

Men and women in the IT services sector (36 for men and 35 for women) are, on average, younger than men and women in the ITEC sector as a whole, as are women working in broadcasting services (38 for men, 34 for women).

People in ITEC occupations throughout the UK economy are, on average, younger (36 years of age) than those in the ITEC sector (Figure 21, Table 36).

Figure 21: The average age of people in ITEC jobs in the UK, 2000



Source: Office of National Statistics (ONS), Labour Force Survey, March-May 2000.

Further analysis reveals differences between the average ages of men and women in ITEC occupations in the UK – the average age for men is 38 and for women is 34 (Figure 21). Women who hold ITEC jobs in the UK (34) are four years younger on average than men (38), three years younger than the average age of people working in the ITEC sector (37), and five years younger than the average age of people in other occupations (39) (Table 36).

No detailed occupational analysis is possible due to the small number of women in some occupations – this means that taking average ages for women in these occupations is unreliable. However, female software engineers are three years younger than their male counterparts (at 33 compared to 36) but female and male computer analysts and programmers are the same age at 34.

2. Women in ITEC courses and careers in the US

2.1 Chapter summary

Access/Education

- Women represented the majority (56 per cent) of the graduate population in 1996/97
- 40 per cent of graduates in ITEC-related subjects were women
- The participation of women, both numerically and proportionally, in ITEC-related courses was skewed towards business studies
- Women were particularly under-represented among graduates in computer and information science (27 per cent) and engineering (16 per cent)
- The proportion of women graduating from all ITEC-related courses except computing and information science has been increasing since 1971/72
- The decline in the numbers graduating in computing and information science, together with the reduction in the proportion of women graduating, has reduced the supply of women with Bachelor's level degrees in computing and information science from 14,966 in 1985/86 to 6,731 in 1996/97.

Recruitment/Employment

- ITEC employment is graduate intensive, and the majority of the better educated workforce (all occupations) in the ITEC sector in 2000 were male
- Women in ITEC occupations tend, in general, to be better educated than men – i.e. a higher proportion of the women in ITEC occupations were graduates than the men.
- 47 per cent of all ITEC occupations were located within the core ITEC sector
- In 2000 more men than women worked in ITEC occupations – both within the ITEC sector and in other sectors
- The majority of women in ITEC occupations worked outside the ITEC sector (64 per cent), whereas the majority of men worked in it (52 per cent)
- Women were under-represented in the ITEC sector (37 per cent)
- Women represented 21 per cent of ITEC jobs within the ITEC sector, and 34 per cent of ITEC jobs in other, non-ITEC, sectors
- Within the ITEC sector, there were higher proportions of women in ITEC jobs in telecommunications services (23 per cent) and IT services (22 per cent) than in electronics manufacturing (18 per cent) and broadcasting services (12 per cent)
- Women's participation in ITEC occupations across the US economy (28 per cent), which, in 2000, was already below that expected given the extent of their participation in other, non-ITEC, occupations and sectors (48 per cent), declined between 1993 (when women made up 37 per cent of those in ITEC jobs) and 2000.

Employment/Retention

- Women were relatively well represented in lower status ITEC occupations in the year 2000
- 12.2 per cent of employment (all occupations) in the ITEC sector in 2000 was part-time. Women were more likely than men to work part-time in the ITEC sector (16.4 per cent against 9.8 per cent)
- 13.9 per cent of ITEC jobs were part-time, and women were much more likely than men to work in these part-time ITEC jobs (18.3 per cent of the women in ITEC jobs worked part-time, compared with 12.2 per cent of the men)
- Both men and women in the US were much less likely to be working part-time in ITEC occupations and in ITEC sectors than overall (all sectors and all occupations) where 23.9 per cent of work was part-time

- While in 2000 there was little overall difference in the average ages of men and women working in ITEC sectors or occupations, in some sub-sector industries, such as IT services and broadcasting services, women were younger than men.

2.2 Introduction

This chapter focuses on the proportion of women in ITEC courses and careers in the US. There are two main parts to this analysis.

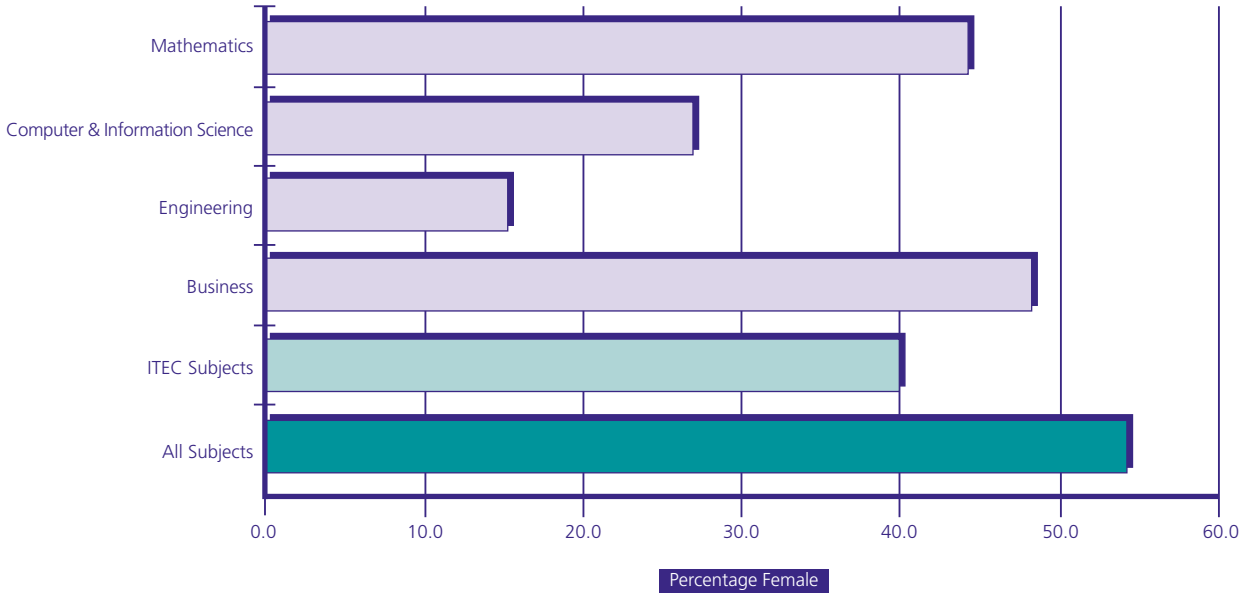
- First, the chapter examines patterns and trends in the data on the participation of women on ITEC-related courses in the US. It presents evidence on the educational base of occupations in the ITEC sector and examines the formal qualifications of those in the ITEC sector and in ITEC jobs.
- Second, evidence relating to the scope, scale and nature of women's participation in the ITEC sector and in ITEC occupations is presented.

2.3 Women in ITEC-related courses in the US: the evidence base

Graduation from university in ITEC-related subjects

Women were the majority (56 per cent) of all university graduates in the US in 1996/97 (Table 45). In that year, 29 per cent of all graduates received degrees in an ITEC-related subject, 40 per cent of which were women. Numerically more women graduated in business than in engineering, in engineering than in computer and information science, and in computer and information science than in mathematics. 49 per cent of business graduates were women. The proportion of women business graduates was higher than in any other ITEC-related subject (Figure 22). 46 per cent of mathematics graduates were women, as were 27 per cent of computer and information science graduates and 16 per cent of engineering graduates (Figure 22, Table 45).

Figure 22: The proportion of women graduates in ITEC-related subjects in the US, 1996/97

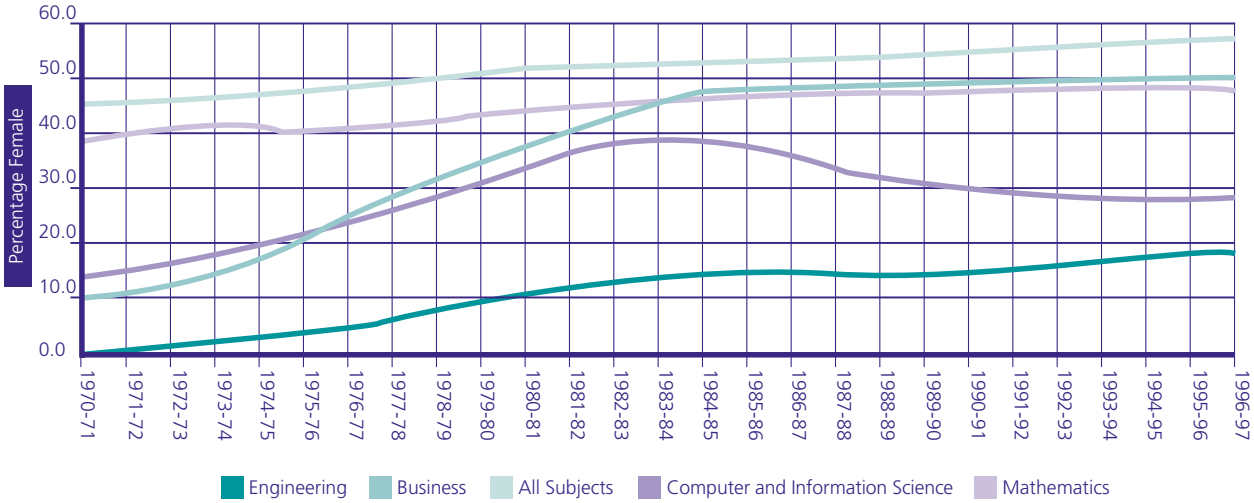


Source: National Centre for Education Statistics, (2000), Digest of Education Statistics 1999, Washington

The proportion of women graduating from university in the US has been rising steadily since 1971/72 (Figure 23, Table 45). The proportion of women mathematics graduates, while lower than the overall proportion of women among the graduate population, has also been increasing (Figure 23, Table 45).

The general trend in the proportion of women graduates in business, which showed rapid growth between 1971/72 and 1984/85 from 10 per cent to 45 per cent, has continued to be upward. The proportion of women engineering graduates, while still small, has also been increasing steadily over time (Figure 23, Table 45).

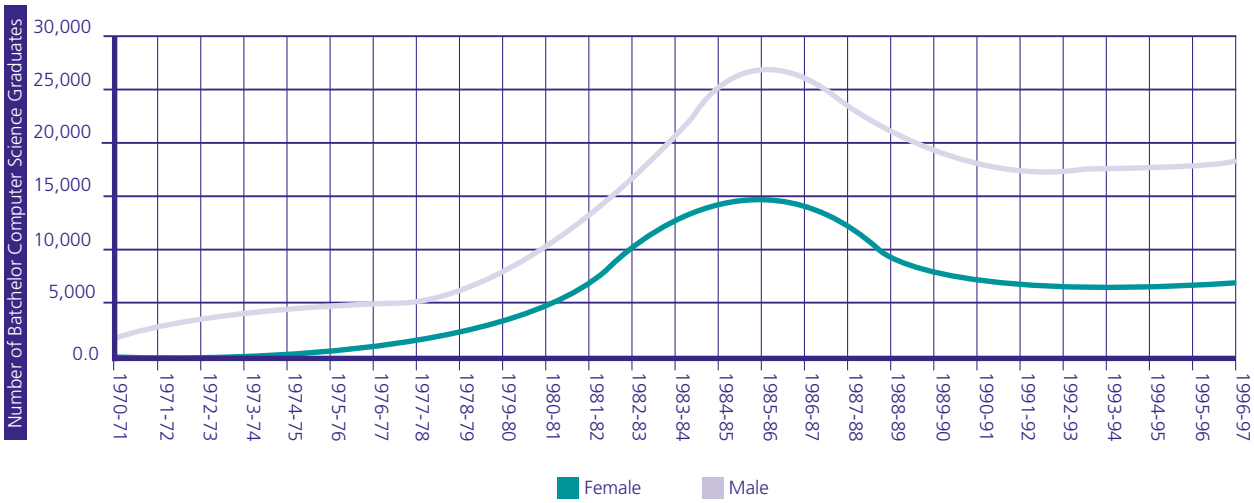
Figure 23: Graduation in ITEC-related subjects in the US, 1970/71-1996/97



Sources: National Centre for Education Statistics, Digest of Education Statistics (1994 and 1999).

In contrast, the proportion of women computer and information science graduates has declined quite rapidly since a peak in 1983/4 of 37 per cent. This decline does not, however, appear to be confined to women. The proportion of male computer science graduates also declined over the same period, but more gradually. The number of women graduating in computer and information science in the period 1985/86 to 1996/97 has more than halved (from 14,966 in 1985/86 to 6,731 in 1996/97). There has also been a reduction in the total number of graduates in computer and information science – from 41,889 in 1985/86 to 24,768 in 1996/97 (Figure 24, Table 45).

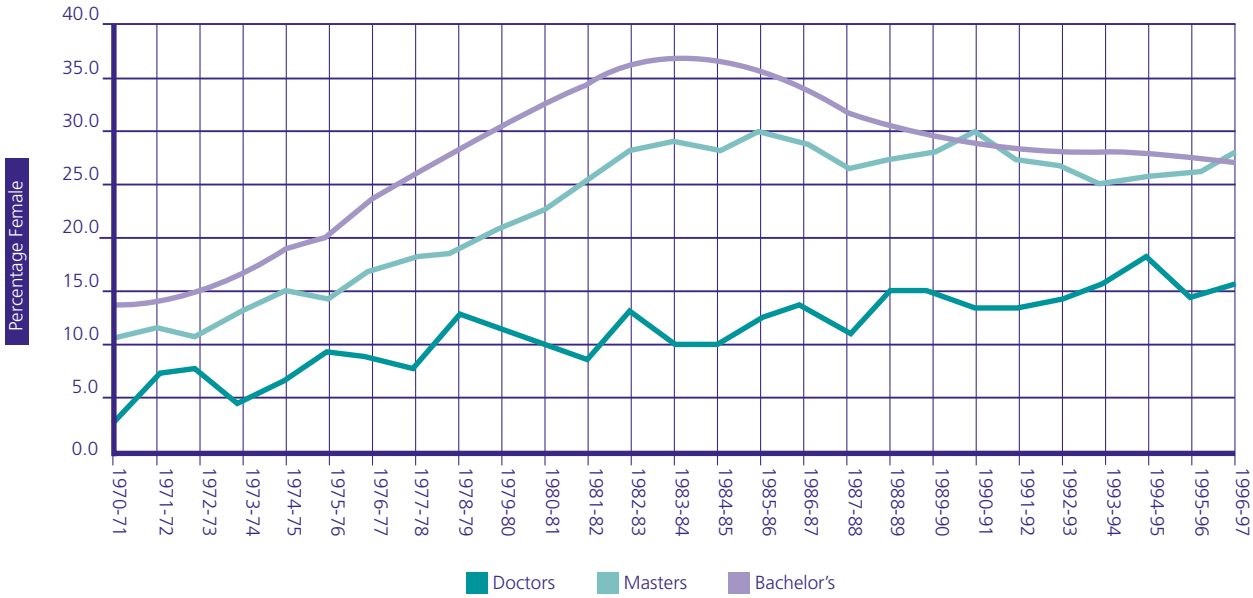
Figure 24: Bachelor degrees in computer and information sciences in the US, 1970/71-1996/97



Sources: National Center for Education Statistics, Digest of Education Statistics (1994 and 1999), Washington

The general decline in the proportion of women graduates in computer and information science, however, appears to be confined to Bachelor's level degrees. Although the proportion of women among Master's level graduates in computer and information science has shown signs of punctuated decline (particularly between 1985/86 and 1993/94 (Figure 25, Table 45)) the overall trend between 1970/71 and 1996/97 has been towards growth.

Figure 25: University graduates in computer and information science in the US 1970/71-1996/97



Sources: National Center for Education Statistics, Digest of Education Statistics (1994 and 1999), Washington

Women were severely under-represented among Doctoral graduates in computer and information science, with only 16 per cent in 1996/97 being women.

The education base of employment in the ITEC sector (all occupations) in the US

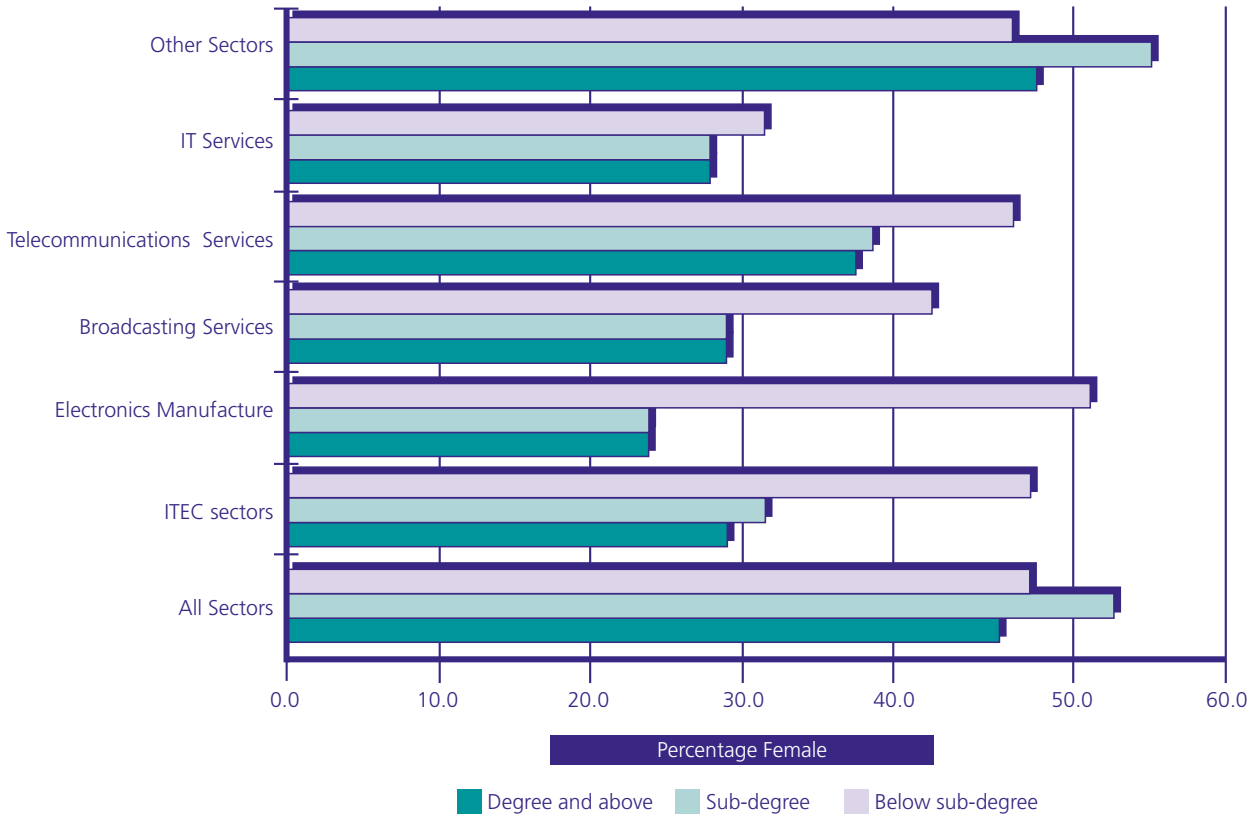
In 2000 in the US, the ITEC sector is a major employer of graduates – 38 per cent of ITEC sector employment were graduates (43 per cent of the males and 29 per cent of the females) as opposed to 26 per cent (equal males and females) in other, non-ITEC sectors. There was also a high proportion of women who had not received a college education in the ITEC sector (62 per cent of the women, 42 per cent of the men) (Table 46).

Not surprisingly given their low participation, women at all levels of education were clearly under-represented in the ITEC sector in 2000. The level of participation of female graduates in the ITEC sector (29 per cent) was considerably lower than might be expected given the level of their participation in other sectors, where 48 per cent of all graduates are women.

Women with sub-degree levels of education were also under-represented (Figure 26, Table 46) in the ITEC sector. Only 30 per cent of those in the ITEC sector who were educated to sub-degree level[83] were women, compared to 55 per cent in other, non-ITEC sectors.

[83] This includes some, post-school, college qualifications.

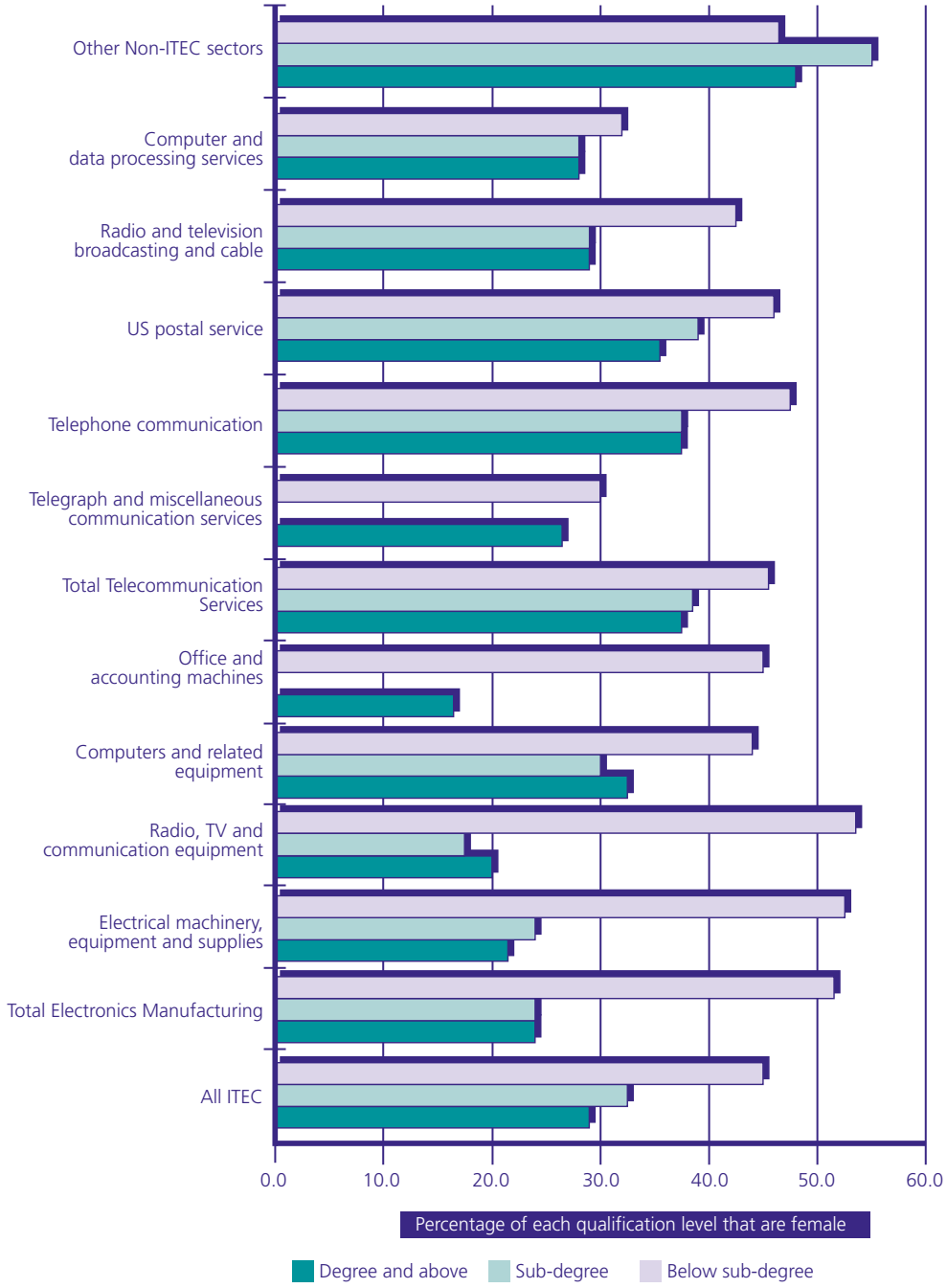
Figure 26: The education base of women in the ITEC sector in the US, 2000



Source: Bureau of Labor Statistics, Annual Demographic Survey, March 2000 Current Population Survey

Within the ITEC sector in 2000, 37 per cent of graduates in the telecommunication services industry (Figure 26, Table 46), 37 per cent in telephone communication and 36 per cent in US postal service industries (Figure 27) were women.

Figure 27: The education base of women in ITEC sector industries in the US, 2000



Source: Bureau of Labour Statistics, Annual Demographic Survey, March 2000 Current Population Survey

In most of the other ITEC sector industries women were between 24 and 29 per cent of the graduate workforce (Figure 27, Table 46). Women graduates were particularly poorly represented among graduates in the electronics manufacturing industry, where the majority (51 per cent) of those without a college education were women (Figure 26). The level of participation of women without a college education in the ITEC sector (45 per cent) is only slightly lower than the level of their participation in other, non-ITEC sectors (47 per cent) (Figure 26, Table 46).

The majority of the highly educated workforce in the ITEC sector was male (Table 47). 43 per cent of the men in the ITEC sector in March 2000 were educated to degree level or above as opposed to only 19 per cent of the women. The percentage of women in the ITEC sector with degree level qualifications was higher than the proportion of all women with degrees in other, non-ITEC, sectors (26 per cent) and in all sectors of the US economy (26 per cent) (Table 47).

The education base of ITEC occupations in the US

ITEC jobs in the US were graduate intensive (Table 48) in 2000. As males were the majority of those in ITEC occupations, it is not surprising that the percentage of people (men and women) in ITEC occupations who were male graduates (30 per cent) was higher than female graduates (12 per cent). In other non-ITEC occupations, 13 per cent of those employed were male graduates and 12 per cent were female graduates.

The participation of female graduates in ITEC occupations was, therefore, similar to the level of their participation in other, non-ITEC jobs. In contrast, there was a substantially higher percentage of male graduates in ITEC jobs than in other, non-ITEC, occupations.[84] ITEC jobs where male graduates were particularly heavily concentrated include:

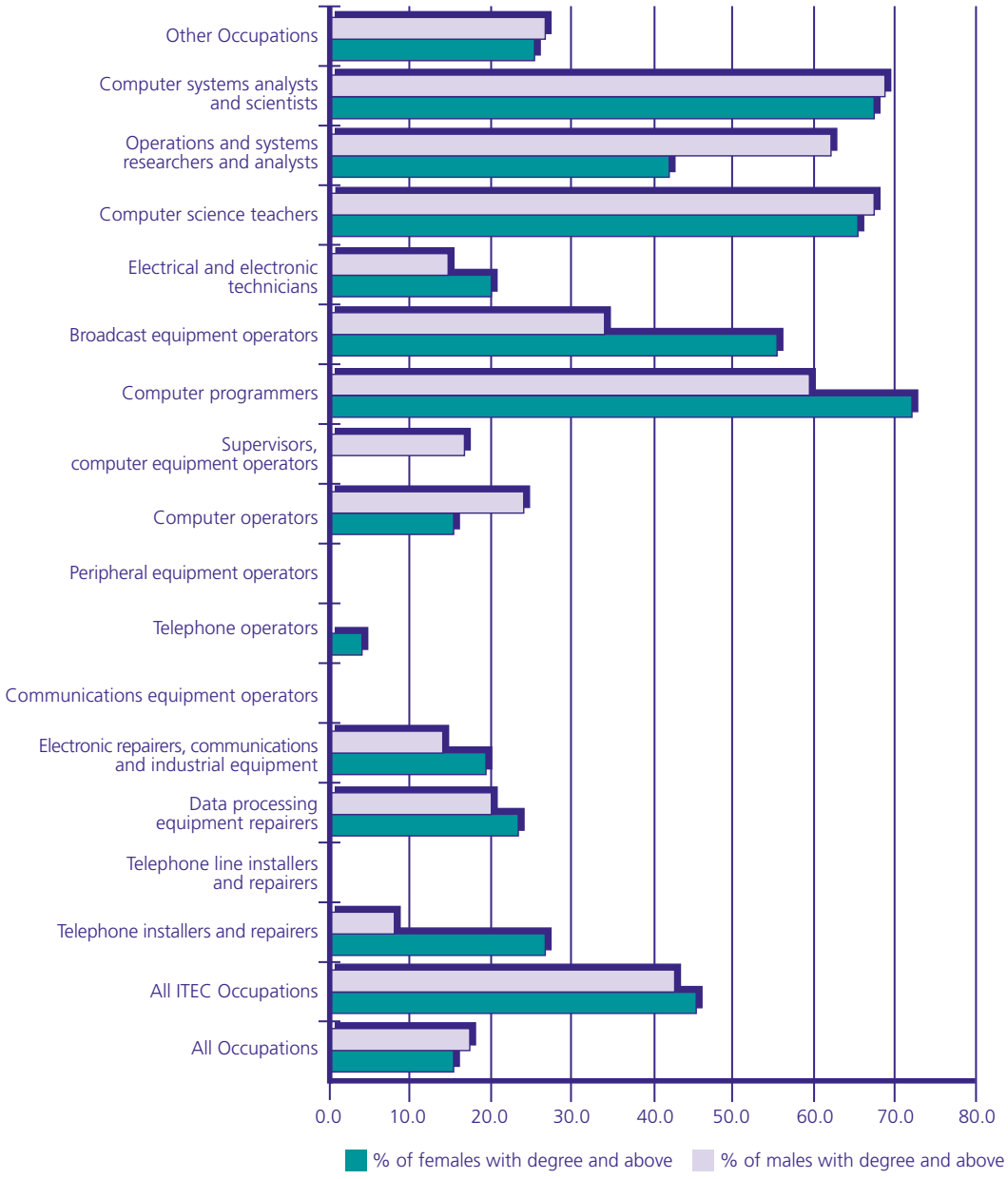
- computer systems analysts and scientists (48 per cent of all those employed were male graduates, 19 per cent female graduates)
- computer science teachers (64 per cent of all those employed were male graduates, 4 per cent female graduates),
- computer programmers (43 per cent of all those employed were male graduates, 21 per cent female graduates)
- operations and systems researchers and analysts (34 per cent of all those employed were male graduates, 19 per cent female graduates)
- broadcast equipment operators (29 per cent of all those employed were male graduates, 9 per cent female graduates)
- electronics, communications and industrial equipment repairers (13 per cent of all those employed were male graduates, 1 per cent female graduates)
- supervisors, computer systems operators (12 per cent of all those employed were male graduates, no female graduates).

However, the women occupying ITEC jobs in the US were generally more highly educated than the men; in 2000 44 per cent of all the women, but only 42 per cent of all the men in ITEC jobs were graduates (Figure 28, Table 49). Of the women employed, the percentage that were graduates was considerably higher among those in ITEC jobs (44 per cent) than among those in other, non-ITEC, jobs (26 per cent).

Disproportionately high percentages of the women graduates were in lower skilled occupations, such as telephone operators, data processing equipment repairers, telephone installers and repairers, and electronics, communications and industrial equipment repairers. There were lower proportions of the male graduates in these occupations.

[84] Reflecting the generally high levels of male, and low levels of female participation in these jobs.

Figure 28: The proportion of men and women graduates in ITEC occupations in the US, 2000



Source: Bureau of Labour Statistics, Annual Demographic Survey, March 2000 Current Population Survey

The proportions of male and female graduates in jobs not involving ITEC in March 2000 were similar (Figure 28). However, the relative proportions of male and female graduates in certain ITEC jobs varied considerably. For example, the proportion of the female broadcast equipment operators (56 per cent), computer programmers (72 per cent), and electrical and electronic technicians (20 per cent) with degrees was substantially higher than the proportion of the male broadcast equipment operators (34 per cent), computer programmers (60 per cent), and electrical and electronics technicians (15 per cent) who were graduates.

Only among operations and systems researchers and analysts, supervisors, computer equipment operators, computer operators and computer science teachers was the proportion of graduate males higher than the proportion of graduate females (Figure 28, Table 49).

2.4 Women in ITEC careers in the US: the evidence base

ITEC occupations in the US are not confined to the ITEC sector. In the US, just under half (47 per cent) of ITEC occupations in March 2000 were within the ITEC sector per se. The majority of the women (64 per cent) in ITEC jobs worked outside the ITEC sector whereas the majority (52 per cent) of the men in ITEC jobs worked within it.

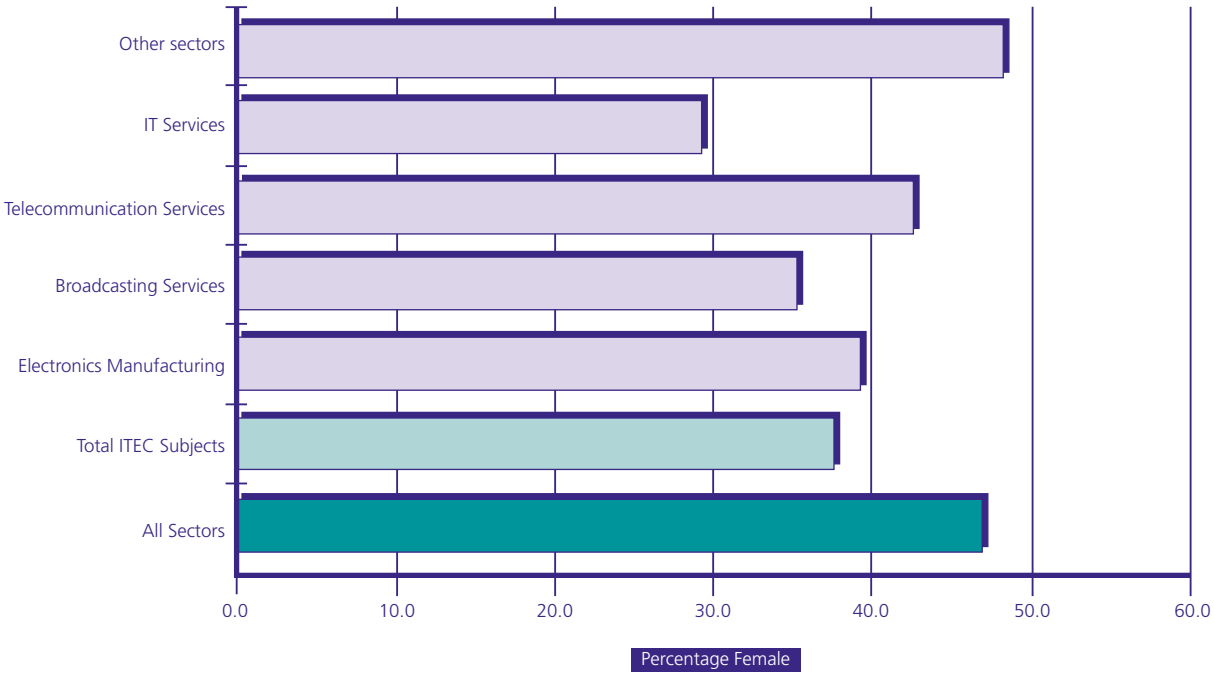
Women in the ITEC sector in the US

Women were generally well represented in the ITEC sector (37 per cent, all occupations) (Figure 29, Table 51) and in other, non-ITEC, occupations within ITEC sector industries (44 per cent) (Table 50).

However, the participation of women in ITEC occupations within the ITEC sector (21 per cent) was particularly low and below that expected, given the level of their participation in other, non-ITEC, occupations within the sector (44 per cent) and in ITEC occupations in other, non-ITEC sectors (34 per cent) (Table 50).

In aggregate, a higher proportion of women in ITEC jobs within the ITEC sector in the US worked in IT services (22 per cent) and telecommunication services (23 per cent) than in electronics manufacturing (18 per cent) and broadcasting services (12 per cent) (Table 50). These figures stand in contrast to the relatively high levels of women's participation in other occupations in those industries (Table 50). In the US, the largest proportion (38 per cent) of women in ITEC occupations within the ITEC sector was employed in the US postal service.

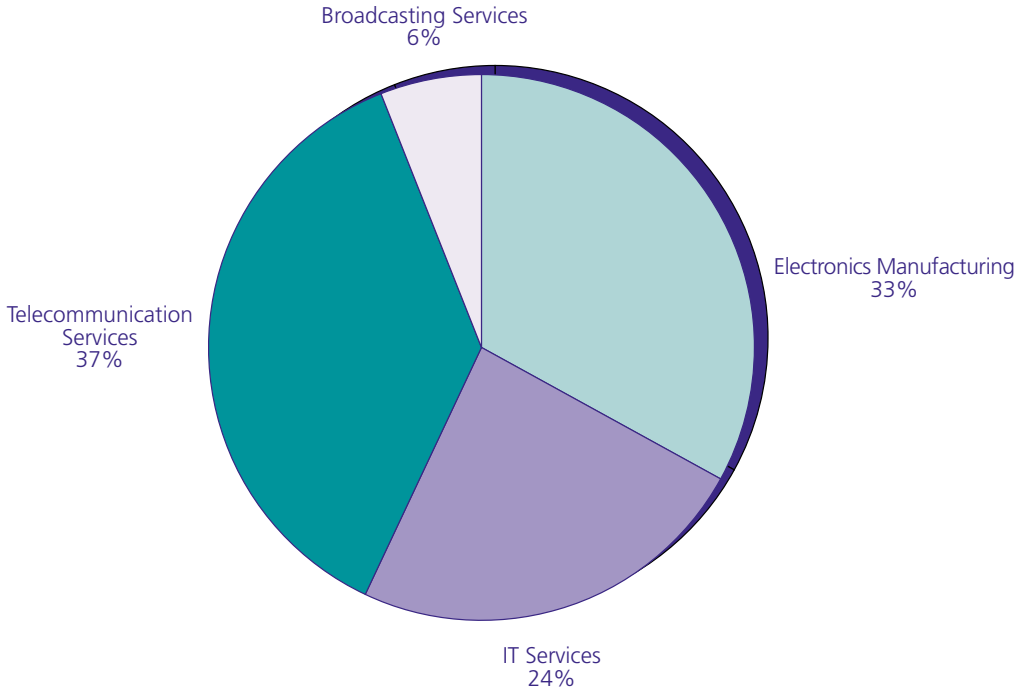
Figure 29: The proportion of women in the ITEC sector (all occupations) in the US, 2000



Source: Bureau of Labor Statistics, Annual Demographic Survey, March 2000 Current Population Survey

In the ITEC sector (all occupations), women were particularly concentrated in the telecommunications services industry (especially the US postal services and the telephone communication industries), and in the electrical machinery, equipment and supplies industries (Figure 29). The levels of female participation in these ITEC sector industries (44 per cent, 55 per cent and 43 per cent respectively) were around the average for women in non-ITEC jobs in other, non-ITEC sectors (48 per cent) (Table 50, Table 51, Table 52).

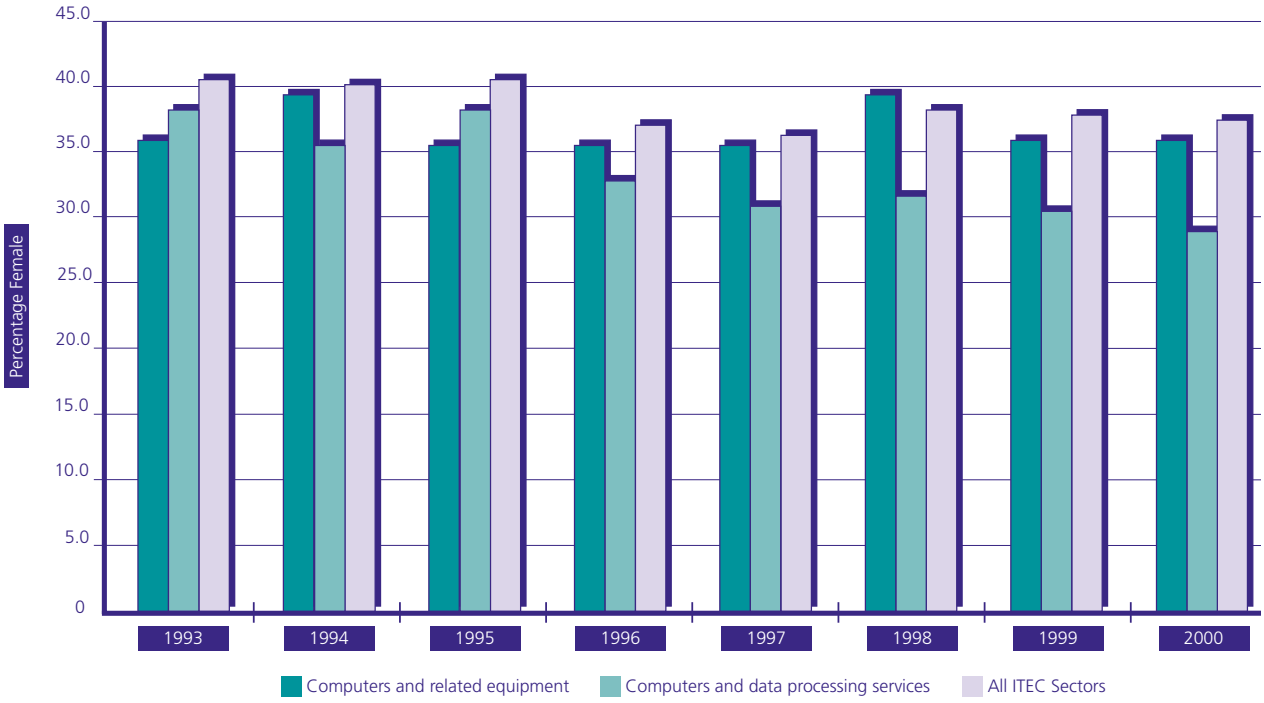
Figure 30: The distribution of women in the ITEC sector in the US, 2000



Source: Bureau of Labor Statistics, Annual Demographic Survey, March 2000 Current Population Survey

Time series data reveal that the proportion of women in key ITEC sector industries in the US has tended to cluster at between 36-40 per cent (Figure 31). However, downward trends can be observed in the participation of women in the computer and data processing services sector and in the radio, TV, broadcasting and cable industries in the US between 1993 and 2000.

Figure 31: Women in ITEC sector jobs in the US, 1993-2000



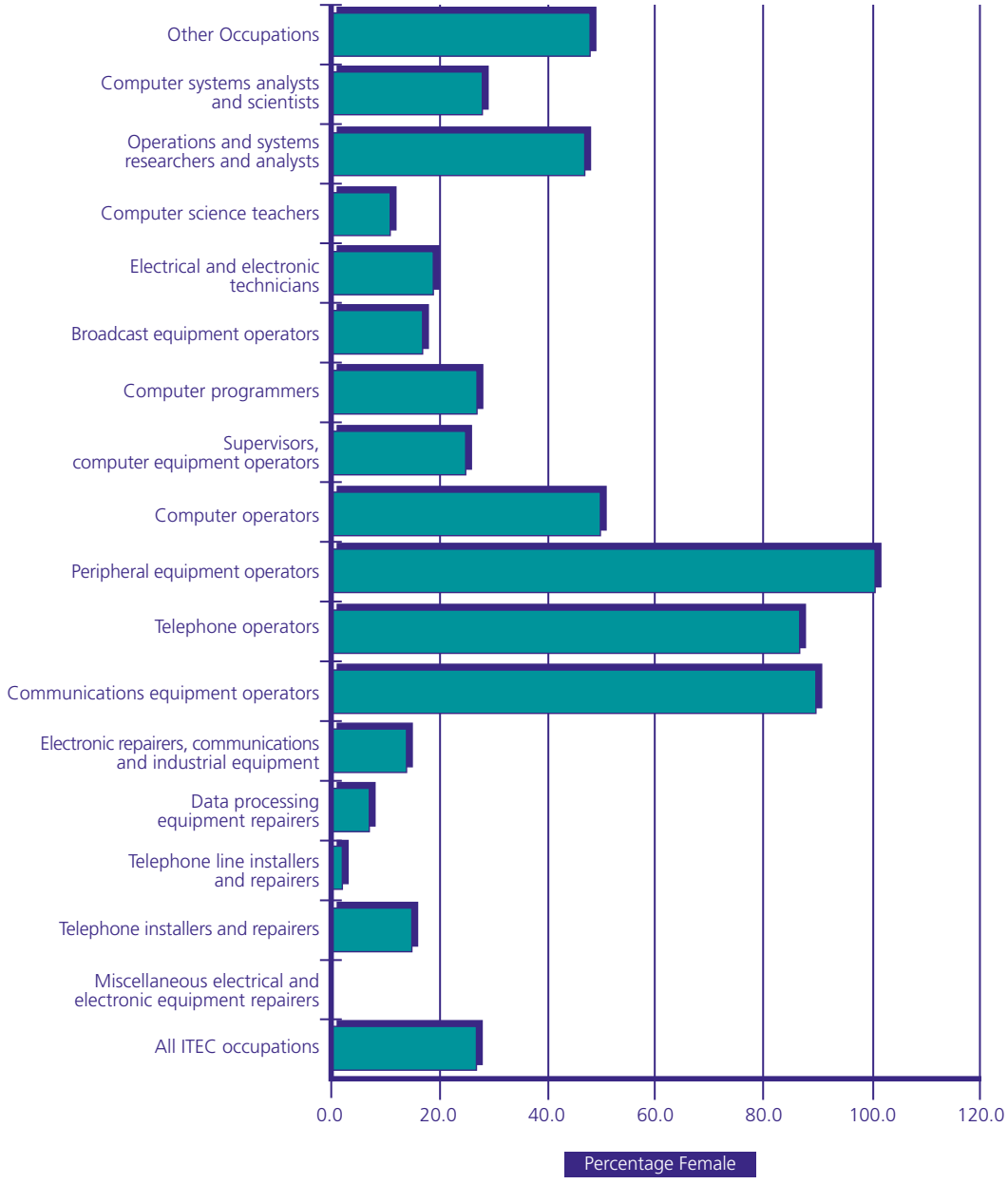
Source: Bureau of Labor Statistics, Annual Demographic Survey, March 2000 Current Population Survey

Women in ITEC occupations in the US

Women were vastly under-represented in ITEC jobs in the US in 2000 – accounting for the minority (28 per cent) of all those in ITEC occupations.

Women made up the majority of those in relatively low status ITEC jobs (Figure 32, Table 52) such as peripheral equipment operators, communications equipment operators, and telephone operators.

Figure 32: The participation of women in ITEC jobs in the US, 2000



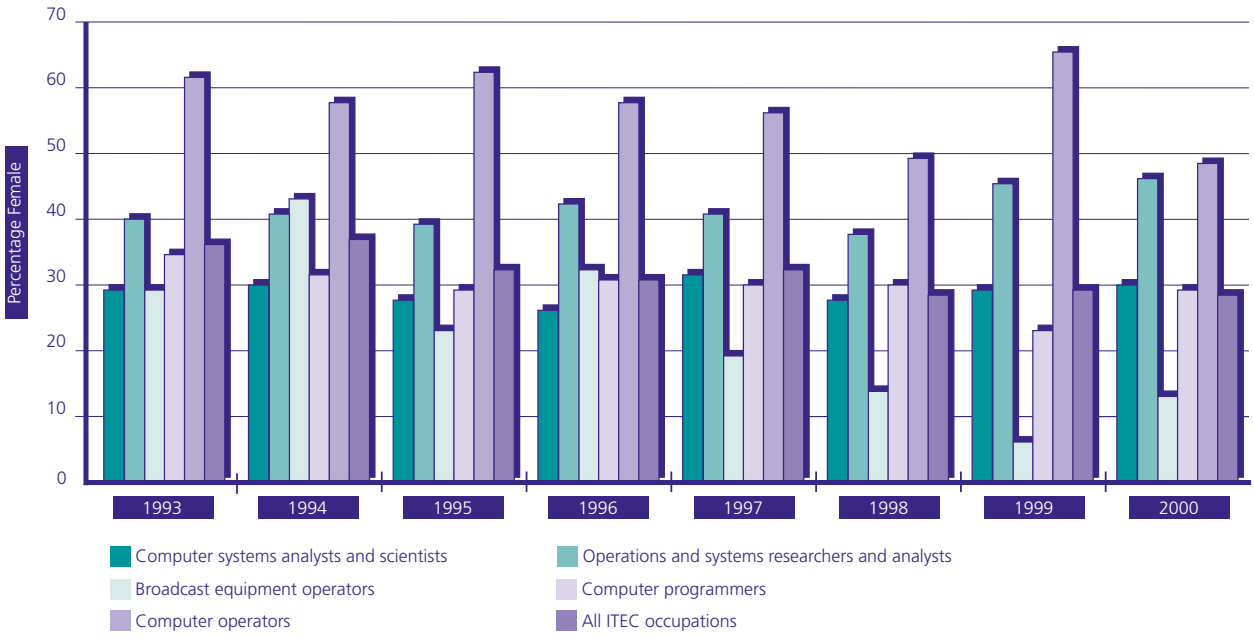
Source: Bureau of Labor Statistics, Annual Demographic Survey, March 2000 Current Population Survey

Women were also well represented among computer operators, where they accounted for 49 per cent of the workforce and among operations and systems researchers and analysts, where 46 per cent were women. However, women were severely under-represented in computer science teaching (only about 6 per cent of computer science teachers in the US are women) and various types of ITEC equipment repairers[85] (Figure 32, Table 52).

[85] For example, there are no female miscellaneous electrical and electronic equipment repairers.

Women's participation in the other ITEC occupations was typically low, and ranged from around 16 per cent of broadcasting equipment operators to 29 per cent of computer systems analysts and scientists (Figure 32, Table 52).

Figure 33: The participation of women in ITEC occupations in the US, 1993-2000



Source: Bureau of Labor Statistics, Annual Demographic Survey, March 2000 Current Population Survey

The participation of women in ITEC occupations in the US is declining (for example, from 37 per cent in 1993 to 28 per cent in 2000) (Figure 33). This downward trend can be seen in a range of ITEC occupations, with the exception of operations and systems researchers and analysts (Figure 33).

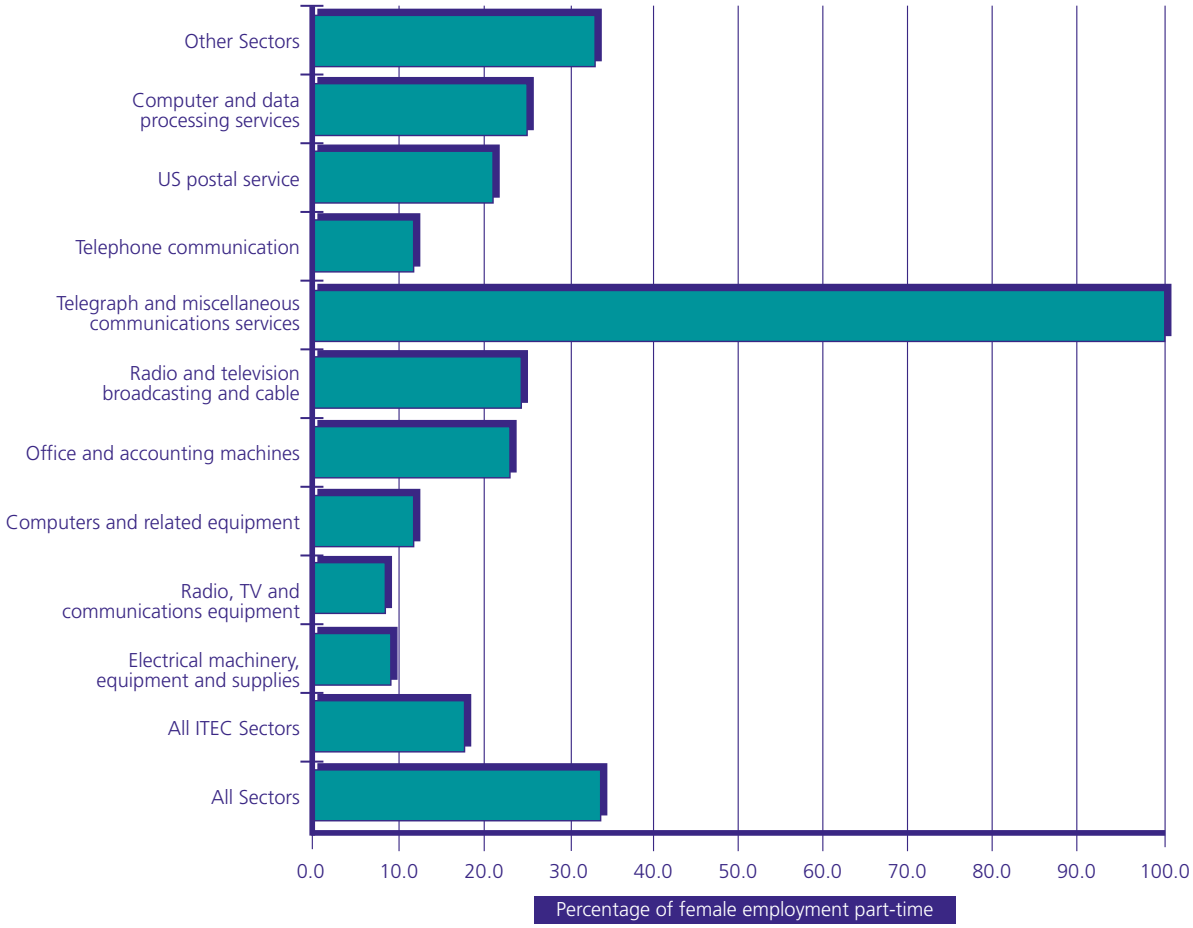
Opportunities for part-time work

Only 12 per cent of employment (all occupations) in the ITEC sector in 2000 was part-time, and women were more likely than men (16.4 per cent against 9.8 per cent) to be working in part-time ITEC sector jobs (Table 53).

There were fewer opportunities for part-time work (for either women or men) in the ITEC sector than more generally across the US economy (24 per cent of employment in the US was part-time in 2000), where women made up 32 per cent and men 17 per cent of the part-time employed.

The limited tendency for part-time work in the ITEC sector applied particularly in the electronics manufacturing sector and to a lesser extent the telecommunications services sector (Figure 34, Table 53).

Figure 34: Percentage of women in part-time employment in the US ITEC sector, 2000

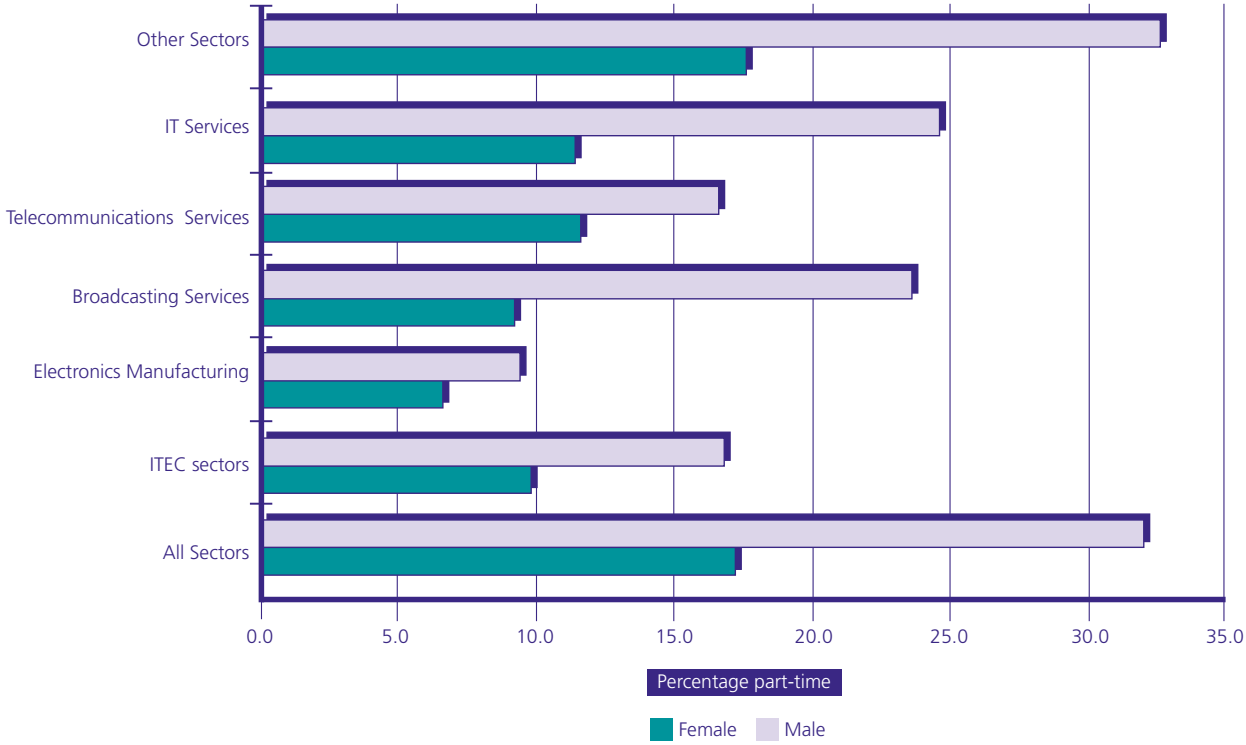


Source: Bureau of Labor Statistics, Annual Demographic Survey, March 2000 Current Population Survey

Within the ITEC sector in industries such as office and accounting machines, and telegraph and miscellaneous communication services the entire part-time workforce is female. In other ITEC sector industries, around half of those employed part-time were women, a much smaller proportion than in other, non-ITEC, sectors (63 per cent).

Although a much higher proportion of women in other, non-ITEC, sectors was employed on a part-time basis (33 per cent), women in the ITEC sector still formed the majority of the part-time workforce (Figure 35).

Figure 35: Opportunities for part-time work in the ITEC sector in the US, 2000

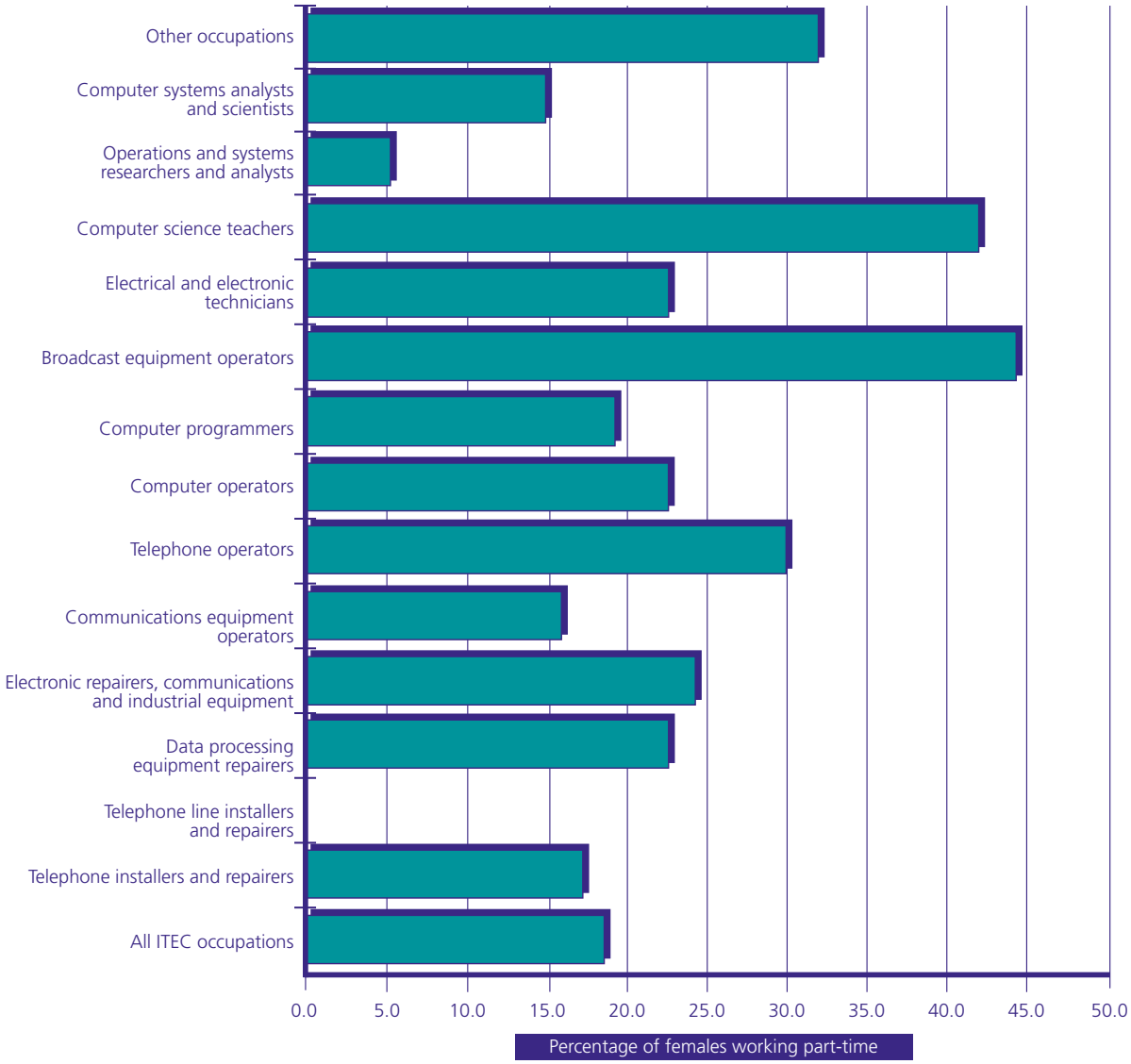


Source: Bureau of Labor Statistics, Annual Demographic Survey, March 2000 Current Population Survey

In 2000, only 13.9 per cent of ITEC occupations were part-time, 18.3 per cent of the women and 12.2 per cent of the men in ITEC occupations worked part-time. Women typically were poorly represented in all but a few ITEC jobs in terms of both full- and part-time employment (Table 54). The exceptions to this were (Figure 36):

- computer science teachers, where 41.5 per cent of the women are employed part-time
- broadcast equipment operators where 43.7 per cent of the women work part-time
- telephone operators where 30.1 per cent of the women work part-time.

Figure 36: The proportion of women working part-time in ITEC occupations in the US, 2000



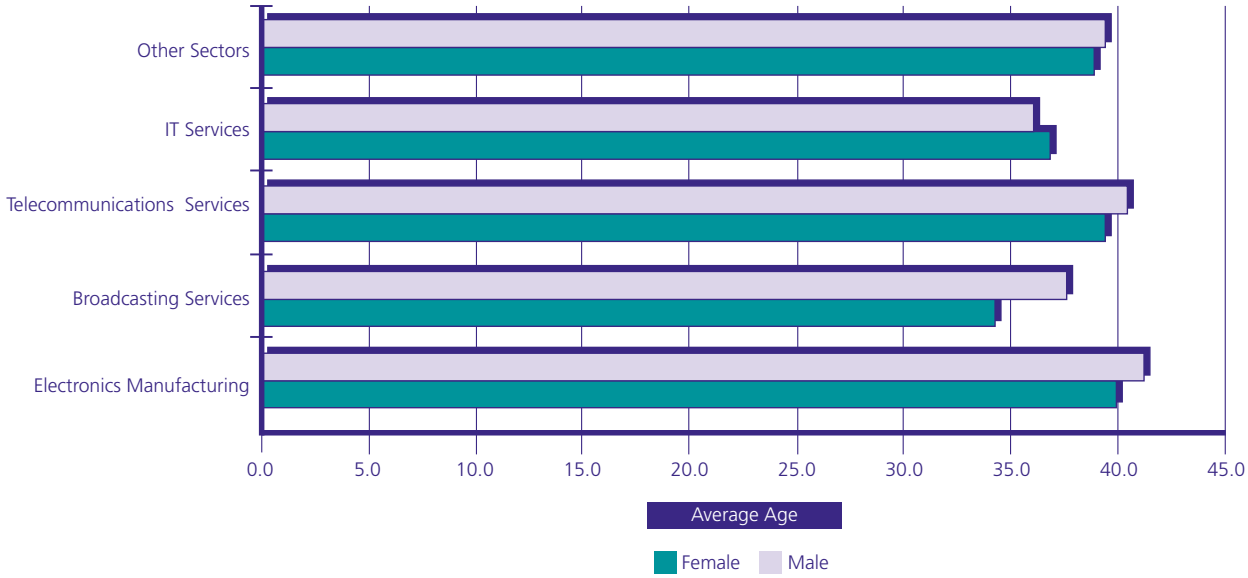
Source: Bureau of Labor Statistics, Annual Demographic Survey, March 2000 Current Population Survey

In the majority of ITEC occupations, women's participation in full-time and part-time work is generally below the level of their participation in other occupations.

The average age of the ITEC workforce in the US

The average age of ITEC sector employees (all occupations) in the US in 2000 was 39 and there was little difference in the ages of men and women in the sector, or indeed between the average ages of men and women in other sectors (Table 55).

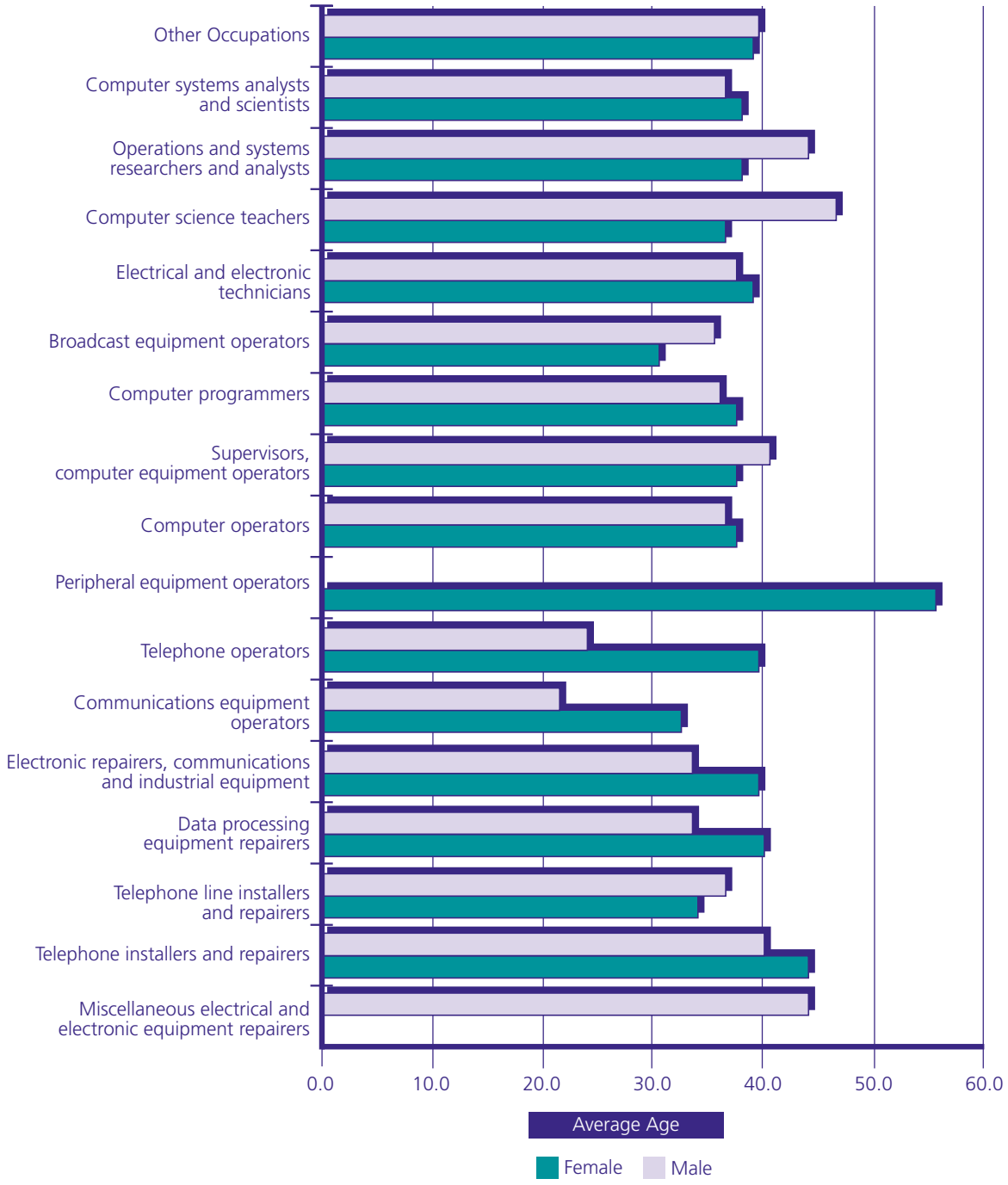
Figure 37: The average age in the ITEC sector in the US, 2000



Source: Bureau of Labor Statistics, Annual Demographic Survey, March 2000 Current Population Survey

Some variations from the average, however, can be observed at the sub-sector level. For example, the average ages of men and of women working in IT Services (37 years) was younger than the average for the sector as a whole. The average age of women working in broadcasting services (34 years) was lower than that for men (38 years).

Figure 38: The age of the ITEC workforce in the US, 2000



Source: Bureau of Labor Statistics, Annual Demographic Survey, March 2000 Current Population Survey

The average age of those in ITEC occupations in 2000 was 38 (39 for men, and 37 for women). Women in ITEC jobs were only marginally younger than men, and than those employed in other non-ITEC occupations (39 years) (Table 56).

However, there was a noticeable difference in the ages of men and women in particular ITEC occupations. For example, women communications equipment operators and telephone operators were considerably older than men whereas women computer science teachers, broadcast equipment operators, and operations and systems researchers and analysts were, on average, younger than the men in those jobs (Figure 38).

3. Women in ITEC courses and careers in Canada

3.1 Chapter summary

Access/Education

- The graduate population in Canada, which increased annually to 1996, has recently declined to below the 1994 level
- Women were the majority (59 per cent) of the graduate population in 1997, and the proportion of women graduates had increased, at least since 1993
- The proportion of students being awarded degrees in ITEC-related subjects has declined between 1993 and 1997; in 1997 21.7 per cent of graduates achieved degrees in an ITEC-related subject whereas in 1993, the corresponding figure was 22.6 per cent
- 36 per cent of graduates in ITEC-related subjects in 1997 were women, and this was an increase on 1993, when the proportion of women among ITEC graduates was 35 per cent
- Most women ITEC graduates were awarded their degrees in business management and commerce (48 per cent of business management and commerce graduates are women) in 1997
- After business management and commerce, the proportion of women among ITEC graduate was highest in mathematics (44 per cent) followed by computer science (20 per cent) and engineering (20 per cent)
- Graduation among women in all ITEC-related subjects except computer science had increased from 1993 to 1997
- While the total number of students graduating in computer science had increased between 1993 and 1997, the percentage of women among computer science graduates (20.4 per cent) in 1997, had declined to below the 1994 level (21.7 per cent)

Employment

- The labour market participation of men (74 per cent) and women (58 per cent) has been converging as, between 1980 and 1999, the proportion of males in employment had fallen and the proportion of women in employment had risen. Despite this, in 1999, women were still the minority (45 per cent) of the workforce
- Women were under-represented in the ITEC sector in 1997. 38 per cent of those in the ITEC sector were women, whereas 49 per cent of those in other, non-ITEC sectors were women
- Greater proportions of women were employed in the telecommunication services (42 per cent) and broadcasting services (41 per cent) industries, than in the electronics manufacturing (34 per cent) and IT services (32 per cent) industries
- Women were severely under-represented in ITEC occupations in 1996. 47 per cent of the Canadian workforce were women, yet women accounted for only 21 per cent of those in ITEC jobs and, despite years of concern, this proportion has declined since 1991
- Women were comparatively well represented among computer operators (47 per cent but this had fallen from 57 per cent in 1991) and telecommunication carriers managers (31 per cent rise from 26 per cent in 1991)
- There had been a slight rise in the number of women computer systems analysts and computer programmers between 1991 and 1996, but while the proportion of women computer systems analysts in 1996 (30 per cent) had increased slightly since 1991, the proportion of women computer programmers in 1996 (25 per cent) had fallen more substantially from 28 per cent in 1991
- Women represented about 27 per cent (a decline from 32 per cent in 1991) of postal and courier service managers and 24 per cent (a rise from 22 per cent in 1991) of information and data processing managers in 1996
- The participation of women in a wide range of other ITEC occupations in 1996 was negligible

3.2 Introduction

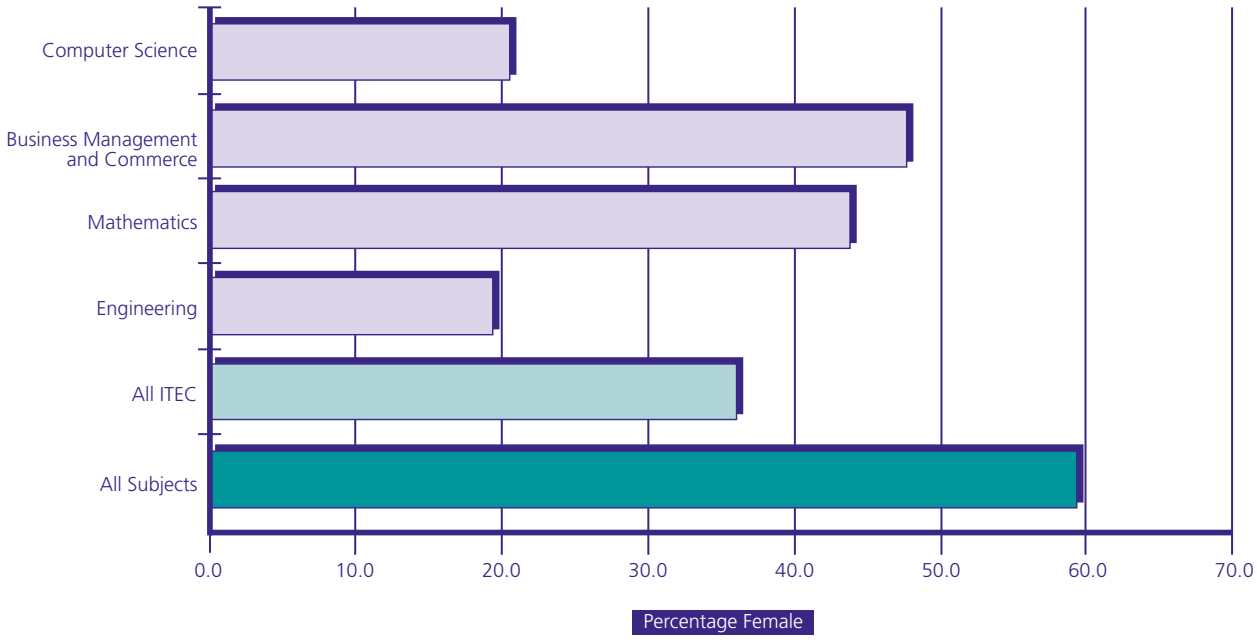
This chapter uses existing quantitative data[86] to examine the participation of women in ITEC courses and jobs in Canada.

- It highlights the pattern, scale and trends in women's education in subjects that might be expected to lead to careers in ITEC
- It shows the participation of men and women in the core ITEC sector and more widely across the Canadian economy over time

3.3 Women in ITEC-related courses in Canada: the evidence base

The number of people graduating from university Bachelor's and first professional courses in Canada increased between 1993 and 1996 and then declined again in 1997 to below the 1994 level (Table 57). Women were the majority (59 per cent) of graduates from university bachelors and first professional degree courses in Canada in 1997 (Figure 39, Table 57) and the participation of women in the graduate population had increased, at least since 1993 (Table 57).

Figure 39: The proportion of women graduates in ITEC-related subjects in Canada, 1997



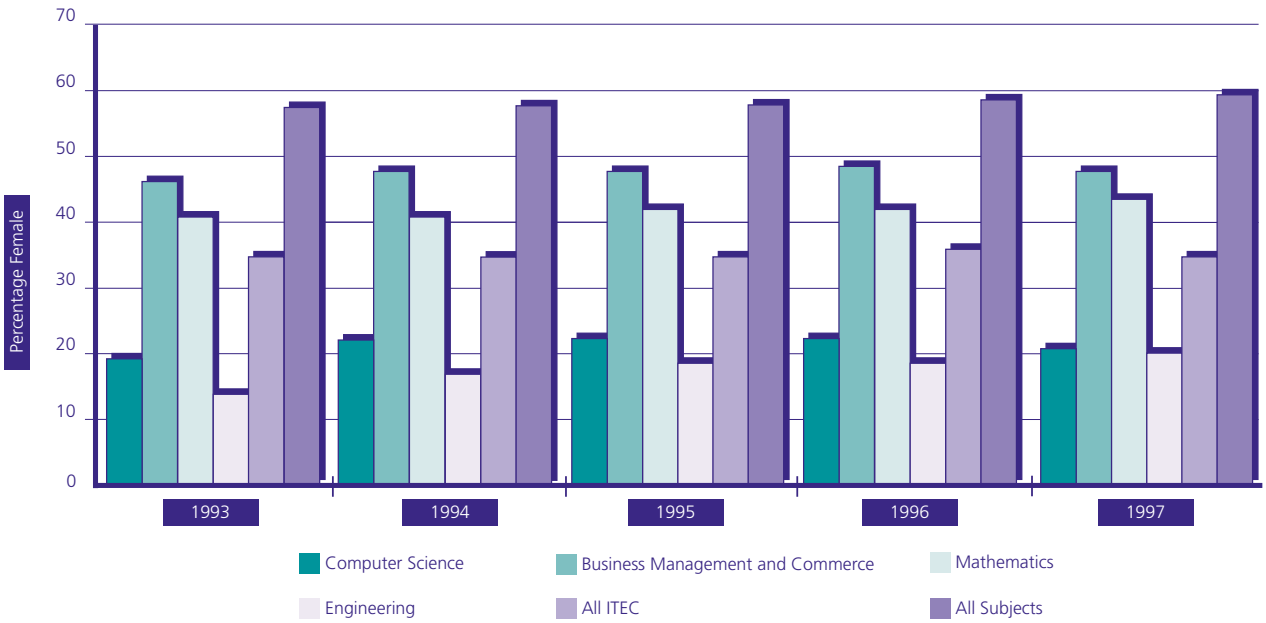
Source: Statistics Canada, 2000, Education in Canada.

The significance of graduating in an ITEC-related subject, i.e. a subject that could be considered to lead to a career in ITEC, has declined over time. In 1993, those graduating in ITEC-related subjects in Canada (including business management and commerce, computer science, mathematics and engineering) represented 22.6 per cent of the total graduate population. In 1997 the proportion of graduates who were awarded their degrees in ITEC-related subjects had decreased to 21.7 per cent.

However, the proportion of women graduates in ITEC-related subjects had increased by 1 per cent between 1993 and 1997. In 1997, women represented 36 per cent of ITEC graduates (Figure 40, Table 57).

[86] The ITEC sectors and ITEC occupations that are covered in this analysis are described in Appendix 1.

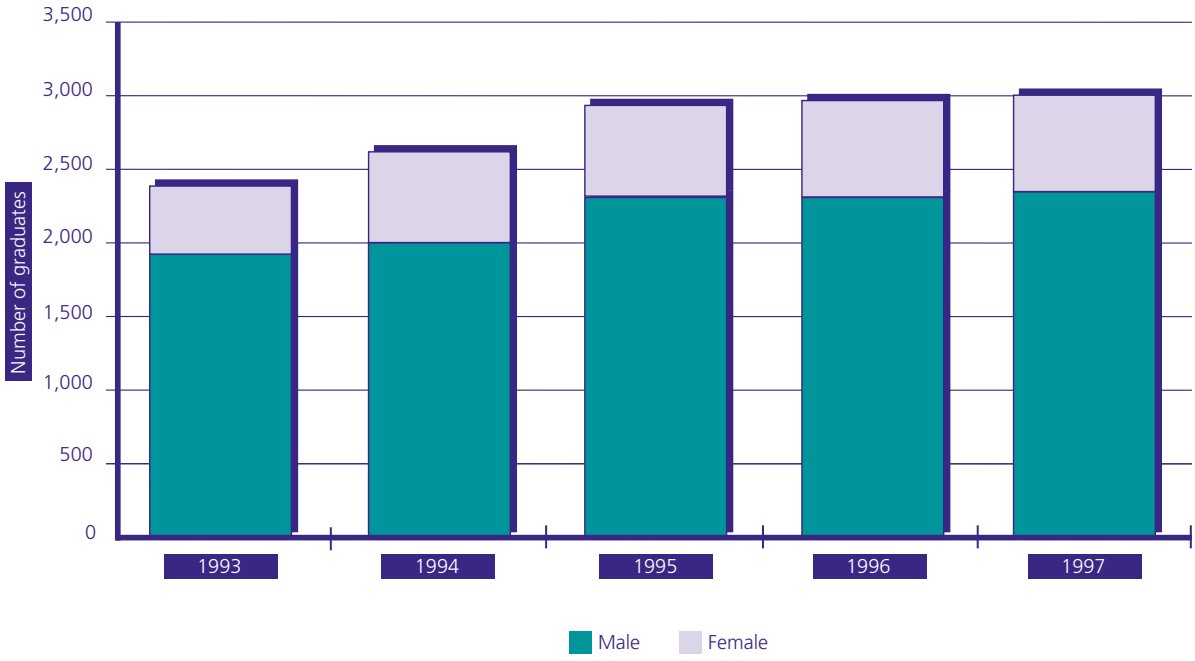
Figure 40: Women graduates in ITEC-related subjects in Canada, 1993-1997



Source: Statistics Canada, 2000, Education in Canada.

In 1997, numerically more women graduated in business management and commerce than any other ITEC-related subject. After business management and commerce, the number of women graduates was higher in engineering than in mathematics, and in mathematics than in computer science (Table 57).

Figure 41: Graduates in computer science in Canada, 1993-1997



Source: Statistics Canada, 2000, Education in Canada.

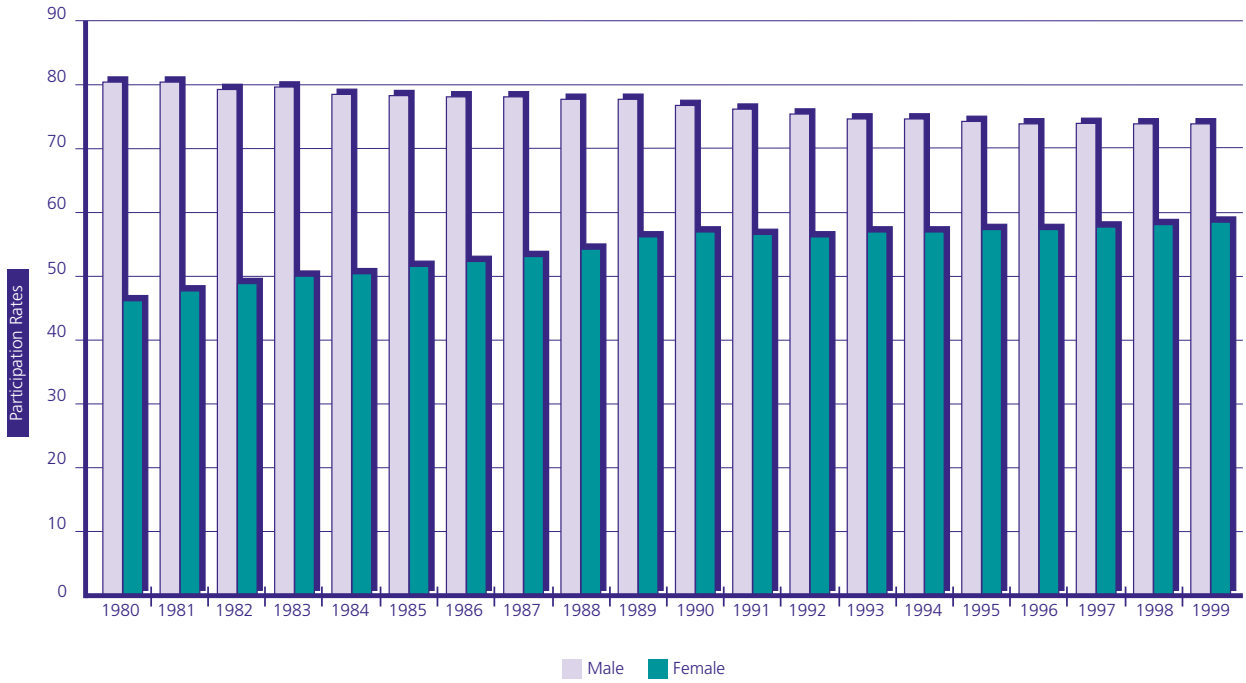
Women represented 48 per cent of business management and commerce graduates, 44 per cent of mathematics graduates and 20 per cent of computer science and engineering graduates in 1997 (Figure 40, Table 57). With the exception of computer science, there had been an upward trend in the proportions of women graduating in all ITEC-related subjects between 1993 and 1997 (Figure 40, Table 57).

While the total number of computer science graduates, and the number of women among computer science graduates had risen between 1993 and 1997, the percentage of women graduates in computer science in 1997 (20.4 per cent) had declined to below its 1994 level (Table 57). This was because the number of male computer science graduates had increased more than the number of female computer science graduates. In 1997, only 613 out of 3,012 graduates in computer science were women (Figure 41, Table 57).

3.4 Women in ITEC employment in Canada: the evidence base

Labour market participation rates for men and women above the age of 25 in Canada seem to have been converging (Figure 42, Table 58). The participation rate for women has increased from 46 per cent in 1980 to 58 per cent in 1999. In contrast, the participation of men has decreased (Figure 42) from 80 per cent in 1980 to 74 per cent in 1999.

Figure 42: Labour market participation rates by gender in Canada, 1980-1999



Source: Statistics Canada (2000), Historical Labour Force Statistics 1999, Ottawa

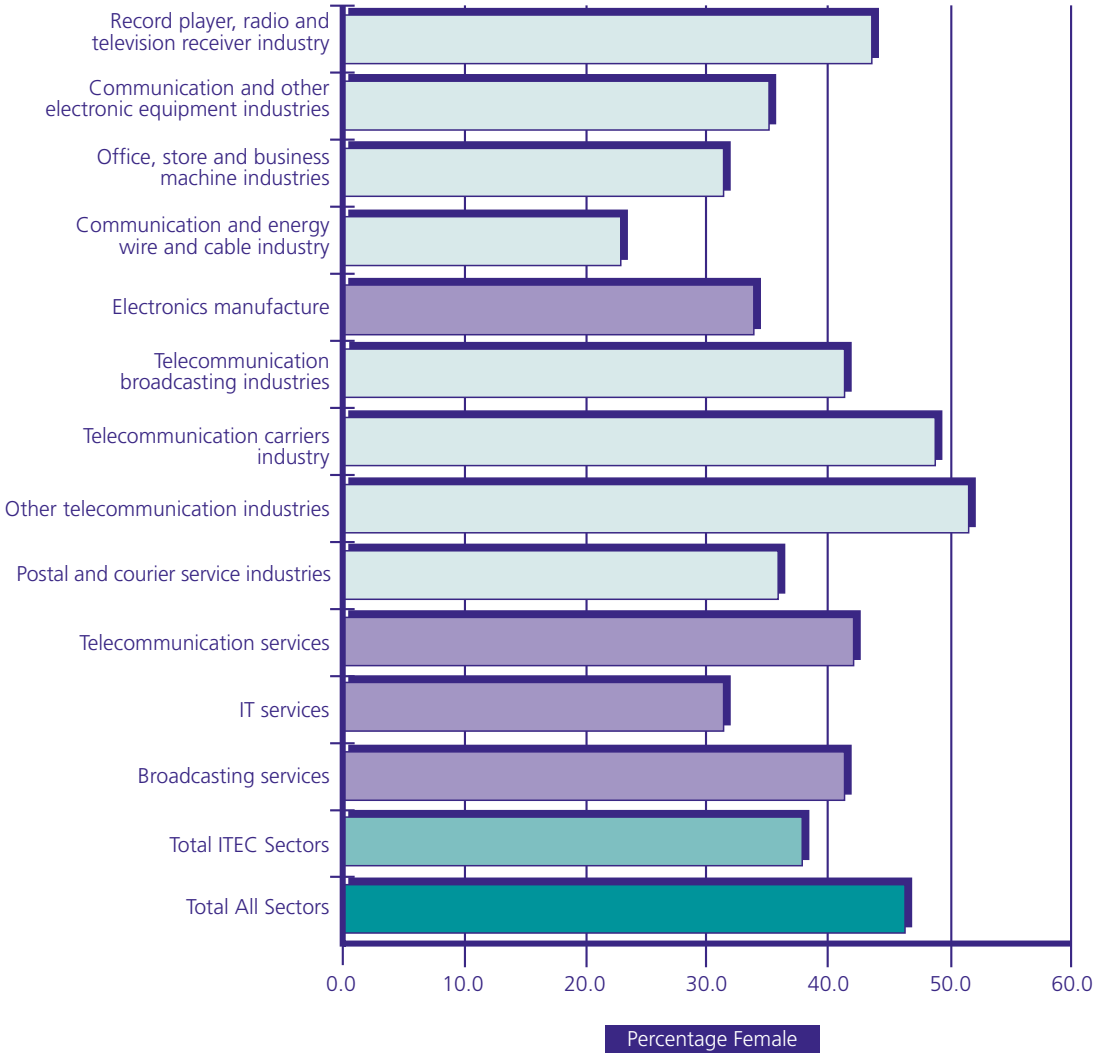
The proportion of women, as a percentage of those employed, has increased from 37 per cent in 1980 to 45 per cent in 1999 (Table 58). Women are still the minority in the workforce in Canada.

The proportion of women working in the ITEC sector in Canada

In 1996, women were under-represented in the ITEC sector, only 38 per cent of those in the ITEC sector were women. However, women represented 46 per cent of the workforce in other, non-ITEC sectors (Figure 43, Table 59).

Within the ITEC sector, in 1996, women were proportionally well represented in telecommunications services (42 per cent) and broadcasting services (41 per cent) and less well represented in electronics manufacture (34 per cent) and IT services (32 per cent) (Figure 43, Table 59).

Figure 43: Women in the ITEC sector in Canada, 1996

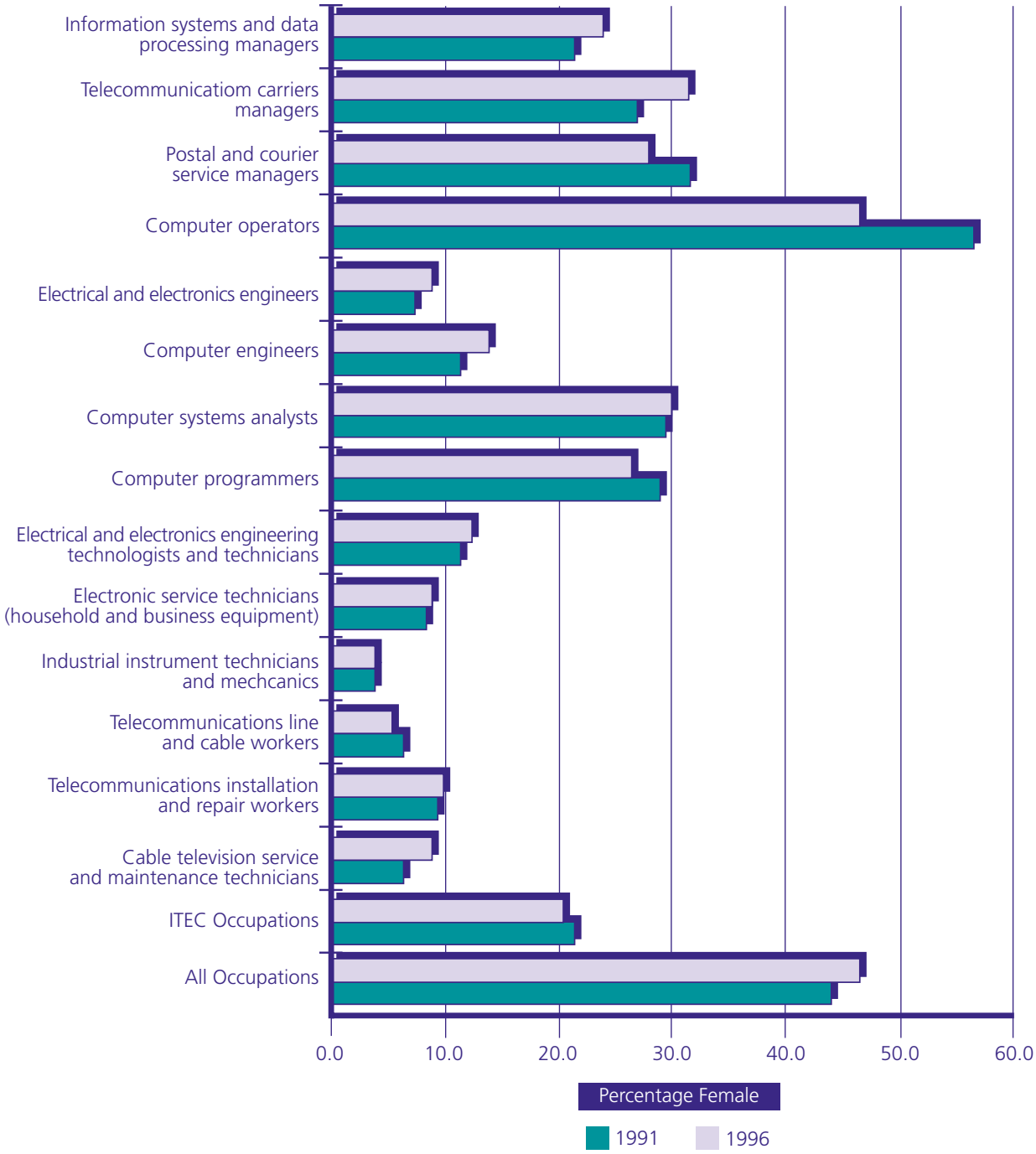


Source: Statistics Canada Labour Force 15 years and over by detailed industry (Based on the 1980 Standard Industrial Classification) and Sex, for Canada, 1996 Census (20% Sample Data)

The proportion of women in ITEC occupations in Canada

Figure 44 (and Table 60, Table 61) shows trends in the pattern of women's participation in ITEC occupations in Canada between 1991 and 1996. The severe under-representation of women in ITEC jobs – 45 per cent of the total Canadian workforce are women, yet only 21 per cent of those in ITEC occupations across the Canadian economy are women – is highlighted in Figure 44. Moreover, despite years of concern about the relationship between women, employment and ITEC, the participation of women in ITEC occupations declined by 4.8 per cent between 1991 and 1996.

Figure 44: Women in ITEC occupations in Canada, 1991-1996



Source: Statistics Canada (1998) Nation Series: Complete Edition CD-ROM 96 Census

The main exceptions to the overall trend towards the under-representation of women in ITEC jobs are computer operators and telecommunication carriers managers. The high proportion (57 per cent) of women computer operators in 1991 declined to 47 per cent in 1996. In contrast, women represented 27 per cent of telecommunication carriers managers in 1991 and this rose to 31 per cent in 1996 (Table 61).

In 1996, numerically more women were employed in Canada as computer systems analysts and computer programmers than computer operators, and the number of computer systems analysts and computer programmers had grown since 1991. However, the proportion of women computer systems analysts in 1996 (30 per cent) had risen very slightly since 1991 and the percentage of women computer programmers in 1996 (25 per cent) had fallen more substantially from 28 per cent in 1991.

In 1996, 27 per cent of postal and courier services managers and 24 per cent of information and data procession managers were women (Figure 44, Table 61). The proportion of female data processing managers had grown from 22 per cent in 1991, whereas the proportion of female postal and courier services managers had fallen from 32 per cent in 1991.

In 1996, women were the minority of those employed as industrial instrument technicians and mechanics (3 per cent), as cable television service and maintenance technicians (5 per cent), as telecommunication line and cable workers (5 per cent), as electrical and electronics engineers (8 per cent) and as electronic service technicians (8 per cent). In most of these occupations, the proportion of women employed had grown between 1991 and 1996 (Table 61).

Key growth areas for women in ITEC jobs between 1991 and 1996 were cable television service and maintenance technicians, computer engineers, electrical and electronics engineers, electronics service technicians (household and business equipment) and telecommunication carriers managers (Table 60).

Areas of substantial decline in terms of female participation between 1991 and 1996 were telecommunications line and cable workers, computer operators, postal and courier services managers and computer programmers (Table 61).

4. Women in ITEC courses and careers in Ireland

4.1 Chapter summary

Access/Education

- There has been rapid expansion in the higher education sector in Ireland. For example, in 1999, 41 per cent of school leavers went directly into higher education, compared with 32 per cent in 1990
- In 1998, women were the majority (55 per cent) of graduates, and their participation in higher education had been increasing since 1965/66, when women represented less than half of the graduate population
- 24 per cent of all graduates were awarded a degree in an ITEC-related subject in 1998
- 42 per cent of graduates in ITEC-related subjects were women
- 72 per cent of ITEC graduates received degrees in business and administration – and 50 per cent of graduates in business and administration were women
- Women were relatively under-represented among graduates from other ITEC-related courses in 1998, such as mathematics and statistics (29 per cent), computing (23 per cent), engineering and engineering trades (13 per cent)

Education/Employment

- In 1999, women working in Ireland were, on average, better educated than men

Employment

- In 1999, 41 per cent of the workforce in Ireland were women
- 35 per cent of those in the ITEC sector were women
- Women accounted for 41 per cent of those in other sectors
- Within the ITEC sector, in 1999, women are relatively well represented in employment in the electrical machinery industry (44 per cent) and the office machinery and computer manufacture industry (43 per cent)
- Lower percentages of women were employed in IT services (34 per cent) and telecommunications services (25 per cent) in 1999
- The proportion of women in ITEC occupations is estimated at 19 per cent in 2000, this had declined from 22 per cent in 1999
- Women were comparatively well represented among computer analysts/programmers. In 2000, an estimated 31 per cent of all computer analyst/programmers were women, but this was a decrease from 33 per cent in 1999

4.2 Introduction

This chapter examines the extent of women's participation in ITEC-related courses and careers in Ireland. It examines the pattern, and the scale of female graduation from higher education in Ireland, and the proportion of women among ITEC graduates in the country. The chapter also examines the limited data that are available on trends in the participation of women in the ITEC sector and in ITEC occupations in Ireland.

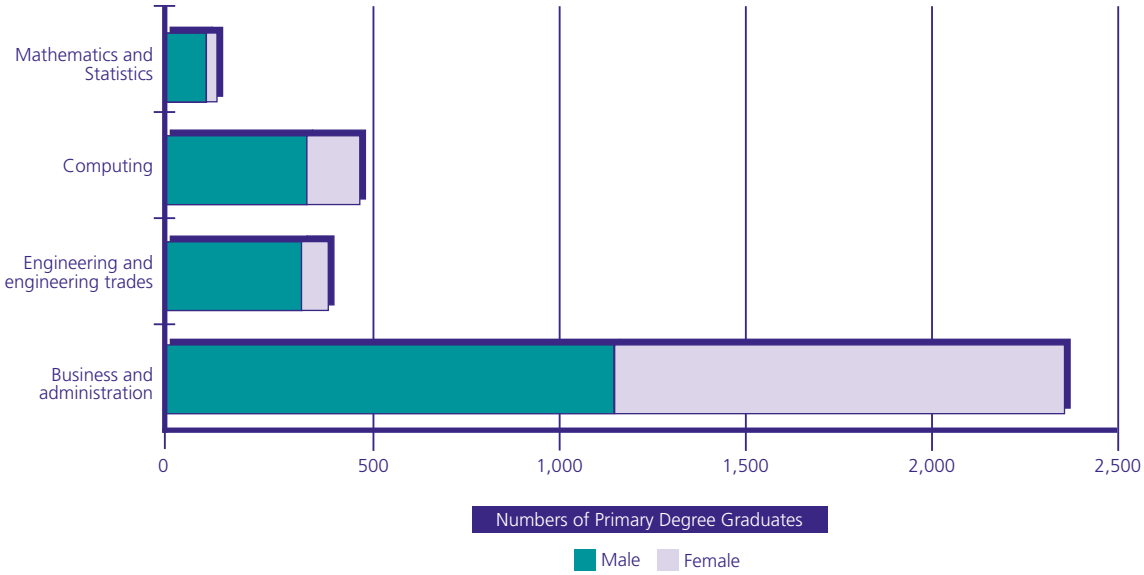
4.3 Women in ITEC-related courses in Ireland: the evidence base

There has been considerable expansion in higher education in Ireland in the past three decades. In 1997/98, about 41 per cent of school-leavers went directly into higher education, compared with 32 per cent in 1990.[87]

[87] Time series data extracted from the Report of Review Committee on Post Secondary Education and Training Places.

Women were the majority of university graduates in Ireland in 1998, 55 per cent of all those graduating from full and part-time primary degree courses were women (Figure 45, Figure 46, Table 62). In 1965/66, female students formed less than half the student population[88] and so their participation in higher education has increased, at least to 1998.

Figure 45: Primary degree graduates in ITEC-related subjects in Ireland, 1998

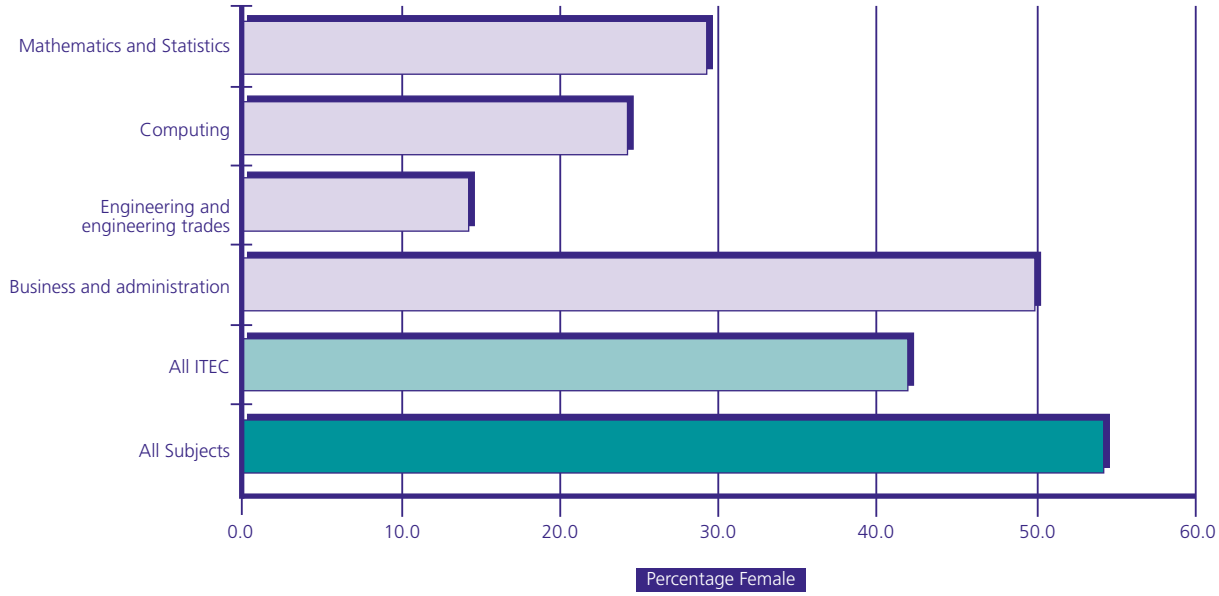


Source: Higher Education Authority (2001) 1998/99 Annual Report

In 1998 (Table 62), 24 per cent of all graduates were awarded degrees in ITEC-related subjects. The majority of ITEC graduates (72 per cent) were awarded their degrees in business and administration. There was a comparatively small graduate output from courses in computing (14 per cent), engineering and engineering trades (12 per cent) and mathematics and statistics (2 per cent) in that year.

Figure 46 (and Table 62) shows that the proportion of women graduates in ITEC-related subjects in Ireland in 1998 was 42 per cent, lower than the proportion of women among all graduates of 55 per cent.

Figure 46: The proportion of women among graduates in Ireland, 1998



Source: Higher Education Authority (2001) 1998/99 Annual Report

[88] Time series data extracted from the Report of Review Committee on Post Secondary Education and Training Places.

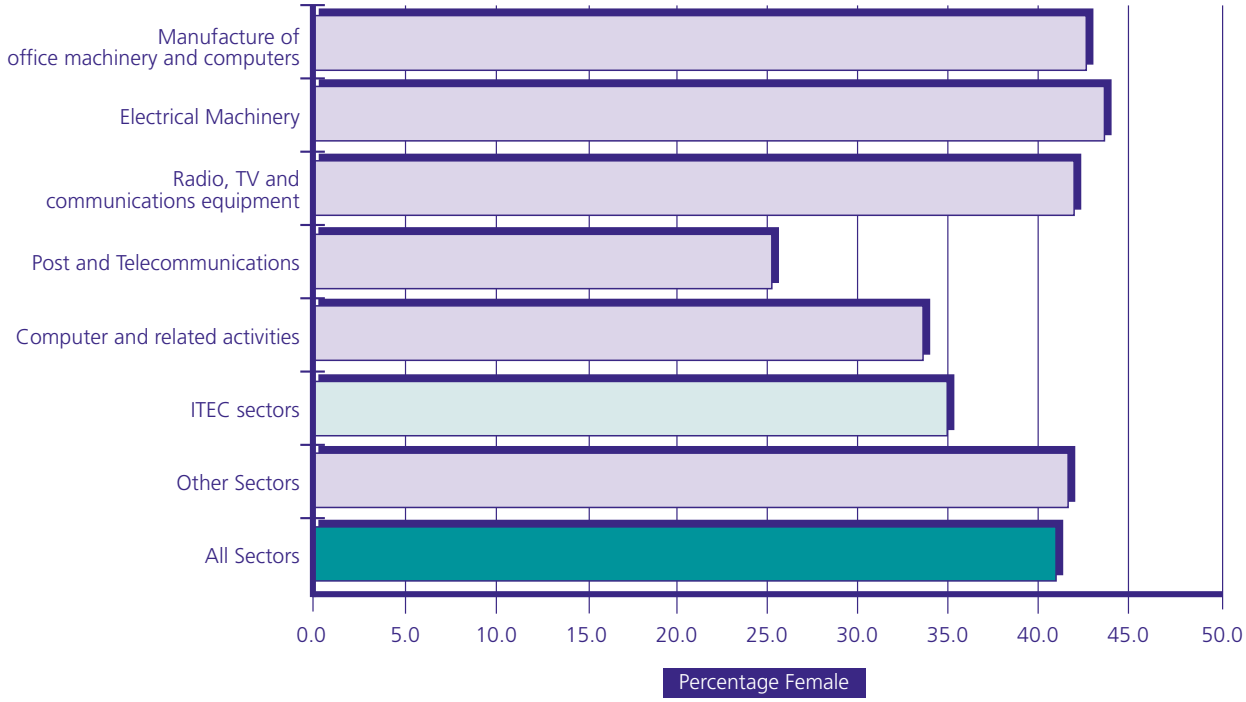
50 per cent of the graduates from business and administration were women (Figure 46, Table 62). However, the proportion of women graduates in other ITEC-related subject areas was low – 29 per cent in mathematics and statistics, 23 per cent in computing, and 13 per cent in engineering and engineering trades.

In 1999 in Ireland, more employed women were graduates (16.8 per cent) than men (13.9 per cent) and a higher proportion of employed men had an education attainment level below Upper Secondary (40 per cent), compared to women (25 per cent).[89]

4.4 Women in ITEC careers in Ireland: the evidence base

In 1999, women represented 41 per cent of the workforce. 35 per cent of those in the ITEC sector in Ireland and 41 per cent of those in other, non-ITEC sectors were women (Figure 47, Table 63).

Figure 47: The participation of women in the ITEC sector in Ireland, 1999



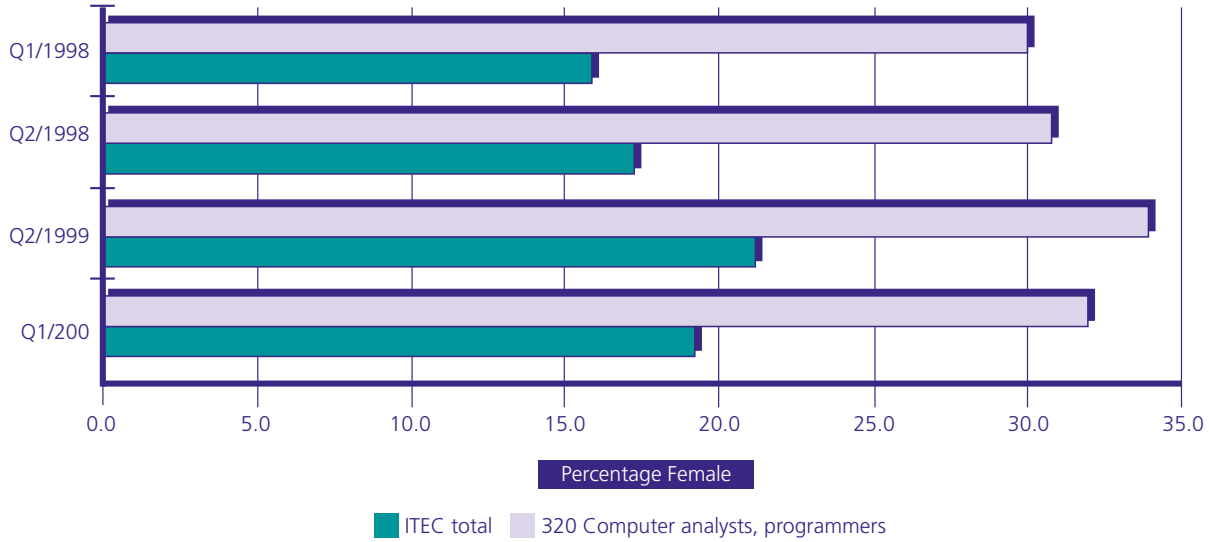
Source IES/Eurostat Special tabulation of the Community Labour Force Survey

In particular industries within the ITEC sector the participation of women exceeded that for all sectors in 1999. For example, 44 per cent of those in the electrical machinery and apparatus manufacturing industry were women, 43 per cent of those in office machinery and computer manufacture, and 42 per cent of those employed in the radio, TV and communications equipment industry. Smaller proportions of women worked in IT services[90] (34 per cent) and in post and telecommunications (25 per cent).

[89] Data extracted from Quarterly National Household Survey, Q2, 1999 and abstracted in 'Ireland's National Employment Action Plan 2000', Appendix 6, p.47.

[90] NACE72, 'Computer and related activities'.

Figure 48: Women in ITEC occupations in Ireland, 1998-2000 (estimated)



Source: Central Statistics Office, Personal Communication, Quarterly National Household Survey
Note: Particular care should be taken in respect of small estimates.

Figure 48 (and Table 64) shows the proportion of women in ITEC occupations between 1998 and 2000 (estimated data). The proportion of women in ITEC jobs in Ireland is estimated to have increased from 16 per cent in 1998 to 22 per cent in 1999, but then decreased to 19 per cent in 2000.

Women are relatively well represented among computer analysts/programmers – in 1999 the proportion of women computer analysts/programmers was at its peak (33 per cent). In 2000, this dropped by 2 per cent. Their participation in other ITEC occupations was too low to provide a reliable analysis.

5. Women in ITEC courses and careers in Taiwan

5.1 Chapter summary

Access/Education

- Increasing numbers of women are entering into and graduating from higher education in Taiwan
- In 1998, women were the majority (54 per cent) of Junior College students, and they represented 47 per cent of the university population
- Women also made up the majority of Bachelor's degree level graduates in 1997/98
- 37 per cent of those graduating in ITEC-related subjects were women, and there had been an increase over time in the proportion of women among ITEC-graduates
- A substantial proportion (61 per cent) of graduates in commercial and business administrations were women
- However, women were under-represented in other ITEC-related subjects such as mathematics and computer science (34 per cent) and engineering (10 per cent)

Employment

- In 1999, 43 per cent of the workforce in Taiwan were women
- Women are in the majority in the ITEC sector, and their participation has remained stable for a number of years
- There is a high concentration of women in the data processing and information services (66 per cent, and this has been rising since 1994) and the electrical and electronic equipment sectors (52 per cent)
- Women are under-represented in the telecommunications sector (25 per cent)
- Women form the majority (53 per cent) of those in professional occupations, and are well represented (40 per cent) among technicians and associate professional staff

5.2 Introduction

This chapter looks at the participation of women in ITEC courses and careers in Taiwan. It focuses on the trend in the proportion of women with a university education between 1971 and 1998, and examines patterns in the data relating to women's graduation in ITEC-related subjects.[91] The chapter also presents data on the labour market participation of women in Taiwan. It addresses the scale and scope of women's participation in the ITEC sector, and their representation among professional and technical staff.[92]

5.3 Women in ITEC-related courses in Taiwan: the evidence base

In 1998, women were the majority (54 per cent) of Junior College[93] students, and represented 47 per cent of the college and university population in Taiwan (Figure 49, Table 65). The participation of women in the education system in Taiwan, with the exception of a three-year period from 1991-1993 when the proportion of women among college and university students dropped slightly, has been growing since 1977.

[91] ITEC subjects are defined in Taiwan to include courses in commercial and business administrations, maths and computer science, and engineering.

[92] Data are not available on the participation of women in ITEC occupations, instead the more general categories 'professionals' and 'technicians and associate professionals' have been used.

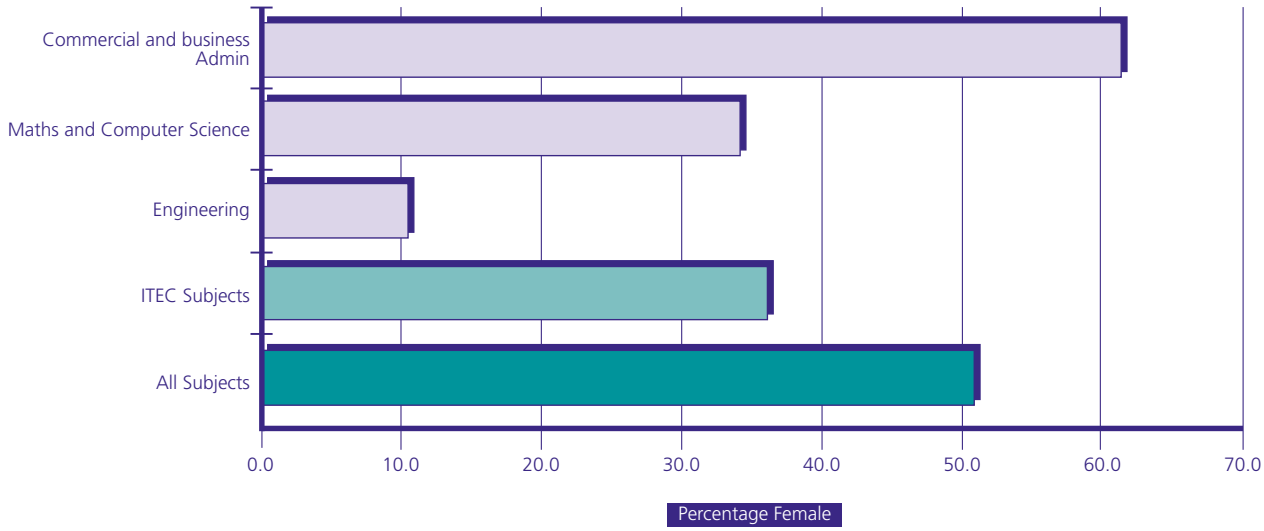
[93] There are two main categories of Junior College in Taiwan. The first admits students from compulsory education (junior high school graduates) into a 5-year programme of study and the second admits senior vocational high school students (who typically specialise in either agriculture, industry (engineering), commerce, maritime, medical technology, nursing or home economics) into a 2-year study programme.

Figure 49: The participation of women in college and university education in Taiwan, 1973-1998

Source: Bureau of Statistics, Ministry of Education (1999), Education in the Republic of China, Tapei.

In 1997/98, the majority (51 per cent) of those with Bachelor's degrees were women (Figure 50) and there had been an upward trend in the proportion of women graduating from university in ITEC-related subjects (Figure 51, Table 66).

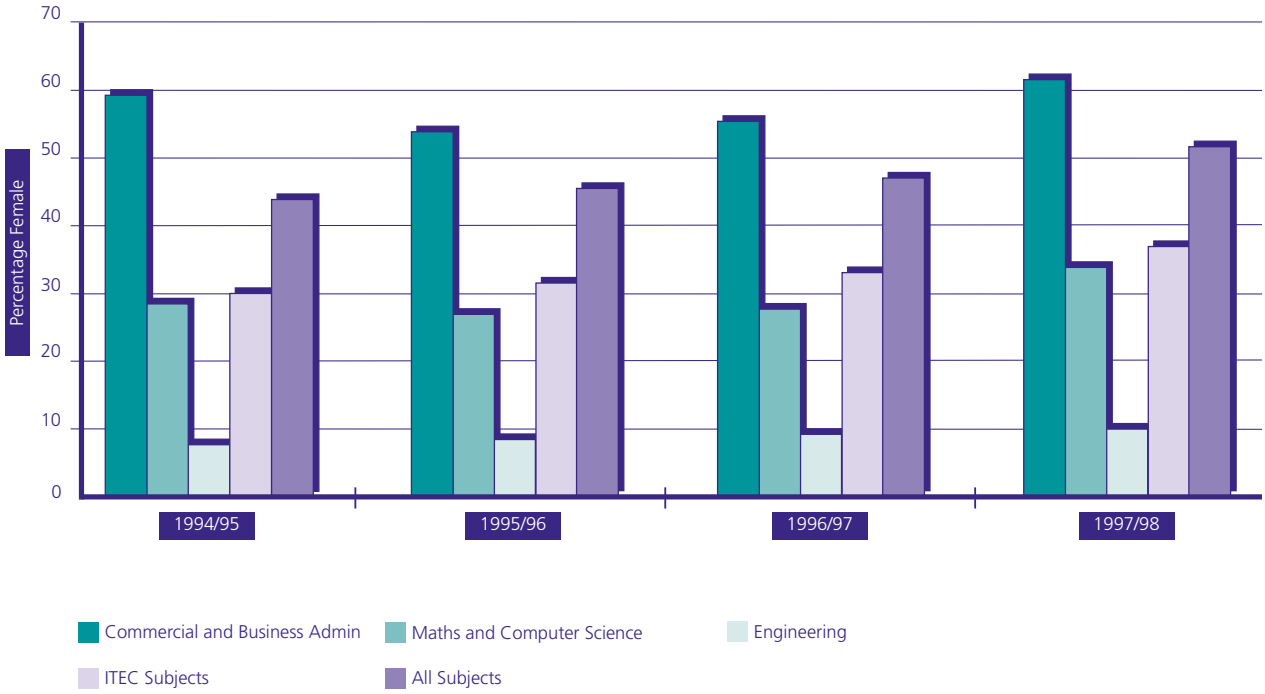
Figure 50: The proportion of women among Bachelor's graduates in ITEC-related subjects in Taiwan, 1997/98



Source: Ministry of Education (2000) Education Statistics of the Republic of China

Women were the minority (37 per cent) among graduates in ITEC-related subjects in 1997/98 (Figure 50, Table 66) yet the proportion of women graduating in ITEC-related subjects had been increasing, particularly at the Bachelor's level, since 1994/95 (Figure 51, Table 67, Table 68, Table 69).

Figure 51: The proportion of women among graduates in ITEC-related subjects in Taiwan, 1994-98



Source: Ministry of Education (various years) Education Statistics of the Republic of China

Focusing on the percentages of women among graduates in particular ITEC subjects, in 1997/98, more women (61 per cent) graduated with Bachelor's degrees in commercial and business administrations than men (Table 66). However, women were under-represented among graduates in other ITEC-related subjects. For example, 34 per cent of all graduates in mathematics and computer science and only 10 per cent of engineering graduates were women.

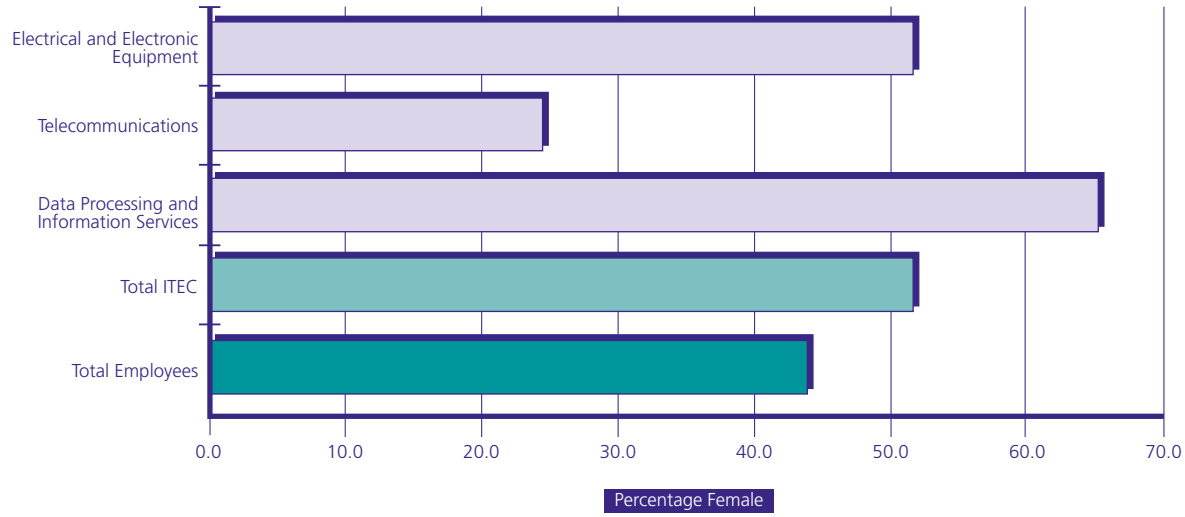
A very small proportion of women have degrees or Doctorates in ITEC subjects (Table 68, Table 69). In 1997/98, a mere 14 per cent of Masters graduates and 8 per cent of Doctorates in ITEC subjects were women.

5.4 Women in ITEC careers in Taiwan: the evidence base

Women accounted for 43 per cent of the workforce in Taiwan in 1999 (Figure 52) and the proportion of women in employment has remained relatively stable at least since 1991 (Table 70).

The proportion of women in the ITEC sector was higher than the average employed in Taiwan. Women are the majority (51 per cent) in the ITEC sector, and particularly high proportions of women work in the data processing and information services industry (66 per cent) and in electrical and electronic equipment manufacture (52 per cent) (Figure 52, Table 71) where there is an abundance of low skilled and assembly work.

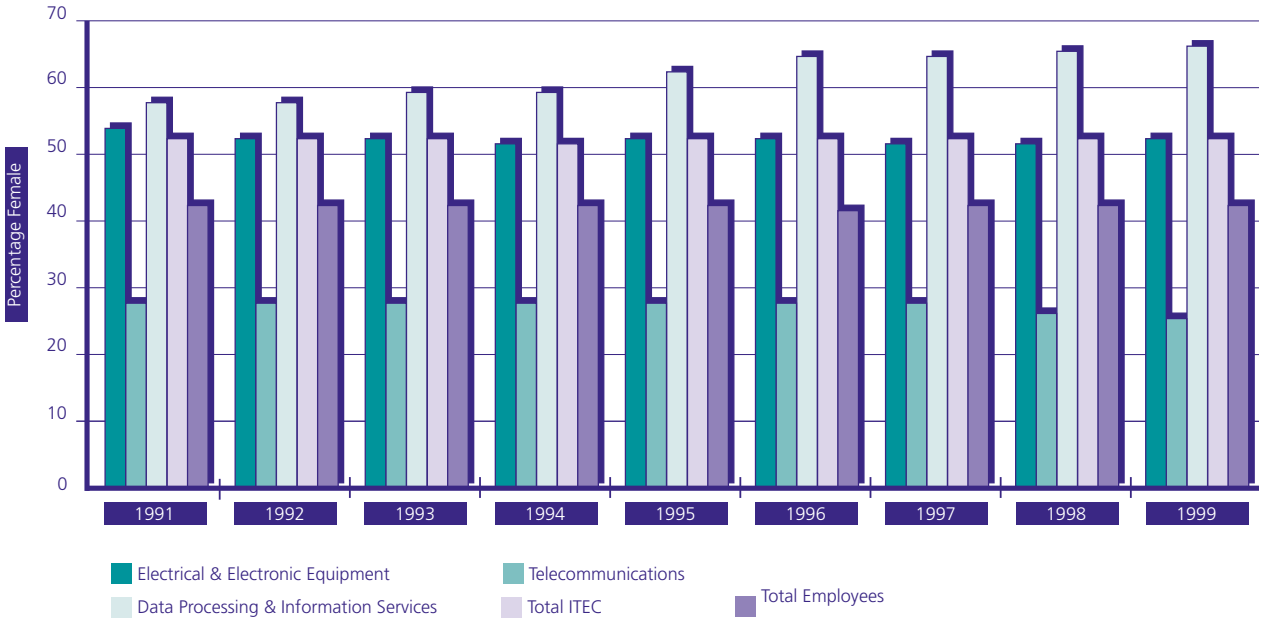
Figure 52: Women in ITEC sector employment in Taiwan, 1999



Source: Personal Communication Directorate-General of Budget, Accounting and Statistics based on the Report on Manpower Utilization Survey Taiwan Area

The proportion of women working in the ITEC sector has remained stable since about 1992 (Figure 53, Table 71). Between 1991 and 1999, there have been consistently above average proportions of women in the data processing and information services and in the electrical and electronic equipment manufacturing sectors and below average proportions in the telecommunications sector.

Figure 53: The employment of women in the ITEC sector in Taiwan, 1991-99

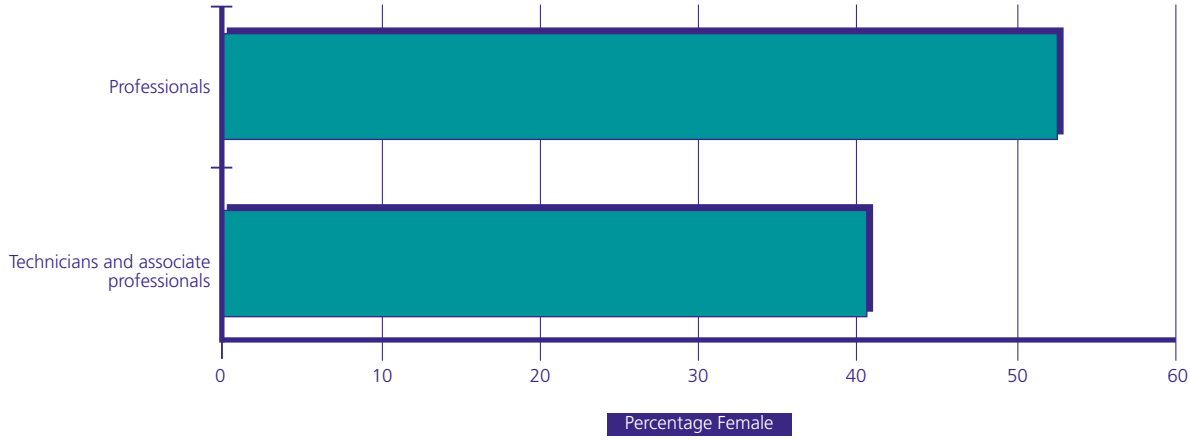


Source: Personal Communication Directorate-General of Budget, Accounting and Statistics based on the Report on Manpower Utilization Survey Taiwan Area

In most of the ITEC sector industries, there has been little change since 1991 in the proportions of women employed. The single exception is data processing and information services where the proportion of women has been increasing since 1994 (Figure 53, Table 71).

Figure 54 (and Table 72) shows that, in 1998, women were the majority (53 per cent) of professional staff employed in Taiwan, and they were relatively well represented (40 per cent) among technicians and associate professionals (these two occupational categories include, but are considerably broader than, ITEC and non-ITEC jobs).

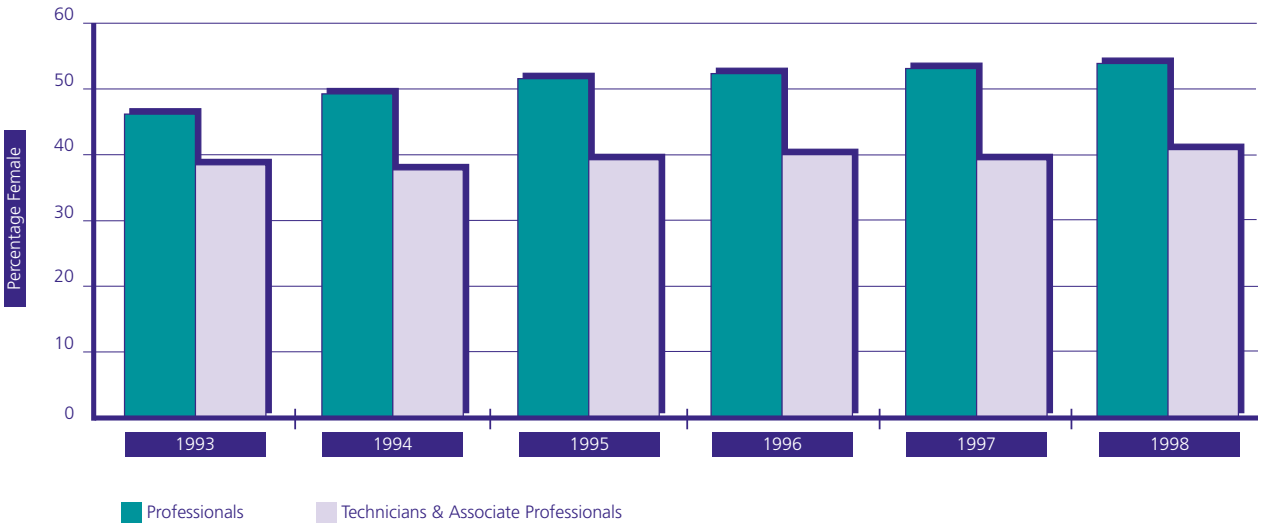
Figure 54: The proportion of women in professional employment in Taiwan, 1998.



Source: Directorate-General of Budget, Accounting and Statistics 'Report on Manpower Utilization Survey Taiwan Area'

This proportion of women technicians and associate professionals has barely changed since 1993 (Table 72). However, there has been an upward trend in the proportion of women in professional occupations (Figure 55, Table 72).

Figure 55: Women in professional employment in Taiwan, 1993-98



Source: Directorate-General of Budget, Accounting and Statistics 'Report on Manpower Utilization Survey Taiwan Area'

6. Women in ITEC courses and careers in Spain

6.1 Chapter summary

Access/Education

- In 1996/97, 58 per cent of all post-compulsory graduates in Spain were women
- Overall only 4.3 per cent of these graduates were in mathematics and computing, of whom a third (33 per cent) were female
- Women were also fairly well represented among engineering and technology graduates, 24.6 per cent of engineering and technology students were women and this proportion had risen from 18 per cent in 1992/93
- The percentage of female graduates in mathematics and computing had fallen slightly since 1992/93, while the percentage of engineering and technology graduates had risen slightly in the same period.

Employment

- Women were the minority of the workforce in Spain (36 per cent) in 1999
- Only about a quarter (27 per cent) of those working in the ITEC sector were women, whereas, in other sectors, women made up 37 per cent of the workforce
- Within the ITEC sector, more women were employed in telecommunication services (34 per cent) than in other sector industries, where only about a fifth of those employed were women
- The participation of women in the post and telecommunications and in the manufacture of electrical machinery and apparatus industries increased between 1997 and 1999. In other ITEC sector industries the trend in women's participation over the period was towards decline.
- Women are severely under-represented in ITEC occupations in Spain, in 1999 they accounted for a mere 7 per cent of the ITEC workforce, and this proportion had been diminishing (in 1997, 10.2 per cent of those in ITEC jobs were women)
- Women represented about 26 per cent of optical and electronic equipment operators, 13 per cent of computer professionals, and 12 per cent of computer associate professionals. The participation of women in computer professional and computer associate professional occupations had declined since 1997.
- In other ITEC jobs, such as electrical and electronic equipment mechanics and fitters, the participation of women, in 1999, was almost negligible

6.2 Introduction

This chapter examines the participation of women in ITEC courses and careers in Spain. It draws together the limited historical data on the distribution of graduate level qualifications in order to examine the proportion of women in the graduate population, and graduates in ITEC-related subjects. The chapter also examines the scope and scale of women's employment, with particular reference to the participation of women in the ITEC sector and in ITEC occupations.

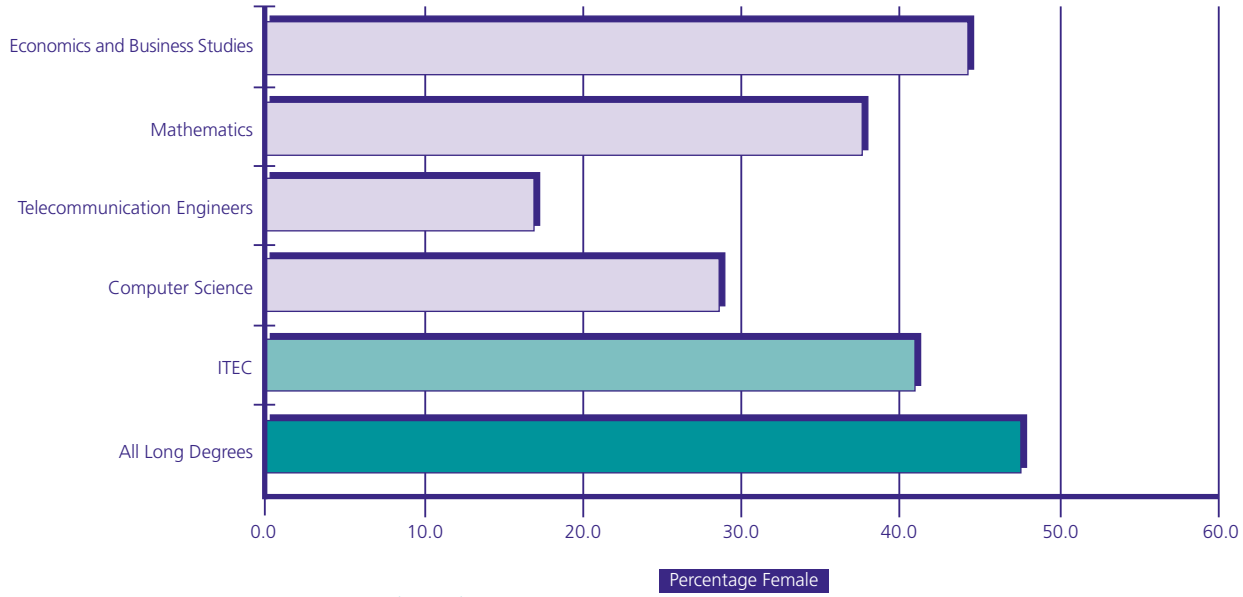
6.3 Women in ITEC-related courses in Spain: the evidence base

This section begins with a focus on the participation of women in the graduate population in Spain between 1986/87 and 1990/91, where most data are available. This period pre-dates the reform and general regulation of the education system that was introduced by the Ministry of Education in 1990. It is also historically prior to the implementation of two linked national vocational training initiatives that were introduced by the Ministry of Labour in 1993 and 1997. In an economy suffering from high rates of unemployment, these initiatives aimed to integrate the various training sub-systems through which work-related competencies were accumulated and refreshed (Castillo *et al.*, 1999; Gatti *et al.*, 1999).

Detailed data allowing the mapping of ITEC subjects are only available up to 1990/91 and are supplemented with more recent, but less detailed data from Eurostat that covers the period 1992/93 to 1996/97. Since the split in data availability also marks a divide in policy for education both data sets are reported.

In 1990/91, 48 per cent of all graduates were women (Figure 56, Table 73), and this proportion had declined since at least 1986 when women made up 49 per cent of the graduate population (Figure 57). 41 per cent of graduates in ITEC-related subjects were women, and the proportion had been increasing from 37 per cent in 1986/87. The proportion of women graduating in economics and business was above average (44 per cent) for the sector as a whole (Figure 56), and there had been a general trend towards their increased participation since 1986/87 (Figure 57, Table 73).

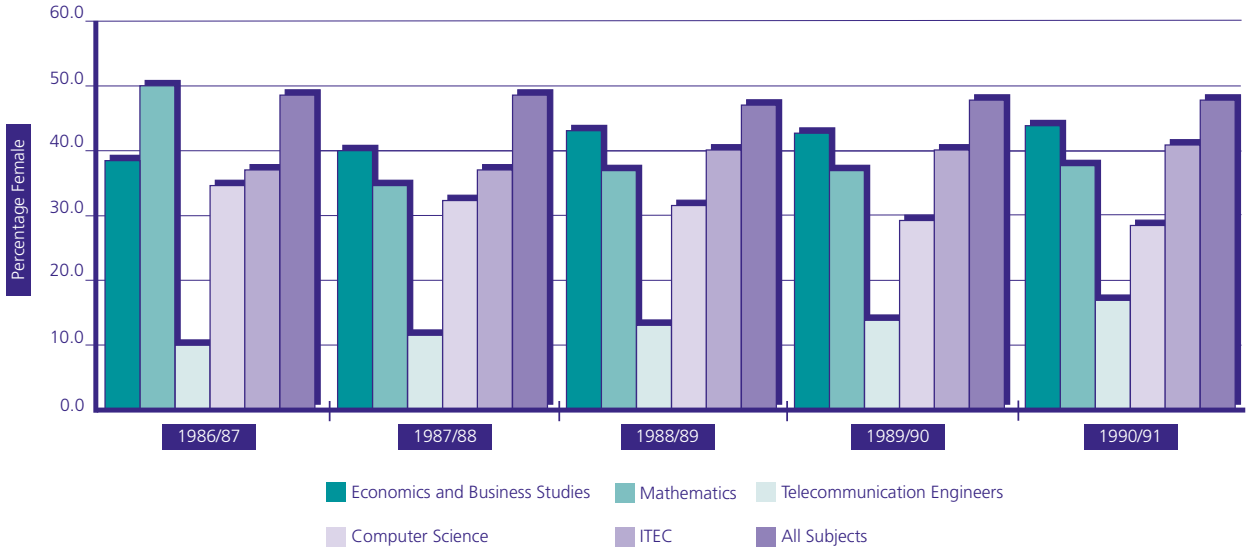
Figure 56: ITEC graduates in Spain (1990/91), percentage female



Source: Consejo de Universidades (1994) Auario de estadistica unviersitaria 1992

Women were relatively well represented (38 per cent) among graduates in mathematics. However, the proportion of women mathematics graduates dropped suddenly from 50 per cent in 1986/87 to 36 per cent in 1987/88.

Figure 57: The proportion of women graduating in ITEC in Spain, 1986-1991

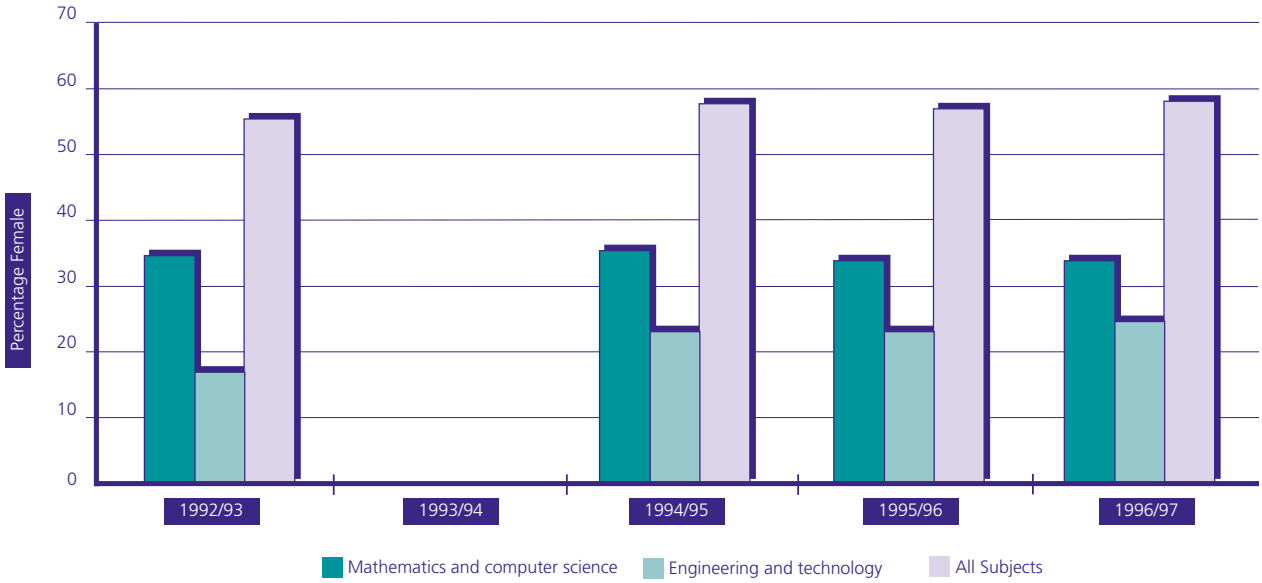


Source: Consejo de Universidades (1994) Auario de estadistica unviersitaria 1992

In 1990/91, women represented 29 per cent of those who graduated in computer science. For some years, the proportion of women computer science graduates had decreased. In 1986/87, for example, 34 per cent of computer science graduates were women (Figure 57, Table 73). Women were the minority (18 per cent) in telecommunication engineering graduates, although the proportion of women graduating had increased since 1986/87 when it was 10 per cent.

More recent graduate data for Spain aggregates mathematics with computing and engineering with technology, while data on graduation from courses in business studies are combined with data on graduation from courses in all the other social sciences. These data also cover all post-compulsory levels of education. Therefore data on sub-degree, first degree and postgraduate qualifications are merged. This means that direct comparisons with the earlier data set are not possible.

Figure 58: Graduates in mathematics, computing and engineering Spain, 1992/93 to 1996/97



Source: Eurostat (various years) Education Across the European Union Statistics and Indicators

Figure 58 (and Table 74) presents data for the period after the university reforms from 1992/93 to 1996/97 (1993/94 is missing from the published Eurostat data). This shows the percentage of women among the graduate population had risen from 55 percent in 1992/93 to 58 percent in 1996/97. Over the same period the proportion of women mathematics and computing graduates fell slightly from 34 percent to 33 percent, while the percentage of women among engineering and technology graduates rose from 18 per cent to 25 percent.

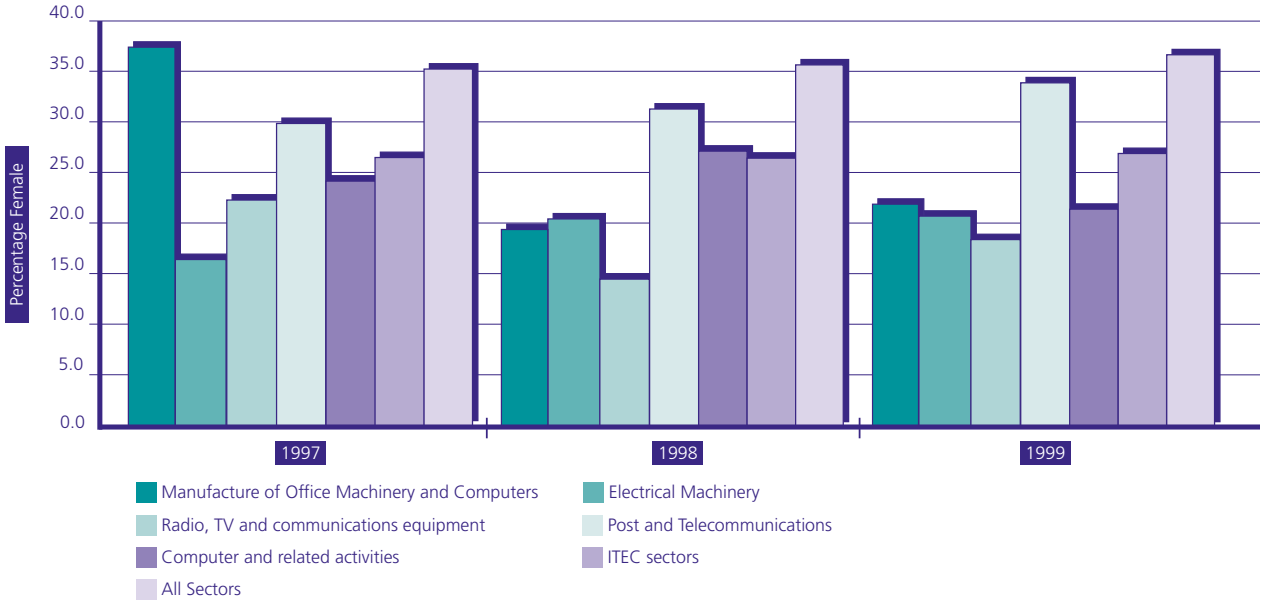
6.4 Women in ITEC careers in Spain: the evidence base

In 1999, women were the minority (36 per cent) in the workforce in Spain (Figure 59). Their participation in the ITEC sector (27 per cent) is below what would be expected given the extent of their participation in the economy and in other, non-ITEC sectors (37 per cent) (Table 75) and has been fairly constant, at least since 1997 (Figure 59, Table 75).

Within the ITEC sector, the proportion (34 per cent) of women in the post and telecommunications industry was higher, in 1999, than in any other ITEC sector industry, and this had risen from 30 per cent in 1997. In other ITEC sector industries, in 1999, low proportions of women were employed. For example, just under a fifth (19 per cent) of the workforce in the radio, TV and communications equipment and apparatus manufacturing industry were women, and women represented a similar percentage (21 per cent) in the manufacture of electrical machinery and apparatus (Table 75).

With the exception of the post and telecommunications industry and in the manufacture of electrical machinery and apparatus, the general trend between 1997 and 1999 was towards a smaller participation of women in the ITEC sector industries in Spain (Figure 59, Table 75).

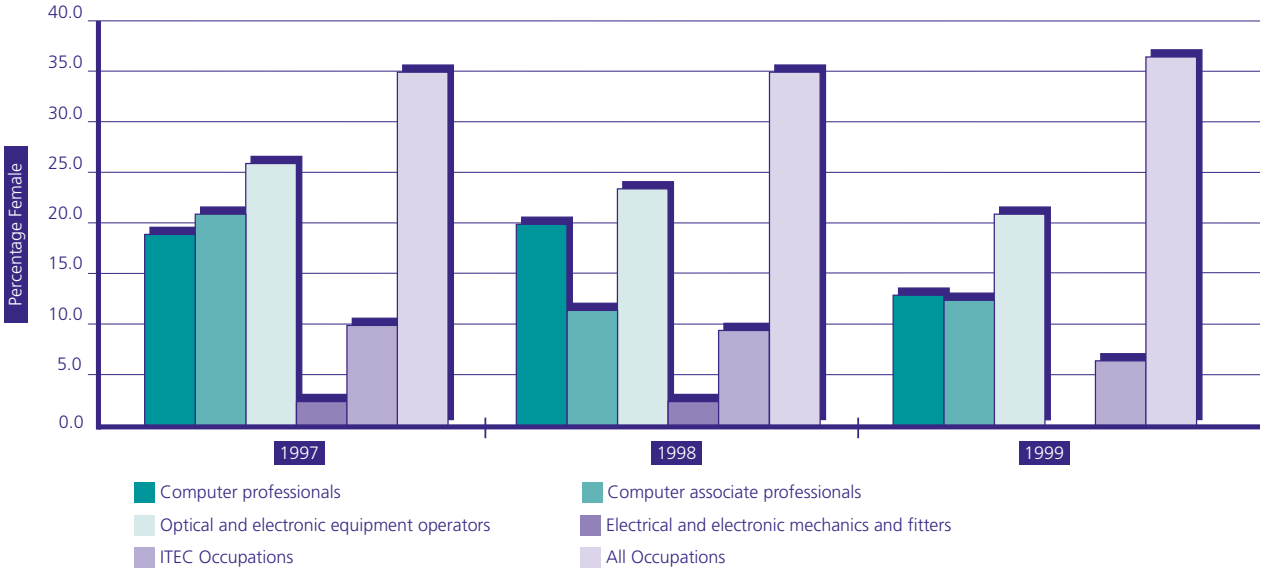
Figure 59: The participation of women in selected sectors in Spain, 1999



Source: IES/Eurostat Special tabulation of the Community Labour Force Survey

Figure 60 (and Table 76) shows the participation of women in a selected range of ITEC occupations in Spain between 1997 and 1999. It highlights the severe under-representation of women in ITEC jobs. In 1999, women represented a mere 7.3 per cent of ITEC jobs, and the trend in their participation in these jobs had been declining – in 1997, women made up 10 per cent of those in ITEC jobs.

Figure 60: The participation of women in ITEC occupations in Spain, 1997-1999



Source: IES and a special analysis of the Community Labour Force Survey by Eurostat

In 1999, about a quarter (26 per cent) of optical and electronic equipment operators were women, and this percentage was higher than the percentage of women in any other ITEC occupation. Only 12 per cent of computer associate professionals and 13 per cent of computer professionals were women, and the participation of women in both of these occupations had declined from 21 per cent and 19 per cent respectively in 1997. Very few women were employed as electrical and electronic equipment mechanics and fitters.

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Appendix 1

Defining the ITEC sector

Defining the ITEC sector in the UK

In the UK, where economic activities are classified under the 1992 Standard Industrial Classification (SIC 92) scheme, the implementation of Hawkins *et al.*'s conceptual framework of the ITEC sector gives rise to the following ITEC sector map[94] (Table 8).[95]

Table 8: The ITEC sector map in the UK.

UK SIC(92)	Description
IT Services	
72.1	Hardware consultancy
72.2	Software consultancy and supply
72.3	Data processing
72.4	Data base activities
72.5	Maintenance and repair of office, accounting and computing machinery
Telecommunication Services	
64.2	Telecommunications
64.1	Postal and courier activities
Broadcasting Services	
92.20	Radio and television activities
Electronics Manufacturing	
30	Manufacture of office machinery, computers and other information processing equipment
32.1	Manufacture of electronic valves and tubes and other electronic components
32.20/1	Manufacture of telegraph and telephone apparatus and equipment
32.20/2	Manufacture of radio and electronic capital goods
32.3	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods
33.30/1	Manufacture of electronic industrial process control equipment

Defining the ITEC sector in the US

In the US, the ITEC sector map that can be derived from Hawkins *et al.*'s conceptual framework of the ITEC sector is different in detail from the ITEC sector map that has been articulated for the UK. The map is based on the US Current Population Survey (CPS) that uses the US Standard Industrial Classification (SIC) system. This classification system is broadly similar to the UK SIC 92.

[94] Economic activities relating to publishing have been omitted because of known difficulties in accessing such data. Other categories in the Hawkins et al. sector map, such as SIC 36.30, the manufacture of musical instruments, have been omitted because it is difficult to separate out ITEC-related activities e.g. 'the sound of which is produced electronically', from the non-ITEC producers.

[95] In practice, at the three digit level, this classification is identical to that used by Eurostat (NACE Rev. 1).

Table 9: ITEC sector map in the US

US SIC Code	Description
IT Services	
732	Computer and data processing services
Telecommunication Services	
412	US postal service
441	Telephone communication
442	Telegraph and miscellaneous communication services
Broadcasting Services	
440	Radio and television broadcasting and cable
Electronics Manufacturing	
321	Office and accounting machines
322	Computers and related equipment
341	Radio, TV, and communication equipment
342	Electrical machinery, equipment and supplies

However, in the US classification scheme, the data that relate to the IT services and electronics manufacturing sectors are less detailed than they are in the UK. This poses problems in establishing a direct comparison between the ITEC sector in the UK and the US. As a result, while it is possible to make international comparisons between aggregate categories, the composition of these categories in the two countries is very different, and therefore comparability between the ITEC sector in the UK and in the US is superficial.

Defining the ITEC sector in Canada

The data used in this report are derived from the Canadian 1996 Census. Data relating to the ITEC sector were classified using the 1980 Standard Industrial Classification (SIC) scheme. The articulation of the ITEC sector map for Canada that can be derived using the Canadian 1980 SIC system is shown in Table 10.

Table 10: The ITEC sector map in Canada

Canadian SIC Code	Description
334	Record player, radio and television receiver industry
335	Communication and other electronic equipment industries
336	Office, store and business machine industries
338	Communication and energy wire and cable industry
481	Telecommunication broadcasting industries
482	Telecommunication carriers industry
483	Other telecommunication industries
484	Postal and courier service industries
772	Computer and related services
931	Motion picture, audio and video production and distribution

Again, the ITEC sector classification that is possible in Canada differs from that in the UK and so direct comparisons are only possible at the aggregate, ITEC-sector, level.

Defining the ITEC sector in Ireland and Spain

The data for Ireland and Spain are derived from Eurostat's Community Labour Force Survey (LFS). In the analysis of this survey, data relating to the sector are coded using NACE Rev 1 (which at the three digit level is identical to the UK SIC 92). However, data are only available at the two-digit level. These give rise to the following ITEC sector map (Table 11).

Table 11: The ITEC sector map in Ireland and Spain

NACE 2 digit code	Description
30	Manufacture of Office Machinery and Computers
31	Electrical Machinery
32	Radio, TV and communications equipment
64	Post and Telecommunications
72	Computer and related activities

As this table makes clear, NACE Rev 1 at the three-digit level does not include reference to the broadcasting services sector. As a result, only partial coverage of the ITEC sector is possible in Ireland and Spain.

Defining the ITEC sector in Taiwan

In Taiwan, a national sector classification scheme has been developed. The articulation of the ITEC sector definition in this scheme results in an ITEC sector map with three categories:

- Electrical and electronic equipment manufacture
- Telecommunications
- Data processing and information services

Again in Taiwan, it is not possible to provide a full analysis, i.e. one that includes the broadcasting services sector, of the ITEC sector.

Defining ITEC occupations

Defining ITEC occupations in the UK

In the UK the IT National Training Organisation (IT NTO) has proposed that any conceptual framework used to classify ITEC occupations should include computer managers, electrical and electronics engineers and technicians, software engineers, computer analysts and programmers, and a range of occupations associated with telecommunications. The articulation of these requirements in the UK gives rise to the following ITEC occupational map (Table 12).

Table 12: Map of ITEC occupations in the UK

SOC 90 code	Occupational Category
Computer/IT related occupations	
126	Computer systems and data processing managers[96]
320	Computer analysts, programmers[97]
214	Software engineers[98]
526	Computer engineers[99]
Electronics and Electrical Engineering-related occupations	
212	Electrical engineers[100]
213	Electronic engineers[101]
302	Electrical/electronic technicians
525	Radio, TV & video engineers
Telecommunications Engineering-related occupations	
523	Telephone fitters[102]
524	Cable jointers, line repairers[103]

However, the 1990 Standard Occupational Classification (SOC 90) system that is used in the UK is not well suited for the analysis of ITEC occupations. For example, the ITEC occupations that are possible to define do not incorporate data processing work, where the majority of women in ITEC employment are concentrated. It is anticipated that the creation of a new minor group within SOC 2000, SOC 2000 313, that relates to IT service delivery occupations will go some way towards addressing this.

Defining ITEC occupations in the US

The US Current Population Survey (CPS), run by the Bureau of the Census, uses an occupational classification system that is based on the US 1980 Standard Occupational Classification (US SOC 80).

[96] Category includes computer managers, computer operations managers, data processing managers and systems managers.

[97] Category includes analyst/programmers, applications programmers, computer programmers and systems analysts.

[98] Category includes project leaders, software engineers and computing systems designers.

[99] Category includes computer engineers, computer maintenance engineers, computer service engineers and computer service technicians.

[100] Category includes electrical engineers, generating engineers, power engineers and power transmission engineers.

[101] Category includes broadcasting engineers, electronic engineers, microwave engineers, radar research engineers and professional radio engineers.

[102] Category includes telecommunications engineers (telephones), telephone installation engineers and telephone technicians.

[103] Category includes cable jointers, cable repairers, overhead linesmen and overhead wiremen.

Table 13: Map of ITEC occupations in the US

US SOC Code	Occupations
Computing/IT-related occupations	
64	Computer systems analysts and scientists
65	Operations and systems researchers and analysts
129	Computer science teachers
229	Computer programmers
304	Supervisors, computer equipment operators
308	Computer operators
309	Peripheral equipment operators
525	Data processing equipment repairers
Electrical and Electronics Engineering-related occupations	
213	Electrical and electronic technicians
228	Broadcast equipment operators
523	Electronic repairers, communications and industrial equipment repairers
533	Miscellaneous electrical and electronic equipment repairers
Telecommunications Engineering-related occupations	
353	Communications equipment operators
527	Telephone line installers and repairers
529	Telephone installers and repairers
348	Telephone operators*

Note: *omitted from 'Telecommunications Engineering-related occupations' category

Although the US SOC 80 is conceptually different from the UK SOC 90 a broad match is possible at the aggregate level rather than at the level of individual SOC codes. The ITEC occupational map that has been derived using US SOC 80 is shown in Table 13.

Defining ITEC occupations in Canada

The Canadian occupational data that have been used in this report come from the 1986, 1991 and 1996 censuses and have been coded using the Canadian 1980 Standard Occupational Classification.

Table 14: Map of ITEC occupations in Canada

SOC 1980 Code	Description
Computing/IT-related occupations	
A122 (0213)	Information systems and data processing managers
B521 (1421)	Computer operators
C047 (2147)	Computer engineers
C062 (2162)	Computer systems analysts
C063 (2163)	Computer programmers
Electrical and Electronics Engineering-related occupations	
C033 (2133)	Electrical and electronics engineers
C141 (2241)	Electrical and electronics engineering technologists and technicians
C142 (2242)	Electronic service technicians (household and business equipment)
C143 (2243)	Industrial instrument technicians and mechanics
H217 (7247)	Cable television service and maintenance technicians
Telecommunications Engineering-related occupations	
A311 (0131)	Telecommunication carriers managers
A312 (0132)	Postal and courier services managers
H215 (7245)	Telecommunications line and cable workers
H216 (7246)	Telecommunications installation and repair workers

As with the US SOC system, the Canadian system is conceptually different from the UK SOC system. This means that a broader range of occupational classifications has to be used to obtain a comparable map of ITEC occupations.

Defining ITEC occupations in Ireland

Ireland has only recently adopted the UK SOC 90 classification scheme and this replaced a 1950 occupational classification scheme. This means that the UK definition can be mapped directly on to Irish data.

Defining ITEC occupations in Taiwan

Taiwan uses a national occupational classification. Available, internationally comparable, data were coded to one digit of the ISCO system. This meant that it is only possible to compare data on two very broad categories of employment in Taiwan, 'professionals' and 'technicians and associate professionals'. These categories include, but are not restricted to, ITEC occupations.

Defining ITEC occupations in Spain

The Spanish occupation data are from the Eurostat Community Labour Force Survey where occupations are coded using the International Standard Classification of Occupations (ISCO). At the three-digit level, where data are available, the ISCO classification is considerably less detailed than the UK SOC. This means that only four ISCO categories could be mapped onto the ITEC occupation conceptual framework used to guide this research.

Table 15: Map of ITEC occupations in Spain

ISCO 3 digit codes	Description
Computing/IT-related occupations	
213	Computer professionals
312	Computer associate professionals
Electrical and Electronics Engineering-related occupations	
313	Optical and electronic equipment operators
724	Electrical and electronic equipment mechanics and fitters

Defining ITEC-related courses

Defining ITEC-related courses in the UK

The UK core definition of ITEC subject categories was defined in terms of the Higher Education Statistics Agency (HESA) subject categories (Table 16). In the UK the analysis is focused on first (Bachelor's) degrees, which are normally obtained after three years of University education.

Table 16: ITEC-related courses in the UK

HESA Subject Description
Mathematical Sciences
Computer Science
Engineering and Technology
Business and Administrative Studies

Defining ITEC-related courses in the US shows how the HESA categories map onto US subject categories (Table 17). Apart from semantic differences the mapping is close. As in the UK, the analysis in the US is focused on first university degrees or Bachelor's degrees. These qualifications are normally obtained after four years of university study.

Table 17: ITEC-related courses in the US

UK HESA subject category	US Subject categories
Mathematical Sciences	Mathematics
Computer Science	Computer & Information Science
Engineering and Technology	Engineering
Business and Administrative Studies	Business

Defining ITEC-related courses in Canada

Table 18 shows how the HESA categories were mapped onto the Canadian subject categories. Apart from some semantic differences the mapping appears to be close. The Canadian higher education system is very similar to the UK system and, as in the UK, the analysis is focused on first degrees.

Table 18: ITEC-related courses in Canada

UK HESA subject category	Canadian subject categories
Mathematical Sciences	Mathematics
Computer Science	Computer Science
Engineering and Technology	Engineering
Business and Administrative Studies	Business Management and Commerce

Defining ITEC-related courses in Ireland

Table 19 shows the mapping of the ITEC HESA categories onto the Irish subject categories. As with the US and Canadian systems, given the historical similarities between the higher education systems, the mapping is close. Ireland's higher education system has commonalties with the UK (and Canada). The analysis is focused on first degrees.

Table 19: ITEC-related courses in Ireland

UK HESA subject category	Irish subject categories
Mathematical Sciences	Mathematics and Statistics
Computer Science	Computing
Engineering and Technology	Engineering and engineering trades
Business and Administrative Studies	Business and administration

Defining ITEC-related courses in Taiwan

Graduate data in Taiwan were coded using the International Standard Classification of Educational Diplomas (ISCED). The 1976 version of ISCED is still widely in use, but this does not distinguish between mathematics and computer sciences. This means that the ITEC definition maps on to only three ISCED fields of study (Table 20). The Taiwanese higher education system is derived from the Japanese and US systems and it is similar to the UK system. The analysis focuses on first university degrees.

Table 20: ITEC-related courses in Taiwan

UK HESA subject category	
Mathematical Sciences	Maths and Computer Science
Computer Science	
Engineering and Technology	Engineering
Business and Administrative Studies	Commercial and Business Admin.

Defining ITEC-related courses in Spain

The Spanish subject classification system links economics with business studies and allows telecommunications engineering to be examined separately. Therefore the map (Table 21) is not as close as it is in Anglo Saxon countries. The data cover the 'Ciclo Corto', or short cycle, level of university qualifications. This is usually considered to be lower than a UK honours degree and more like an ordinary Bachelor's degree.

Table 21: ITEC-related courses in Spain

UK HESA subject category	Spanish subject categories
Mathematical Sciences	CC. Matemáticas
Computer Science	Informática
Engineering and Technology	Ingenieros de Telecomunicación
Business and Administrative Studies	CC. Económicas y Empresariales

Analysis of labour force information in the UK

The data that have been used to inform the analyses of data in the UK are drawn from the UK Labour Force Survey of a random sample of about 59,000 (0.3 per cent) responding households in Britain and 2000 (0.4 per cent) responding households in Northern Ireland. After the response to the survey has been generalised across the entire population, data items relating to 10,000 people are actually based on about three respondents. Given normal methods of calculating the reliability of sample surveys, the Office of National Statistics (ONS) states that cell sizes below 10,000 in tables derived from the Labour Force Survey should be considered unreliable (Office of National Statistics, 1999). Because of this, in the tables that follow, data where the cell values are less than 10,000 have been suppressed. This impacts on the extent to which an analysis of women's participation in ITEC, where cell values are typically low, is possible. Cell sizes that are only marginally larger than 10,000 should also be treated with caution. This is especially true for characteristics that tend to be shared by people in the same household such as ethnicity, or graduate level qualifications.

Analysis of labour force information in the US

The data that form the basis for these analyses are mainly drawn from the March supplement to the Current Population Survey (CPS). This supplement has a boosted sample especially amongst Hispanic households. Like the UK LFS the CPS is a household-based sample survey. The households sampled are selected using a multi-stage technique that is designed to increase the reliability of the weighted results. As with the UK LFS, low responses should be treated with caution as they are based on very few respondents. However, no advice about suppressing low results has been provided by the US Bureau of Census or the US Bureau of Labor that, together, are responsible for the survey.

Analysis of labour force information in Canada

The Canadian analysis is based on the population census conducted every ten years. This is because there is insufficient occupational or sectoral detail in the annual labour force survey. The advantage of using census data is that there are no sampling problems, the disadvantage is that time series analysis is more problematic.

Analysis of labour force information in Ireland

The Irish data are based, in part, on data supplied by Eurostat from the Community Labour Force Survey. The Community Labour Force Survey aggregates all the EU national surveys. Sectoral data are coded using Eurostat's NACE classification. NACE is almost identical to the UK SIC classification scheme, although NACE data are only available at the two digit level and this prevents direct comparison with UK data, which are coded at the three digit level.

As Eurostat did not have reliable occupational data, a direct approach was made to the Irish Central Statistical Office (CSO). As with the UK survey, small cells may be unreliable due to sampling problems. In Ireland cell sizes smaller than 4,500 are not considered reliable.

Analysis of labour force information in Taiwan

The Taiwanese labour force data are based on the Taiwanese equivalent of the labour force survey called the 'Report on Manpower Utilization Survey'. The data are presented in round thousands and as in the other countries small numbers should be treated with caution.

Analysis of labour force information in Spain

Both the sectoral and occupational data in Spain come from the Eurostat Community Labour Force Survey. This means that the Ssectoral data (as with Ireland) are coded usiusing NACE at the two- digit level. While the occupationsOccupational data are coded using the International Standard Classification of Occupations (ISCO88-(COM)). The available three- digit ISCO data haves slightly fewer categories than the UK SOC scheme and as suchconsequently the data isare less detailed. In Spain cell sizes of less than 5,000 are considered unreliable.

Appendix 2[104] – UK

Table 22: GCSE entries and achievements of 15 year old pupils in all schools in England, 1993/94 – 1998/99

		1993/94	1994/95	1995/96	1996/97	1997/98	1998/99
Computer Studies grades A* to C	Female	8,656	3,612	2,613	4,532	10,727	16,988
	Male	13,479	4,150	2,476	4,034	13,414	22,322
	Total	22,135	7,762	5,089	8,566	24,141	39,310
	% Female	39.1	46.5	51.3	52.9	44.4	43.2
Mathematics grades A* to C	Female	111,219	115,842	125,217	126,918	128,322	134,118
	Male	116,810	120,895	128,676	129,564	128,675	134,754
	Total	228,029	236,737	253,893	256,482	256,997	268,872
	% Female	48.8	48.9	49.3	49.5	49.9	49.9
Information systems grades A* to C	Female	–	5,981	9,376	10,208	5,456	1,278
	Male	–	9,501	14,140	15,483	7,799	1,268
	Total	–	15,482	23,516	25,691	13,255	2,546
	% Female	–	38.6	39.9	39.7	41.2	50.2

Sources: DfEE (various years) Statistics of Education: Public Examinations GCSE/GNVQ and GCE/AGNVQ in England

Table 23: Numbers (from all schools and FE colleges) achieving GCE A-Level grades A to E by subject in England, 1993/94-1998/99

		1993/94	1994/95	1995/96	1996/97	1997/98	1998/99
Computer Science	Male	5,067	5,470	5,783	6,114	6,645	9,853
	Female	895	937	998	1,001	1,073	2,464
	Both	5,962	6,407	6,781	7,115	7,718	12,317
	% Female	15.0	14.6	14.7	14.1	13.9	20.0
Mathematics	Male	31,576	32,223	35,044	36,103	36,410	35,844
	Female	17,398	17,852	18,973	19,877	20,557	20,453
	Both	48,974	50,075	54,017	55,980	56,967	56,297
	% Female	35.5	35.7	35.1	35.5	36.1	36.3
All Subjects	Male	255,625	258,149	266,910	284,658	291,329	292,686
	Female	285,626	289,401	301,796	326,989	340,671	341,632
	Both	541,251	547,550	568,706	611,647	632,000	634,318
	% Female	52.8	52.9	53.1	53.5	53.9	53.9

Source: DfEE (various years) Statistics of Education: Public Examinations GCSE/GNVQ and GCE/AGNVQ in England

[104] In the statistical tables that follow, figures that appear in brackets should be interpreted with caution because they reflect small sample size.

Table 24: Graduates in ITEC-related subjects in the UK, 1994/95-1998/99

		1994/95	1995/96	1996/97	1997/98	1998/99
Mathematical Sciences	Female	1,528	1,608	1,468	1,602	1,663
	Male	2,541	2,460	2,237	2,337	2,587
	Both	4,069	4,068	3,705	3,939	4,250
	% Female	37.6	39.5	39.6	40.7	39.1
Computer Science	Female	1,805	1,940	2,019	2,164	2,213
	Male	6,469	7,272	7,276	7,827	8,167
	Both	8,274	9,212	9,295	9,991	10,380
	% Female	21.8	21.1	21.7	21.7	21.3
Engineering and Technology	Female	3,194	3,468	3,374	3,253	3,254
	Male	18,889	19,850	19,643	19,321	18,758
	Both	22,083	23,318	23,017	22,574	22,012
	% Female	14.5	14.9	14.7	14.4	14.8
Business and Administrative Studies	Female	12,708	14,261	15,220	15,420	16,411
	Male	13,208	14,152	14,279	14,161	14,526
	Both	25,916	28,413	29,499	29,581	30,937
	% Female	49.0	50.2	51.6	52.1	53.0
ITEC-related subjects	Female	19,235	21,277	22,081	22,439	23,541
	Male	41,107	43,734	43,435	43,646	44,038
	Both	60,342	65,011	65,516	66,085	67,579
	% Female	31.9	32.7	33.7	34	34.8

Source: HESA Student Returns (various years)

Table 25: First destinations of ITEC graduates in the UK, 1998/99

		Employed	Further study	Unemployed	Total of known destination
Male	Mathematical sciences	1,281	526	127	2,049
	Computer science	4,439	342	403	5,382
	Engineering & technology	7,166	1,329	710	9,795
	Business & administrative studies	6,847	671	592	8,791
	ITEC Subjects	19,733	2,868	1,832	26,017
	Total – All subject areas	53,128	14,419	5,281	78,011
Female	Mathematical sciences	896	370	38	1,377
	Computer science	1,058	123	141	1,409
	Engineering & technology	1,408	274	77	1,884
	Business & administrative studies	8,170	825	531	10,272
	ITEC Subjects	11,532	1,592	787	14,942
	Total – All subject areas	67,595	19,438	4,436	98,194
		% Employed	% Further study	% Unemployed	% Total of known destination
Male	Mathematical sciences	62.5	25.7	6.2	100.0
	Computer science	82.5	6.4	7.5	100.0
	Engineering & technology	73.2	13.6	7.2	100.0
	Business & administrative studies	77.9	7.6	6.7	100.0
	ITEC Subjects	75.8	11.0	7.0	100.0
	Total – All subject areas	68.1	18.5	6.8	100.0
Female	Mathematical sciences	65.1	26.9	2.8	100.0
	Computer science	75.1	8.7	10.0	100.0
	Engineering & technology	74.7	14.5	4.1	100.0
	Business & administrative studies	79.5	8.0	5.2	100.0
	ITEC Subjects	77.2	10.7	5.3	100.0
	Total – All subject areas	68.8	19.8	4.5	100.0

Source: HESA (2001) First Destinations of Students Leaving Higher Education Institutions 1998/99

Table 26: Initial employment of graduates in the UK, 1998/99

		Manufacturing	Wholesale & retail trade etc.	Financial activities	Property development, renting, business & research activities	Public administration & defense/Social security	Education	Health & social work
Male	Mathematical sciences	7.6	7.2	26.9	34.7	6.2	2.0	1.7
	Computer science	11.2	4.4	7.5	51.9	3.9	3.8	1.7
	Engineering & technology	29.8	5.5	3.8	26.9	5.9	2.1	0.8
	Business & administrative studies	12.3	13.0	15.0	29.7	4.5	1.5	1.8
	ITEC-related subjects	18.2	7.9	10.0	34.0	5.0	2.3	1.4
	Total – All subject areas	12.5	9.1	8.6	26.8	6.2	5.7	8.8
Female	Mathematical sciences	5.6	8.0	23.3	39.3	7.2	2.9	2.2
	Computer science	10.6	6.4	11.0	39.7	4.9	7.0	2.9
	Engineering & technology	28.2	12.8	4.7	23.0	5.7	2.3	1.8
	Business & administrative studies	11.2	13.1	13.1	26.0	6.2	2.7	3.1
	ITEC-related subjects	12.8	12.1	12.6	27.9	6.1	3.0	2.8
	Total – All subject areas	8.0	10.6	6.9	17.7	6.7	14.5	18.2

Source: HESA (2001) First Destinations of Students Leaving Higher Education Institutions 1998/99

Table 27: The educational base of employment in the ITEC sector in the UK, 2000

	Degree and above		Sub degree		Below sub degree	
Male	(N)	(% total)	(N)	(% total)	(N)	(% total)
Other, non-ITEC, Sectors	2,211,176	15.6	1,462,882	10.3	10,503,840	74.1
IT Services	183,926	47.8	52,149	13.5	149,092	38.7
Telecommunication Services	46,481	10.8	40,712	9.5	341,525	79.7
Post, courier activities	11,860	4.7	10,483	4.2	229,930	91.1
Telecommunications	34,621	19.6	30,229	17.1	111,595	63.2
Broadcasting Services	19,403	39.5	–	–	21,329	43.5
Electronics Manufacturing	52,372	21.2	42,524	17.2	152,542	61.6
Office mach, computer manufacture	27,161	27.7	16,301	16.6	54,639	55.7
Electronic components etc man.	–	–	–	–	44,749	76.6
Tph, tphone eqt radio, TV trans. man.	–	–	–	–	18,281	63.5
TV, radio receivers, etc eqt man.	–	–	–	–	15,293	64.6
Testing, navigating etc eqt man.	11,689	30.4	–	–	19,581	50.9
Industrial proc control eqt man.	–	–	–	–	–	–
All ITEC Sectors	302,182	27.2	143,733	12.9	664,489	59.8
All Sectors	2,515,410	16.4	1,609,292	10.5	11,173,725	73.0
Female	(N)	(% total)	(N)	(% total)	(N)	(% total)
Other, non-ITEC, sectors	1,706,933	14.2	1,478,390	12.3	8,816,606	73.5
IT Services	36,867	31.9	12,486	10.8	66,110	57.3
Telecommunication Services	19,744	11.7	13,813	8.2	152,588	80.1
Post, courier activities	–	–	–	–	76,294	86.8
Telecommunications	12,770	15.8	–	–	58,994	72.9
Broadcasting Services	16,284	41.9	–	–	18,995	48.9
Electronics Manufacturing	11,948	11.7	–	–	83,998	81.9
Office mach, computer manufacture	–	–	–	–	31,081	78.7
Electronic components etc man.	–	–	–	–	26,919	87.4
Tph, tphone eqt radio, TV trans. man.	–	–	–	–	12,797	79.1
TV, radio receivers, etc eqt man.	–	–	–	–	–	–
Testing, navigating etc eqt man.	–	–	–	–	–	–
Industrial proc control eqt man.	–	–	–	–	–	–
All ITEC Sectors	84,843	19.9	36,464	8.6	304,391	71.5
All Sectors	1,791,776	14.4	1,514,854	12.2	9,122,958	73.4

Source: Office of National Statistics (ONS) Labour Force Survey, March-May, 2000.

Table 28: The graduate level skills base of employment in ITEC in the UK, 2000

	Other Non-ITEC jobs	Total ITEC jobs	126 computer systems etc managers	212 electr'al eng'rs	213 electr'nic eng'rs	214 software eng'rs	302 electr'al/ electr'nic technic'n	320 computer analysts, progr'ers	523 telephone fitters	524 cable jointers, line repairers	525 radio, TV & video engineers	526 computer engineers etc
Total												
All employees	26,828,716	909,178	179,259	38,562	37,427	185,903	29,265	300,063	46,664	12,916	21,521	57,598
All degrees	3,945,799	363,354	76,391	12,169	18,206	107,690	–	133,202	–	–	–	12,031
ITEC subjects	124,809	137,769	20,786	–	–	44,596	–	60,897	–	–	–	4,819
Male												
All employees	14,513,307	788,719	143,193	37,677	35,921	170,876	28,578	236,741	45,485	12,916	21,521	55,811
All subjects	2,206,732	309,658	61,072	11,801	17,344	97,039	–	107,011	–	–	–	12,031
ITEC subjects	86,350	118,708	16,399	–	–	39,258	–	51,973	–	–	–	–
Female												
All employees	12,315,410	120,459	36,066	–	–	15,027	–	63,322	–	–	–	–
All subjects	1,739,067	53,696	15,319	–	–	10,651	–	26,191	–	–	–	–
ITEC subjects	37,561	18,206	–	–	–	–	–	–	–	–	–	–

Source: Office of National Statistics (ONS) Labour Force Survey, March-May, 2000.

Table 29: ITEC subject list for the UK

Applied Computing
Applied Information Technology
Artificial Intelligence
Automation and Control
Business Computing
Communications Engineering
Computational Biology
Computational Chemistry
Computational Mathematics
Computational Physics
Computational Science
Computer Appreciation
Computer Education
Computer Studies
Computer Systems Engineering
Computing Economics
Computing Science
Control Engineering
Cybernetics and Robotics
Data Processing
Digital Systems Engineering
Electronic Control
Electronic Musical Instruments
Electronic Servicing
Electronics & Computer Technology
Engineering of Dynamic Systems
Engineering Systems and Control
Information Engineering
Information Systems
Information Technology
Instrumentation and Control Engineering
Instrumentation and Systems Engineering
Integrated Circuit Engineering
Mathematical and computer sciences
Measurement and Control
Medical Electronic Engineering
Medical Informatics
Microelectronics
Microprocessing
Opto-electronic Engineering
Other/general computer sciences
Programming
Software
Software Engineering
Systems Analysis and Design
Telecommunications Engineering
Theoretical Computer Science

Source: SPRU/IES

Table 30: The degree level (single and combined subject) qualifications of those in ITEC occupations in the UK, 2000

	All occu-pations	Other Non-ITEC occu-pations	126 computer systems etc managers	212 electr'al eng'rs	213 electr'nic eng'rs	214 software eng'rs	302 electr'al/ electr'nic technic'n	320 computer analysts, progr'ers	523 telephone fitters	524 cable jointers, line repairers	525 radio, TV & video engineers	526 computer engineers etc	All ITEC occu-pations
All Subjects	4,861,364	3945,799	76,391	12,169	18,206	107,690	–	133,202	–	–	–	12,031	363,354
Medicine	171,685	150,158	–	–	–	–	–	–	–	–	–	–	–
Medical related	242,306	218,464	–	–	–	–	–	–	–	–	–	–	–
Biological sciences	270,485	222,422	–	–	–	–	–	–	–	–	–	–	11,184
Agricultural sciences	60,361	53,186	–	–	–	–	–	–	–	–	–	–	–
Physical/environ-mental sciences	363,036	281,483	–		–	12,961	–	13,986	–	–	–	–	38,618
Maths and computing	357,882	176,111	27,025	–	–	45,572	–	63,951	–	–	–	–	145,162
Engineering &	410,218	309,642	–	–	11,826	21,524	–	14,364	–	–	–	–	65,307
Technology	66,165	52,367	–	–	–	–	–	–	–	–	–	–	–
Architecture and related	115,318	101,660	–	–	–	–	–	–	–	–	–	–	–
Social sciences	735,265	622,095	–	–	–	–	–	–	–	–	–	–	23,898
Business & vocational	516,355	439,611	12,160	–	–	–	–	10,040	–	–	–	–	32,572
Librarianship and information studies	42,351	34,111	–	–	–	–	–	–	–	–	–	–	–
Linguistics and languages	356,733	297,312	–	–	–	–	–	–	–	–	–	–	–
Humanities and arts	622,854	513,064	–	–	–	–	–	–	–	–	–	–	12,829
Education	478,369	427,372	–	–	–	–	–	–	–	–	–	–	–

Source: Office of National Statistics (ONS) Labour Force Survey, March-May, 2000.

Table 31: Participation by gender in ITEC sector employment in the UK, 2000

	All Occupations			ITEC Occupations		
	Male	Female	% Female	Male	Female	% Female
Other Sectors	14,177,898	12,001,929	45.8	378,312	81,407	17.7
IT Services total	385,167	115,463	23.1	270,431	29,613	9.9
Post, courier activities	252,273	87,940	25.8	–	–	–
Telecommunications	176,445	80,905	31.4	63,960	–	–
Telecommunications Services total	428,718	168,845	28.3	67,870	–	–
Broadcasting Services total	49,080	38,833	44.2	–	–	–
Office mach, computer manufacture	98,101	39,506	28.7	33,722	–	–
Electronic components etc man.	58,457	30,803	34.5	–	–	–
Tph, tphone eqt radio, TV trans. man.	28,770	16,179	36.0	–	–	–
TV, radio receivers, etc eqt man.	23,664	–	–	–	–	–
Testing, navigating etc eqt man.	38,447	–	–	–		–
Industrial proc control eqt man.	10,125	–	–	–	–	–
Electronics Manufacturing total	257,564	104,518	28.9	64,016	–	–
All ITEC Sectors	1,120,529	427,659	27.6	410,407	39,052	8.7

Source: Office of National Statistics (ONS) Labour Force Survey, March-May, 2000.

Table 32: Participation by gender in ITEC occupations in the UK, 2000

	Male	Female	% Female
Other Occupations	14,513,307	12,315,410	45.9
Computer systems etc managers	143,193	36,066	20.1
Electrical engineers	37,677	–	–
Electronic engineers	35,921	–	–
Software engineers	170,876	15,027	8.1
Electrical, electronic technicians	28,578	–	–
Computer analysts, programmers	236,741	63,322	21.1
Telephone fitters	45,485	–	–
Cable jointers, lines repairers	12,916	–	–
Radio, TV & video engineers	21,521	–	–
Computer engineers etc	55,811	–	–
All ITEC occupations	788,719	120,459	13.2

Source: Office of National Statistics (ONS) Labour Force Survey, March-May, 2000.

Table 33: Part-time employment in the ITEC sector in the UK, 2000

	Full-time	Part-time	% Part-time
All: total	25,599,932	9,389,283	26.8
Other Sectors	19,421,622	6,753,679	25.8
ITEC sector	1,382,636	165,131	10.7
Male: total	16,753,123	1,822,438	9.8
Other Sectors	12,845,508	1,329,581	9.4
ITEC sector	1,065,426	54,682	4.9
Female: total	8,846,809	7,566,845	46.1
Other Sectors	6,576,114	5,424,098	45.2
ITEC sector	317,210	110,449	25.8

Source: Office of National Statistics (ONS) Labour Force Survey, March-May, 2000.

Table 34: Full- and part-time employment in ITEC occupations in the UK, 2000

	Full-time	Part-time	% Part-time
Other Occupations	19,939,644	6,884,126	25.7
Computer systems etc managers	172,113	–	–
Electrical engineers	37,791	–	–
Electronic engineers	37,030	–	–
Software engineers	179,023	–	–
Electrical, electronic technicians	29,265	–	–
Computer analysts, programmers	283,464	16,599	5.5
Telephone fitters	45,759	–	–
Cable jointers, lines repairers	12,916	–	–
Radio, TV & video engineers	20,798	–	–
Computer engineers etc	53,847	–	–
All ITEC occupations	872,006	37,172	4.1

Source: Office of National Statistics (ONS) Labour Force Survey, March-May, 2000.

Table 35: The average age of those employed in the ITEC sector in the UK, 2000

	Male	Female
Other Sectors	39.4	38.9
IT Services	35.7	34.8
Telecommunication Services		
Post, courier activities	39.9	41.0
Telecommunications	36.9	32.8
Broadcasting Services	38.0	34.5
Electronics Manufacturing		
Office mach, computer manufacture	35.9	34.5
Electronic components etc man.	37.9	38.5
Tph, tphone eqt radio, TV trans. man.	38.9	36.6
TV, radio receivers, etc eqt man.	36.1	35.4
Testing, navigating etc eqt man.	39.1	41.2
Industrial proc control eqt man.	41.2	39.0
All ITEC	37.3	36.1

Source: Office of National Statistics (ONS) Labour Force Survey, March-May, 2000.

Table 36: The average age of those employed in ITEC occupations in the UK, 2000

	Male	Female
Other Occupations	39.4	38.9
Computer systems etc managers	38.9	38.9
Electrical engineers	41.1	22.0
Electronic engineers	38.6	52.2
Software engineers	35.8	33.3
Electrical, electronic technicians	39.7	22.2
Computer analysts, programmers	33.8	33.9
Telephone fitters	38.9	36.4
Cable jointers, lines repairers	39.1	–
Radio, TV & video engineers	41.5	–
Computer engineers etc	33.3	36.1

Source: Office of National Statistics (ONS) Labour Force Survey, March-May, 2000.

Making the right choice: analysis of ITEC applicants

By Helen Connor, IES

Background

The subject of this paper is an analysis of a subset of applicants who indicated their preference for ITEC subjects in the 1998/99 survey of applicants to higher education. This was a large UK-wide survey undertaken by the Institute for Employment Studies, which focused on student choice, in particular choice of universities and colleges.[105]

The survey sample was selected from UCAS (home) applicants for entry in Autumn 1998 to full-time degree and HND courses at UK universities and colleges. Questionnaires were administered in late August/September 1998 and the survey achieved a 61 per cent response (19,800 respondents). The questionnaire covered a number of issues relating to how choices were made. In this analysis, we have focused on three questions:

- how useful or helpful various sources of information were when considering where to study
- the importance of various factors influencing choices of where to apply
- reasons given for choosing to study ITEC subjects.

The sample of ITEC applicants

A subset of the sample was identified from the data set based on their subject preferences. Respondents were asked: *which of courses that you applied to via UCAS (they can specify up to six on UCAS application) did you most want to take?* They were asked for their 1st, 2nd and 3rd choices and if any of the three were in the following subjects, then they were identified as 'ITEC applicants' for the purpose of this analysis:

- Mathematics, statistics and computer science subjects
- Electrical and electronics engineering
- Business management.

This produced a sub-sample of 3,057 applicants, approximately 15 per cent of the total sample, and just over 5 per cent of the total population of UCAS applicants to these 'ITEC' subjects in 1998. Just over one third (38 per cent) of the ITEC sub-sample was female, a similar percentage to the female applicants in the ITEC subjects' applicants population (35 per cent) (UCAS, 1998).

The composition of the sub-sample has not been explored further in terms of personal profile. The total sample of applicants was similar in its personal profile to the UCAS population, and there is no reason to suspect that the sub-sample varied much either. It is worth noting that UCAS covers applicants to full-time courses only and that they tend to be younger on average than the total higher education student population.

Information sources

Overall results

Most applicants in the survey exploited a range of information sources when considering where to study, including formal sources such as guidebooks, prospectuses, etc., visits to campuses and a range of people (e.g. parents, teachers, careers advisers), but their usefulness varied considerably. Male applicants consulted a slightly wider range of sources than female applicants but both groups used the same top six information sources to a similar extent (each over 90 per cent): UCAS handbook, prospectuses, visits to university/college campuses, school/college careers library, parents and friends. These sources were more likely to be used than

[105] 1. The study was sponsored by CVCP, UCAS and HEFCE and 15 HE institutions. The UK findings are presented in *Making the Right Choice*, published by CVCP, June 1999 (Main report and Appendix 1 report).

the Internet, other published guides and 'quality assessments' (e.g. league tables) (used by under 50 per cent) and teachers or careers advisers (consulted by around 70 per cent). (NB use of the Internet will have increased significantly since 1997/98).

Overall, prospectuses and campus visits were considered the two most useful sources of information, quite a long way ahead of the other sources listed. Women found most sources slightly more useful than men. Also, women were slightly more likely than men to rate prospectuses and campus visits as being the most useful sources of information when considering where to apply.

ITEC sub-sample

Table 37 shows the percentages of men and women in the ITEC subject preference sub-sample that had been influenced in their choice of where to study by the various sources of information. (NB documentary information sources and other people were asked about in separate questions but responses have been combined here into one table.)

Women in the ITEC sub-sample were more likely to find most sources very useful or very helpful than were men in the ITEC sub-sample (which is similar to the main survey findings above).

Gender differences were greater in respect of prospectuses and the UCAS handbook, and also in respect of parents, friends and form teachers.

The ITEC sub-sample, compared to all women in the sample, was slightly less likely to have found university/college staff, campus visits and the schools careers library very helpful/very useful sources of information, and slightly more likely to have found the UCAS handbook and friends very helpful/useful sources.

Key sources of information

Overall results

When asked for a recommendation about sources of information i.e. 'if a friend of yours wanted to go to university and asked your advice, who or what would you suggest as the most helpful source of information in choosing universities or colleges and their courses?', prospectuses came out top (by 40 per cent of the whole sample). Women were more likely to give this recommendation than men (44 per cent of women compared with 35 per cent of men). Campus visits (26 per cent) and UCAS handbook (16 per cent) were the next most often mentioned, and results were similar for men and women.

ITEC sub-sample

Table 38 shows that women choosing ITEC subjects had similar views to the sample as a whole. They were more likely to give prospectuses as their main recommendation, and were more likely to do so than men. They were slightly more likely to make this recommendation than women choosing other subjects. The sample of ITEC women was also more likely to recommend the school careers advisor than were ITEC men and women choosing other subjects, although only one in eight gave this as their main recommendation.

Factors influencing choice of institution

Overall results

The search for the right course was by far the main factor influencing choice of where to study. Next, came a group of factors with similar significance for the sample as a whole: overall image, teaching reputation, graduate employment prospects, entry requirements, location and academic facilities. Female applicants rated most factors (on the list they were asked to consider) as more important in their decision than male applicants, in particular teaching reputation, location, academic facilities, safety and security, accommodation, distance from home and cost of living. Some factors scored relatively low in importance overall, such as childcare facilities (mean score of 1.3, on scale of 1 to 7), but this was also very low for women, at 1.4.

ITEC sub-sample

Table 39 shows that the female ITEC sub-sample varied slightly in attitude to factors influencing choice compared to the male ITEC sub-sample, but the differences were mainly very similar to those identified for the whole sample. Factors identified as being of greater importance to women in the ITEC sub-sample included safety and security, availability of combined /joint courses, opportunity for professional work placement, teaching reputation, graduate employment prospects, academic support facilities and location. Compared to women choosing other subjects, the ITEC female sub-sample was more interested in employment issues, including graduate employment prospects and work placements.

Reasons for choosing ITEC courses

Approximately three-quarters of the ITEC sample (2,234) had listed one of the ITEC subjects as their first choice and were asked their reasons for doing so. Just under half (43 per cent) of this sample were women, and this female percentage varied between 59 per cent and 40 per cent of those choosing business management/studies and mathematics/statistics respectively as a first choice subject, to 17 per cent for computer science/studies and just 6 per cent for electronics or electrical engineering (Table 40). This last, of course, reflects the very low take-up of these courses by women.

The reasons for choosing to apply for one of the ITEC subjects were mainly enjoyment, interest and job/career reasons (Table 41). Women were split almost equally between enjoyment and career-related reasons, with just over a third giving each of these as their main reasons. Men were more likely than women to give career-related reasons (40 per cent) ahead of enjoyment reasons (32 per cent). Other, though more minor, reasons of slightly more importance to women were 'natural progression' (from previous studies) and 'to keep options open'. However, these aggregate subject figures mask some important differences between ITEC subjects.

- Enjoyment rather than future jobs/careers was a much more important reason given for choosing maths/statistics courses (over 60 per cent), and also because it was 'achievable' (i.e. get entry qualifications, 34 per cent), see Table 42. There is little difference by gender in the main reasons given for choosing maths/statistics
- By contrast, female applicants to computer science/studies were far more likely to cite enjoyment than their male counterparts, who in turn were slightly more likely to cite job/career related reasons for their subject choice (Table 43)
- Business management/studies applicants were more likely to give job/career reasons (40 per cent), and men were more likely than women to do so (Table 44)
- Numbers of female applicants in electrical/electronics engineering are too small for any meaningful analysis (just 10) but for men and women combined, career reasons were the main reason given for choosing this subject (by 47 per cent), the highest of all the subject groups. Next in importance came 'sounds interesting' (given by 29 per cent) and enjoyment (24 per cent).

Table 37: Finding out about universities: percentage of applicants finding each of the following as very useful or helpful sources of information or advice about where to study in higher education (percentages)

Source of information	ITEC *women	ITEC* men	All women
Prospectus	70	56	70
Visit to HE institutions	57	5	61
UCAS Handbook	45	37	42
Parents	37	26	35
'Big' guides	30	26	29
friends	29	20	24
Form teacher	27	19	26
Subject teacher	27	22	28
School/careers library	26	20	28
Current students	24	18	25
University/HE College staff	20	21	25
School Careers adviser	21	16	18
(N approx)**	(1,870)	(1,160)	(12,000)

Source: IES Making the Right Choice Survey 1989/90

Note: other sources were also viewed as being very useful or helpful but this applied to fewer than 20 per cent of the sample (and also the ITEC sub-sample)

* here and in other tables ITEC women and ITEC men mean the sub-sample who chose ITEC subjects to apply to (see section 2). All women means the whole sample of female applicants in the survey (all subjects)

** sample numbers varied slightly for each item (because some respondents did not answer)

Table 38: Finding out about universities: most helpful source of information or advice (percentages)

Most helpful source of information	ITEC women	ITEC men	All women
Prospectuses	46	35	44
Visit to HE institutions	26	23	27
UCAS Handbook	15	17	16
School Careers adviser	13	9	10
Current students	9	8	11
'Big guides'	7	7	8
University/HE College staff	7	5	7
Subject teacher	5	5	7
Careers centre staff (not school/college)	6	4	5
Form teacher	3	4	4
(N)	(1,015)	(1,557)	(12,129)

Source: IES Making the Right Choice Survey, 1989/90
Note: only those sources mentioned by 3 per cent or more respondents are shown

Table 39: The most important factors when choosing a university/college: average scores for each sample group

Factors	ITEC women	ITEC men	All women
Offered the subjects I wanted	6.6	6.5	6.7
Overall image of university/college	5.6	5.4	5.5
Teaching reputation	5.6	5.2	5.6
Graduate employment prospects	5.9	5.6	5.5
Academic support facilities	5.6	5.1	5.5
University/college Location (i.e. town/ city)	5.5	5.1	5.5
Social life nearby (in town/city)	5.2	5.1	5.3
Social life at university/college	5.4	5.2	5.3
Provision of accommodation for 1st years	4.6	4.3	5.0
Safety and security	5.0	4.0	4.8
Cost of living in area	4.4	4.1	4.6
Research reputation	4.7	4.4	4.6
Opportunity for prof work placement	4.9	4.4	3.9
Prospects for term-time employment	4.1	3.7	3.8
Offered combined or joint courses	3.8	3.1	3.6

Note: Other factors had average scores of less than 3.5 for the sample of women applicants
Source: IES Making the Right Choice Survey, 1998/1999

Table 40: Applicants choosing the following ITEC subjects as first choice of course

ITEC subject area	Female	Male	Female %
Maths/statistics	108	165	40
Computer science/studies	140	705	17
Electrical/electronic engineering	153	10	6
Business management/studies	564	389	59
Any of the above	965	1269	43

Source: IES Making the Right Choice Survey 1998/99

Table 41: Reasons for choosing any of the ITEC subjects as first choice (percentages)

Reason	Female	Male
Enjoyment (like the subject)	35	32
Career/job related reasons	36	40
Sounds interesting	18	20
Achievable (get entry quals)	10	11
Natural progression (from study at school/college)	11	7
Practical/vocationally relevant	6	4
Always wanted to do this	3	5
Keep options open	7	3
Other	10	10
(N)	(965)	(1,269)

NB multi-response so percentages add to more than 100
Source: IES Making the Right Choice Survey, 1998/99

Table 42: Reasons for choosing maths/statistics subjects as first choice (percentages)

Reason	Female	Male
Enjoyment (like the subject)	69	62
Career/job related reasons	24	29
Sounds interesting	5	9
Achievable (get entry quals)	33	35
Natural progression (from study at school/college)	7	2
Practical/vocationally relevant	1	1
Always wanted to do this	6	4
Keep options open	7	3
Other	5	5
(N)	(108)	(165)

NB multi-response so percentages add to more than 100
Source: IES Making the Right Choice Survey, 1998/99

Table 43: Reasons for choosing computer science/studies subjects as first choice (percentages)

Reason	Female	Male
Enjoyment (like the subject)	46	31
Career/job related reasons	36	39
Sounds interesting	18	24
Achievable (get entry qualifications)	9	9
Natural progression (from study at school/college)	11	6
Practical/vocationally relevant	5	3
Always wanted to do this	3	5
Keep options open	4	1
Other	8	10
(N)	(140)	(705)

NB multi-response so percentages add to more than 100
Source: IES Making the Right Choice Survey, 1998/99

Table 44: Reasons for choosing business management/studies as first choice (percentages)

Reason	Female	Male
Enjoyment (like the subject)	26	22
Career/job related reasons	3	43
Sounds interesting	20	15
Achievable (get entry quals)	6	6
Natural progression (from study at school/college)	11	9
Practical/vocationally relevant	8	5
Always wanted to do this	2	3
Keep options open	8	8
Other	10	10
(N)	(564)	(389)

NB multi-response so percentages add to more than 100
Note: electrical engineering not shown as female numbers too small
Source: IES Making the Right Choice Survey, 1998/99

Appendix 3 – US

Table 45: Bachelor's graduates in ITEC-related subjects in the US, 1970/71-1996/97, percentage female

Year	Mathematics	Computer & Information Science	Engineering	Business	All subjects
1970-71	37.9	13.6	0.8	9.1	43.4
1971-72	38.9	13.6	1.0	9.5	42.4
1972-73	40.0	14.9	1.2	10.6	43.8
1973-74	40.7	16.4	1.6	12.8	44.2
1974-75	41.2	18.9	2.2	16.3	45.3
1975-76	40.1	19.8	3.2	19.8	45.5
1976-77	41.1	23.9	4.5	23.5	46.1
1977-78	40.3	25.7	6.7	27.3	47.1
1978-79	40.8	28.1	8.3	30.6	48.2
1979-80	41.5	30.2	9.3	33.7	49.0
1980-81	42.1	32.5	10.3	36.9	49.8
1981-82	42.	34.8	11.4	39.4	50.3
1982-83	43.6	36.3	12.3	42.0	50.6
1983-84	43.9	37.1	12.8	43.5	50.5
1984-85	46.2	36.8	13.1	45.1	50.7
1985-86	46.3	35.7	13.1	45.7	50.8
1986-87	46.4	34.7	13.7	46.5	51.5
1987-88	46.3	32.4	13.7	46.7	52.0
1988-89	45.8	30.8	13.6	46.8	52.3
1989-90	45.7	29.9	13.8	46.8	53.2
1990-91	46.6	29.3	13.9	47.2	53.9
1991-92	46.6	28.7	14.0	47.2	54.2
1992-93	47.2	28.1	14.4	47.2	54.3
1993-94	46.3	28.4	14.9	47.6	54.5
1994-95	46.8	28.4	15.6	48.0	54.6
1995-96	45.7	27.5	16.1	48.6	55.1
1996-97	46.1	27.2	16.6	48.6	55.6

Source: National Center for Education Statistics, 2000, 'Digest of Education Statistics 1999'.

Table 46: The education base of employment in the ITEC sector in the US, 2000

	Below sub-degree	Sub-degree	Degree and above
Male			
IT Services	574,922	126,603	974,481
Telecommunication Services	850,554	183,969	381,199
Broadcasting Services	133,254	34,371	159,048
Electronics Manufacturing	671,844	187,289	579,801
ITEC Sectors	2,230,574	532,232	2,094,529
Other, non-ITEC sectors	47,381,159	4,903,808	18,250,846
All Sectors	49,611,733	5,436,040	20,345,375
Female			
IT Services	262,90	48,316	373,953
Telecommunication Services	728,752	111,241	221,804
Broadcasting Services	96,054	14,110	63,815
Electronics Manufacturing	701,383	59,500	181,952
ITEC Sectors	1,789,093	233,167	841,524
Other, non-ITEC sectors	41,632,083	5,919,337	16,626,767
All Sectors	43,421,176	6,152,504	17,468,291
% Female			
IT Services	31.4	27.6	27.7
Telecommunication Services	46.1	37.7	36.8
Broadcasting Services	41.9	29.1	28.6
Electronics Manufacturing	51.1	24.1	23.9
ITEC Sectors	44.5	30.5	28.7
Other, non-ITEC sectors	46.8	54.7	47.7
All Sectors	46.7	53.1	46.2

Source: Bureau of Labour Statistics, Annual Demographic Survey, March 2000 Current Population Survey

Table 47: The distribution of educated men and women in the ITEC sector in the US, 2000

	Below sub-degree	Sub-degree	Degree and above
Male			
Other Sectors	67.2	7.0	25.9
IT Services	34.3	7.6	58.1
Telecommunication Services	60.1	13.0	26.9
Broadcasting Services	40.8	10.5	48.7
Electronics Manufacturing	46.7	13.0	40.3
ITEC Sectors	45.9	11.0	43.1
All Sectors	65.8	7.2	27.0
Female			
Other Sectors	64.9	9.2	25.9
IT Services	38.4	7.1	54.6
Telecommunication Services	68.	10.5	20.9
Broadcasting Services	55.2	8.1	36.7
Electronics Manufacturing	74.4	6.3	19.3
ITEC Sectors	62.5	8.1	29.4
All Sectors	64.8	9.2	26.1

Source: Bureau of Labor Statistics, Annual Demographic Survey, March 2000 Current Population Survey

Table 48: Distribution of male and female graduates in ITEC occupations in the US, 2000

	Male				Female					
	Below sub-degree	Sub-degree	Degree and above	Total	Below sub-degree	Sub-degree	Degree and above	Total	% male graduates	% female graduates
Other, non-ITEC occupations	48,117,175	4,917,384	18,905,677	71,940,236	42,824,033	6,012,089	16,885,077	65,721,199	13.7	12.3
Computer systems analysts and scientists	313,195	89,116	832,301	1,234,612	111,372	54,446	330,461	496,279	48.1	19.1
Operations and systems researchers and analysts	31,696	8,291	66,673	106,660	47,487	6,850	37,650	91,987	33.6	19.0
Computer science teachers	5,867		12,745	18,612		403	758	1,161	64.5	3.8
Electrical and electronic technicians	256,493	157,297	72,665	486,455	60,349	19,410	19,749	99,508	12.4	3.4
Broadcast equipment operators	9,000	9,670	9,780	28,450	2,295		2,956	5,251	29.0	8.8
Computer programmers	149,992	51,192	298,300	499,484	44,864	10,705	143,695	199,264	42.7	20.6
Supervisors, computer equipment operators	6,537	5,069	2,143	13,749	1,250	2,548	0	3,798	12.2	0.0
Computer operators	105,935	19,959	37,599	163,493	106,708	27,297	20,363	154,368	11.8	6.4
Peripheral equip. operators	0	0	0	0	913			913	0.0	0.0
Telephone operators	20,220	0	0	20,220	137,806	12,715	2,234	152,755	0.0	1.3
Communications equipment operators nec	1,097	0	0	1,097	10,810	0	0	10,810	0.0	0.0
Electronic repairers, communications and industrial equipment	122,991	31,073	24,294	178,358	11,611		2,835	14,446	12.6	1.5
Data processing equipment repairers	158,534	54,250	52,716	265,500	36,197	4,079	13,246	53,522	16.5	4.2
Telephone line installers and repairers	58,635	17,167		75,802	2,898			2,898	0.0	0.0
Telephone installers and repairers	189,807	57,725	21,793	269,325	22,583	1,962	9,268	33,813	8.0	3.1
Miscellaneous electrical and electronic equipment repairers	55,558	17,848	6,048	79,454	0	0	0	0	7.6	0.0
ITEC occupations	1,485,557	518,657	1,437,057	3,441,271	597,143	140,415	583,215	1,320,773	30.2	12.2
Unemployed ex armed forces	9,000		2,642	11,642	0	0	0	0	0.0	0.0
All Occupations	72,597,469	6,460,184	24,055,896	133,932,625	79,576,004	8,255,153	22,828,473	140,154,384	8.8	8.3

Source: Bureau of Labor Statistics, Annual Demographic Survey, March 2000 Current Population Survey

Table 49: Percentage in ITEC occupations with degree and above qualifications by gender in the US, 2000

	% of Males with degree and above	% of Females with degree and above
Other, non-ITEC Occupations	26.3	25.7
Computer systems analysts and scientists	67.4	66.6
Operations and systems researchers and analysts	62.5	40.9
Computer science teachers	68.5	65.3
Electrical and electronic technicians	14.9	19.8
Broadcast equipment operators	34.4	56.3
Computer programmers	59.7	72.1
Supervisors, computer equipment operators	15.6	0.0
Computer operators	23.0	13.2
Peripheral equipment operators	–	0.0
Telephone operators	0.0	1.5
Communications equipment operators	0.0	0.0
Electronic repairers, communications and industrial equipment	13.6	19.6
Data processing equipment repairers	19.9	24.7
Telephone line installers and repairers	0.0	0.0
Telephone installers and repairers	8.1	27.4
ITEC Occupations	41.8	44.2
All Occupations	18.0	16.3

Source: Bureau of Labor Statistics, Annual Demographic Survey, March 2000 Current Population Survey

Table 50: The sector distribution of ITEC jobs in the US, 2000

	Other – Male	Other – Female	Other – % female	ITEC-related – Male	ITEC-related – Female	ITEC-related – %female
Other Non ITEC Sectors	68,866,242	63,330,068	47.9	1,657,928	848,119	33.8
IT Services						
Computer and data processing services	715,358	419,094	36.9	960648	266,081	21.7
Telecommunication Services						
US postal service	547,268	421,368	43.5	4,891	2931	37.5
Telephone communication	406,575	504,445	55.4	442,155	127,380	22.4
Telegraph and miscellaneous communication services	14,834	5,672	27.7	–	–	–
Total	968,677	931,485	49	447,046	130,311	22.6
Broadcasting Services						
Radio and television broadcasting and cable	243,104	162,288	40.0	83,567	11,690	12.3
Electronics Manufacturing						
Office and accounting machines	23,262	12,336	34.7	1,380	0	0.0
Computers and related equipment	190,685	146,714	43.5	112,665	26,934	19.3
Radio, TV, and communication equipment	212,563	166,086	43.9	63,251	17,172	21.4
Electrical machinery, equipment and supplies	720,345	553,128	43.4	114,783	20,465	15.1
All ITEC sector	3,073,994	2,391,131	43.8	1,783,340	472,653	21.0
All Sectors	1,146,855	878,264	43.4	292,079	64,571	18.1

Source: Bureau of Labor Statistics, Annual Demographic Survey, March 2000 Current Population Survey

Table 51: Participation by gender in ITEC sector employment in the US, 2000

	Male	Female	% Female
Other, non-ITEC sectors	70,535,812	64,178,186	47.6
IT Services			
Computer and data processing services	1,676,006	685,174	29.0
Telecommunication Services			
US postal service	552,160	424,299	43.5
Telephone communication	848,728	631,826	42.7
Telegraph and miscellaneous communication services	14,834	5,672	27.7
Total	1415722	1061797	42.9
Broadcasting Services			
Radio and television broadcasting and cable	326,672	173,978	34.8
Electronics Manufacturing			
Office and accounting machines	24,642	12,336	33.4
Computers and related equipment	303,350	173,648	36.4
Radio, TV, and communication equipment	275,814	183,258	39.9
Electrical machinery, equipment and supplies	835,128	573,593	40.7
Total	1438934	942835	39.6
All ITEC Sectors	4857334	2863784	37.1

Source: Bureau of Labor Statistics, Annual Demographic Survey, March 2000 Current Population Survey

Table 52: Participation by gender in ITEC occupations in the US, 2000

	Male	Female	% Female
Other, non-ITEC occupations	71,940,236	65,721,199	47.7
Computer systems analysts and scientists	1,234,612	496,279	28.7
Operations and systems researchers and analysts	106,660	91,987	46.3
Computer science teachers	18,611	1,160	5.9
Electrical and electronic technicians	486,455	99,508	17.0
Broadcast equipment operators	28,450	5,250	15.6
Computer programmers	499,483	199,263	28.5
Supervisors, computer equipment operators	13,749	3,799	21.6
Computer operators	163,493	154,368	48.6
Peripheral equipment operators		913	100.0
Telephone operators	20,220	152,755	88.3
Communications equipment operators	1,097	10,810	90.8
Electronic repairers, communications and industrial equipment	178,358	14,446	7.5
Data processing equipment repairers	265,499	53,522	16.8
Telephone line installers and repairers	75,802	2,898	3.7
Telephone installers and repairers	269,325	33,813	11.2
Miscellaneous electrical and electronic equipment repairers	79,454		0.0
All ITEC Occupations	3,441,268	1,320,771	27.7
All Occupations	75,381,504	67,041,970	47.1

Source: Bureau of Labor Statistics, Annual Demographic Survey, March 2000 Current Population Survey

Table 53: The percentage of men and women in part-time employment in the ITEC sector in the US, 2000

	Male	Female	Both
Other Non ITEC Sectors	17.5	32.5	24.6
IT Services	11.0	24.4	14.9
Computer and data processing services	11.0	24.4	14.9
Telecommunications Services	11.1	16.2	13.2
US postal service	12.7	20.4	16.0
Telephone communication	10.2	12.6	11.2
Telegraph and miscellaneous communications services	0.0	100.0	28.8
Broadcasting Services	9.4	23.4	13.9
Radio and television broadcasting and cable	9.4	23.4	13.9
Electronics Manufacturing	7.2	9.6	8.2
Office and accounting machines	0.0	22.8	8.0
Computers and related equipment	6.9	11.3	8.4
Radio, TV and communications equipment	6.6	8.2	7.2
Electrical machinery, equipment and supplies	7.8	9.2	8.4
ITEC Sectors	9.8	16.4	12.2
All Sectors	17.0	31.8	23.9

Source: Bureau of Labor Statistics, Annual Demographic Survey, March 2000 Current Population Survey

Table 54: The percentage of men and women in part-time employment in ITEC occupations in the US, 2000

	Male	Female	Both
Other Occupations	17.2	32.1	24.3
Computer systems analysts and scientists	12.5	14.6	13.1
Operations and systems researchers and analysts	0.0	5.1	2.4
Computer science teachers	78.1	41.5	75.8
Electrical and electronic technicians	12.7	22.4	14.3
Broadcast equipment operators	11.9	43.7	16.9
Computer programmers	12.9	18.6	14.6
Supervisors, computer equipment operators	10.3	0.0	8.0
Computer operators	16.3	22.1	19.1
Peripheral equipment operators	–	0.0	0.0
Telephone operators	68.9	30.1	34.5
Communications equipment operators nec	0.0	15.5	14.1
Electronic repairers, communications and industrial equipment	9.9	24.4	11.0
Data processing equipment repairers	15.3	22.2	16.5
Telephone line installers and repairers	0.0	0.0	0.0
Telephone installers and repairers	5.6	17.2	6.9
Miscellaneous electrical and electronic equipment repairers	8.8	–	8.8
All ITEC Occupations	12.2	18.3	13.9
All Occupations	17.0	31.8	23.9

Source: Bureau of Labor Statistics, Annual Demographic Survey, March 2000 Current Population Survey

Table 55: The average age of those employed in the ITEC sector in the US, 2000

	Male	Female
Other Non ITEC Sectors	39.3	39.1
IT Services		
Computer and data processing services	36.5	36.7
Telecommunication Services		
US postal service	44.5	40.8
Telephone communication	37.7	38.6
Telegraph and miscellaneous communication services	34.6	36.1
Broadcasting Services		
Radio and television broadcasting and cable	37.4	33.7
Electronics Manufacturing		
Office and accounting machines	44.0	43.1
Computers and related equipment	40.6	39.6
Radio, TV, and communication equipment	39.3	40.2
Electrical machinery, equipment and supplies	41.0	40.0
All ITEC sectors	38.9	38.6
All Sectors	34.2	36.3

Source: Bureau of Labor Statistics, Annual Demographic Survey, March 2000 Current Population Survey

Table 56: The average age in ITEC occupations in the US, 2000

	Male	Female
Other Non ITEC Occupations	39.4	39.1
Computer systems analysts and scientists	36.8	37.7
Operations and systems researchers and analysts	42.4	37.6
Computer science teachers	46.9	36.5
Electrical and electronic technicians	37.7	38.8
Broadcast equipment operators	35.9	30.2
Computer programmers	36.5	37.5
Supervisors, computer equipment operators	40.7	37.9
Computer operators	37.0	37.3
Peripheral equipment operators	–	54.0
Telephone operators	22.3	39.7
Communications equipment operators	21.0	34.4
Electronic repairers, communications and industrial equipment	35.0	39.3
Data processing equipment repairers	35.1	40.0
Telephone line installers and repairers	36.9	34.6
Telephone installers and repairers	40.	43.9
Miscellaneous electrical and electronic equipment repairers	44.0	–
All ITEC occupations	37.3	38.2
All Occupations	34.2	36.3

Source: Bureau of Labor Statistics, Annual Demographic Survey, March 2000 Current Population Survey

Appendix 4 – Canada

Table 57: Bachelor's and first professional degrees granted in Canada, 1993-1997

		Male	Female	Both	% Female
Computer Science	1993	1,910	467	2,377	19.6
	1994	2,011	556	2,567	21.7
	1995	2,305	644	2,949	21.8
	1996	2,321	663	2,984	22.2
	1997	2,399	613	3,012	20.4
Business Management and Commerce	1993	8,297	7,349	15,646	47.0
	1994	8,199	7,336	15,535	47.2
	1995	7,767	7,178	14,945	48.0
	1996	7,506	6,882	14,388	47.8
	1997	7,388	6,882	14,270	48.2
Mathematics	1993	1,356	930	2,286	40.7
	1994	1,31	897	2,215	40.5
	1995	1,278	904	2,182	41.4
	1996	1,161	851	2,012	42.3
	1997	1,096	861	1,957	44.0
Engineering	1993	6,405	1,071	7,476	14.3
	1994	6,56	1,289	7,855	16.4
	1995	6,681	1,553	8,234	18.9
	1996	6,864	1,590	8,454	18.8
	1997	6,520	1,600	8,120	19.7
ITEC subjects	1993	17,968	9,817	27,785	35.3
	1994	18,094	10,078	28,172	35.8
	1995	18,031	10,279	28,310	36.3
	1996	17,852	9,986	27,838	35.9
	1997	17,403	9,956	27,359	36.4
All subjects	1993	52,728	70,474	123,202	57.2
	1994	53,483	73,055	126,538	57.7
	1995	53,551	73,780	127,331	57.9
	1996	53,043	74,946	127,989	58.6
	1997	51,782	74,014	125,796	58.8

Source Table 37 pages 134 to 139 'Education in Canada' Statistics Canada, May 2000

Table 58: Labour market participation in Canada, 1980-1999

	Participation rate 25 years and over		Employment		Females as a percentage of employed
	Male	Female	Male (1,000's)	Female (1,000's)	(%)
1980	80.2	46.0	5121.5	3022.9	37.1
1981	80.2	47.8	5232.2	3208.2	38.0
1982	79.3	48.4	5108.7	3265.1	39.0
1983	78.9	49.5	5133.5	3381.8	39.7
1984	78.5	50.5	5238.1	3523.9	40.2
1985	78.4	51.8	5372.1	3708.2	40.8
1986	78.2	52.6	5523.9	3885.6	41.3
1987	77.9	53.6	5681.3	4069.6	41.7
1988	77.6	54.9	5847.8	4306.0	42.4
1989	77.5	55.7	5979.5	4486.0	42.9
1990	77.1	56.5	6033.8	4650.8	43.5
1991	76.2	56.7	5931.6	4684.5	44.1
1992	75.2	56.4	5889.6	4730.3	44.5
1993	74.9	56.7	5966.0	4804.4	44.6
1994	74.8	56.6	6100.7	4911.2	44.6
1995	74.2	56.8	6215.7	5033.6	44.7
1996	73.9	56.9	6278.2	5110.8	44.9
1997	74.1	57.5	6441.9	5289.4	45.1
1998	74.0	58.0	6580.0	5458.5	45.3
1999	74.0	58.4	6724.8	5600.0	45.4

Source: Statistics Canada (2000), Historical Labour Force Statistics 1999, Ottawa

Table 59: Women in the ITEC sector in Canada, 1996

Canadian SIC code		Male	Female	%Female
334	Record Player, radio and television receiver industry	1,565	1,200	43.4
335	Communication and other electronic equipment industries	41,250	22,305	35.1
336	Office, store and business machine industries	13,810	6,325	31.4
338	Communication and energy wire and cable industry	5,115	1,470	22.3
	Electronics manufacture	61,740	31,300	33.6
481	Telecommunication broadcasting industries	31,740	21,765	40.7
482	Telecommunication carriers industry	60,045	56,435	48.5
483	Other telecommunication industries	1,665	1,795	51.9
484	Postal and courier service industries	81,960	47,350	36.6
	Telecommunications services	175,410	127,345	42.1
772	Computer and related services **(IT Services)**	96,690	44,660	31.6
961	Motion picture, audio and video production and distribution **(Broadcasting Services)**	22,075	15,050	40.5
	Total ITEC sectors	355,915	218,355	38.0
	Other non-ITEC sectors	7,652,040	6,586,395	46.3
	Total All Sectors	8,007,955	6,804,750	45.9

Source: Statistics Canada Labour Force 15 years and over by detailed industry (based on the 1980 Standard Industrial Classification) and Sex, for Canada, 1996 Census (20% Sample Data)

Table 60: Women in ITEC jobs in Canada, 1991 and 1996

	1996	1991
Information systems and data processing managers	23.7	22.3
Telecommunication carriers managers	30.8	26.3
Postal and courier services managers	27.4	32.3
Computer operators	46.9	57.1
Electrical and electronics engineers	8.0	6.7
Computer engineers	14.9	11.6
Computer systems analysts	30.1	29.8
Computer programmers	24.7	28.0
Electrical and electronics engineering technologists and technicians	11.9	11.2
Electronic service technicians (household and business equipment)	8.4	7.1
Industrial instrument technicians and mechanics	2.6	2.5
Telecommunications line and cable workers	4.7	5.8
Telecommunications installation and repair workers	9.6	9.1
Cable television service and maintenance technicians	5.4	3.6
ITEC Occupations	20.7	21.6
Other Non-ITEC Occupations	46.5	45.5
All occupations	45.7	44.9

Source: Source: Statistics Canada (1998) Nation Series: Complete Edition CD-ROM 96 Recesement/Census

Table 61: Participation trends in ITEC jobs in Canada, 1991 and 1996

	Male			Female			% Female		
Census Years	1996	1991	% Growth 1996/1997	1996	1991	% Growth 1996/1997	1996	1991	% Growth 1996/1997
A122(0213) Information systems and data processing managers	15,690	20,590	-31.2	4,865	5,920	-21.7	23.7	22.3	5.6
A311(0131) Telecommunication carriers managers	8,715	9,215	-5.7	3,880	3,285	15.3	30.8	26.3	14.7
A312(0132) Postal and courier services managers	2,475	2,980	-20.4	935	1,420	-51.9	27.4	32.3	-17.7
B521(1421) Computer operator	16,235	16,115	0.7	14,360	21,420	-49.2	46.9	57.1	-21.6
C033(2133) Electrical and electronics engineers	30,685	30,675	0.0	2,655	2,200	17.1	8.0	6.7	16.0
C047(2147) Computer engineers	14,220	8,210	42.3	2,495	1,075	56.9	14.9	11.6	22.4
C062(2162) Computer systems analysts	64,255	53,845	16.2	27,605	22,870	17.2	30.1	29.8	0.8
C063(2163) Computer programmers	53,305	40,250	24.5	17,480	15,635	10.6	24.7	28.0	-13.3
C141(2241) Electrical and electronics engineering technologists and technicians	32,170	24,235	24.7	4,365	3,070	29.7	11.9	11.2	5.9
C142(2242) Electronic service technicians (household and business equipment)	55,080	53,365	3.1	5,050	4,105	18.7	8.4	7.1	15.0
C143(2243) Industrial instrument technicians and mechanics	8,330	6,530	21.6	220	170	22.7	2.6	2.5	1.4
H215(7245) Telecommunications line and cable workers	6,940	8,375	-20.7	340	515	-51.5	4.7	5.8	-24.0
H216(7246) Telecommunications installation and repair workers	21,210	28,105	-32.5	2,265	2,810	-24.1	9.6	9.1	5.8
H217(7247) Cable television service and maintenance technicians	3,785	3,880	-2.5	215	145	32.	5.4	3.6	33.0
ITEC Occupations	333,095	306,370	8.0	86,730	84,640	2.4	20.7	21.6	-4.8
Other Non-ITEC Occupations	7,435,390	7,532,875	-1.3	6,462,330	6,296,345	2.6	46.5	45.5	2.1
All occupations	7,768,485	7,839,245	-0.9	6,549,060	6,380,985	2.6	45.7	44.9	1.9

Source: Source: Statistics Canada (1998) Nation Series: Complete Edition CD-ROM 96 Recesement/Census

Appendix 5[106] – Ireland

Table 62: Primary degrees, full- and part-time, in Ireland, 1998

	Male	Female	Both	% Female
Mathematics and Statistics	41	17	58	29.3
Computing	354	106	460	23.0
Engineering and engineering trades	332	50	382	13.1
Business and administration	1,169	1,175	2,344	50.1
ITEC Subjects	1,896	1,348	3,244	41.6
All subjects	6,114	7,517	13,631	55.1

Source: Higher Education Authority (2001) 1998/99 Annual Report

Table 63: Employment in the ITEC sector in Ireland, 1999

	Male	Female	Both	% Female
NACE 30 Manufacture of office machinery and computers	9,017	6,911	15,928	43.4
NACE 31 Manufacture of electrical machinery and apparatus	4,451	(3,498)	7,949	(44.0)
NACE 32 Manufacture of radio, TV and communications equipment	11,575	8,237	19,812	41.6
NACE 64 Post and telecommunications	22,919	7,788	30,707	25.4
NACE 72 Computer and related activities	19,774	10,120	29,894	33.9
ITEC sectors	67,736	36,554	104,290	35.1
Other, non-ITEC sectors	853,086	601,718	1,454,804	41.4
All sectors	920,822	638,272	1,559,094	40.9

Source: IES and a special Eurostat analysis of the Community Labour Force Survey

[106] In the statistical tables that follow, figures that appear in brackets should be interpreted with caution because they reflect small sample size.

Table 64: Participation in ITEC occupations in Ireland, 1998-2000 (estimated)

SOC-90 Categories Total	Q1/1998	Q2/1998	Q2/1999	Q1/2000
	(1,000's)	(1,000's)	(1,000's)	(1,000's)
126 Computer systems managers	4.9	5.7	5.6	7.4
212 Electrical engineers	.	.	.	.
214 Software engineers	5.7	6.1	5.5	5.4
320 Computer analysts, programmers	8.6	10.1	13.3	14.0
523 Telephone fitters	(3.3)	(3.4)	(3.5)	(4.0)
524 Cable jointers, line repairers	5.7	.	2.8	2.8
526 Computer engineers	4.3	4.2	4.3	4.9
302 Electrical/electronic technicians	3.9	3.7	4.6	4.3
ITEC occupations total	37.9	37.8	41.5	44.6
SOC-90 Categories – Male	**Q1/1998** (1,000's)	**Q2/1998** (1,000's)	**Q2/1999** (1,000's)	**Q1/2000** (1,000's)
126 Computer systems managers	(3.7)	(3.5)	(3.2)	5.0
212 Electrical engineers	.	.	.	.
214 Software engineers	4.7	4.9	(4.1)	(4.4)
320 Computer analysts, programmers	6.0	7.0	8.9	9.6
523 Telephone fitters	(3.3)	(3.3)	(3.4)	(3.9)
524 Cable jointers, line repairers	.	.	(2.7)	(2.7)
526 Computer engineers	(3.5)	(3.6)	(3.5)	(3.9)
302 Electrical/electronic technicians	(3.5)	(3.2)	(4.0)	(4.0)
ITEC occupations total	28.5	29.0	31.6	35.1
SOC-90 Categories – Female	**Q1/1998** (1,000's)	**Q2/1998** (1,000's)	**Q2/1999** (1,000's)	**Q1/2000** (1,000's)
126 Computer systems managers	.	.	.	.
212 Electrical engineers	.	.	.	.
214 Software engineers	.	.	.	.
320 Computer analysts, programmers	(2.6)	(3.1)	(4.4)	(4.4)
523 Telephone fitters	.	.	.	.
524 Cable jointers, line repairers	.	.	.	.
526 Computer engineers	.	.	.	.
302 Electrical/electronic technician	.	.	.	.
ITEC occupations total	6.1	7.0	9.0	8.6
SOC-90 Categories – % Female	**Q1/1998** (%)	**Q2/1998** (%)	**Q2/1999** (%)	**Q1/2000** (%)
126 Computer systems managers	.	.	.	.
212 Electrical engineers	.	.	.	.
214 Software engineers	.	.	.	.
320 Computer analysts, programmers	(30.2)	(30.7)	(33.1)	(31.4)
523 Telephone fitters	.	.	.	.
524 Cable jointers, line repairers	.	.	.	.
526 Computer engineers	.	.	.	.
302 Electrical/electronic technicians	.	.	.	.
ITEC occupations total	16.1	18.5	21.7	19.3

Source: Central Statistics Office, Quarterly National Household Survey.
Note: Particular care should be taken in respect of small estimates.

Appendix 6 – Taiwan

Table 65: Percentage of women in the college and university education system in Taiwan, 1973-1996

	Junior College (% female)	Colleges & Universities (% female)
1971	37.27	36.45
1976	38.50	35.78
1977	38.65	36.81
1978	39.86	37.62
1979	40.80	38.75
1980	41.82	39.42
1981	42.45	40.00
1982	42.92	40.37
1983	43.53	41.05
1984	44.36	41.58
1985	44.48	41.72
1986	44.48	42.16
1987	45.13	42.65
1988	45.73	43.45
1989	47.01	43.82
1990	47.86	44.08
1991	48.67	43.30
1992	49.56	42.86
1993	50.13	42.57
1994	51.11	43.23
1995	52.30	44.40
1996	52.80	45.60
1997	53.51	46.48
1998	53.81	46.90

Source: Bureau of Statistics, Ministry of Education (1999) 1999 Education, Republic of China, Taipei.

Table 66: Percentage of women among graduates in ITEC subjects in Taiwan, 1994/95-1997/98

Bachelor Degrees (% female)	Commercial and Business Admin.	Maths and Computer Science	Engineering	ITEC subjects	All Subjects
1994/95	58.9	28.9	6.5	30.2	44.9
1995/96	54.2	27.6	7.7	31.8	45.6
1996/97	56.8	28.1	8.7	33.5	47.0
1997/98	61.1	34.2	10.3	37.3	50.6

Source: Ministry of Education (2000), Education Statistics of the Republic of China, Taipei.

Table 67: University graduates (Bachelor's) in ITEC subjects in Taiwan[107], 1990/91-1997/98

ITEC Subjects Bachelor					
		Total	Male	Female	% Female
1990/91	Public	958	720	238	24.8
	Private	2,178	1,467	711	32.6
	Both	3,136	2,187	949	30.3
1991/92	Public	1,001	711	290	29.0
	Private	2,465	1,629	836	33.9
	Both	3,466	2,340	1,126	32.5
1992/93	Public	9,729	7,041	2,688	27.6
	Private	15,853	8,790	7,063	44.6
	Both	25,582	15,831	9,751	38.1
1993/94	Public		0	0	
	Private		0	0	
	Both		0	0	
1994/95	Public	13,039	10,480	2,559	19.6
	Private	19,608	12,300	7,308	37.3
	Both	32,647	22,780	9,867	30.2
1995/96	Public	11,838	9,215	2,623	22.2
	Private	20,263	12,685	7,578	37.4
	Both	32,101	21,90	10,201	31.8
1996/97	Public	12,223	9,132	3,091	25.3
	Private	21,396	13,222	8,174	38.2
	Both	33,619	22,354	11,265	33.5
1997/98	Public	13,450	9,570	3,880	28.8
	Private	24,373	14,151	10,222	41.9
	Both	37,823	23,721	14,102	37.3

Source: Ministry of Education (2000), Education Statistics of the Republic of China, Taipei

[107] The data are disaggregated into graduation from public (national) and private universities. There are 41 public and 41 private universities in Taiwan. However, the distinction between these is blurring. Traditionally public (national) universities were funded by the Ministry of Education (MOE). However, in 1995 the MOE urged the public universities to lessen their reliance on government funds and to fund part of their programmes independently. In 1999, each university set up its own fund raising plan. Private universities traditionally relied on financial assistance from the MOE to cover tuition. However, in order to reduce the financial burden on students and to achieve a greater balance between public and private schools, the MOE has substantially increased funding to the private universities. In 1998, 10% of the total MOE budget was given to the private universities. For further information see: **http://www.edu.tw/english/index.htm**

Table 68: University graduates (Masters) in ITEC subjects in Taiwan, 1990/91-1997/98

ITEC Subjects (Masters)					
		Total	Male	Female	% Female
1990/91	Public	418	379	39	9.3
	Private	79	63	16	20.3
	Both	497	442	55	11.1
1991/92	Public	502	432	70	13.9
	Private	91	79	12	13.2
	Both	593	511	82	13.8
1992/93	Public	4,130	3,628	502	12.2
	Private	961	793	168	17.5
	Both	5,091	4,421	670	13.2
1993/94	Public		0	0	
	Private		0	0	
	Both		0	0	
1994/95	Public	5,158	4,507	651	12.6
	Private	1,424	1,194	230	16.2
	Both	6,582	5,701	881	13.4
1995/96	Public	5,634	4,910	724	12.9
	Private	1,477	1,264	213	14.4
	Both	7,111	6,174	937	13.2
1996/97	Public	5,643	4,885	758	13.4
	Private	1,741	1,494	247	14.2
	Both	7,384	6,379	1,005	13.6
1997/98	Public	6,052	5,227	825	13.6
	Private	1,911	1,638	273	14.3
	Both	7,963	6,865	1,098	13.8

Source: Ministry of Education (2000), Education Statistics of the Republic of China, Taipei

Table 69: University graduates (PhD) in ITEC subjects in Taiwan, 1990/91-1997/98

ITEC Subjects (PhD)					
		Total	Male	Female	% Female
1990/91	Public	32	28	4	12.5
	Private	0	0	0	–
	Both	32	28	4	12.5
1991/92	Public	49	44	5	10.2
	Private	0	0	0	–
	Both	49	44	5	10.2
1992/93	Public	328	318	10	3.0
	Private	14	12	2	14.3
	Both	342	330	12	3.5
1993/94	Public		0	0	
	Private		0	0	
	Both		0	0	
1994/95	Public	446	421	25	5.6
	Private	21	19	2	9.5
	Both	467	440	27	5.8
1995/96	Public	531	500	31	5.8
	Private	24	22	2	8.3
	Both	555	522	33	5.9
1996/97	Public	569	545	24	4.2
	Private	24	24	0	0.0
	Both	593	569	24	4.0
1997/98	Public	623	578	45	7.2
	Private	34	31	3	8.8
	Both	657	609	48	7.3

Source: Ministry of Education (2000), Education Statistics of the Republic of China, Taipei

Table 70: Women employed in Taiwan, 1991-1999

Employed all sectors			
	Total	Female	% Female
1991	4,855,059	2,083,732	42.92
1992	5,105,811	2,179,269	42.68
1993	5,299,002	2,251,401	42.49
1994	5,562,536	2,359,232	42.41
1995	5,761,794	2,450,965	42.54
1996	5,687,241	2,430,657	42.74
1997	5,742,852	2,458,559	42.81
1998	5,752,252	2,481,361	43.14
1999	5,756,059	2,496,500	43.37

Source: Personal Communication Directorate-General of Budget, Accounting and Statistics based on the Report on Manpower Utilization Survey Taiwan Area

Table 71: Women in the ITEC Sector in Taiwan, 1991-1999

ITEC Sector	Total ITEC Sector	Total women in ITEC	% women in ITEC
1991	502979	261736	52.00
1992	516793	265677	51.41
1993	519953	266572	51.27
1994	536558	273602	50.99
1995	556434	286788	51.54
1996	567368	292833	51.61
1997	593822	305458	51.44
1998	617675	315801	51.13
1999	626789	318787	50.86
Electrical & electronic equipment	**Total**	**Female**	**%female**
1991	453,785	244,755	53.94
1992	462,195	245,399	53.09
1993	465,803	246,395	52.90
1994	482,277	253,320	52.53
1995	499,971	264,151	52.83
1996	508,995	268,459	52.74
1997	534,180	279,967	52.41
1998	547,828	285,848	52.18
1999	554,094	288,167	52.01
Telecommunication	**Total**	**Female**	**% female**
1991	36699	9752	26.57
1992	36370	9662	26.57
1993	36100	9594	26.58
1994	35957	9535	26.52
1995	35723	9465	26.50
1996	35417	9419	26.59
1997	34862	9309	26.70
1998	40247	10455	25.98
1999	42749	10785	25.23
Data processing & information services	**Total**	**Female**	**% female**
1991	12495	7229	57.86
1992	18228	10616	58.24
1993	18050	10583	58.63
1994	18324	10747	58.65
1995	20740	13172	63.51
1996	22956	14955	65.15
1997	24780	16182	65.30
1998	29600	19498	65.87
1999	29946	19835	66.24

Source: Personal Communication Directorate-General of Budget, Accounting and Statistics based on the Report on Manpower Utilization Survey Taiwan Area

Table 72: Participation in technical and professional jobs in Taiwan, 1990-1998

	Male			Female				
	Employed	Professionals	Technicians & associate professionals	Employed	Professionals	Technicians & associate professionals	Percentage of professionals female	Percentage of technicians & associate professionals female
	(1,000's)	(1,000's)	(1,000's)	(1,000's)	(1,000's)	(1,000's)	(%)	(%)
1990	5120	–	–	3075	–	–	–	–
1991	5243	–	–	3189	–	–	–	–
1992	5368	–	–	3214	–	–	–	–
1993	5393	260	718	3309	218	458	45.6	38.9
1994	5473	237	761	3405	229	477	49.1	38.5
1995	5513	233	793	3496	242	516	50.9	39.4
1996	5455	255	826	3605	277	554	52.1	40.1
1997	5506	266	850	3632	296	560	52.7	39.7
1998	5584	274	892	3692	308	602	52.9	40.3

Source: Directorate-General of Budget, Accounting and Statistics 'Report on Manpower Utilization Survey Taiwan Area'

Appendix 7[108] – Spain

Table 73: ITEC graduates in Spain, 1986/87 – 1990/91

		Male	Female	%Female
1986/87	Economics and Business Studies	50,635	30,389	37.5
	Mathematics	4,933	4,957	50.1
	Telecommunications Engineering	5,816	649	10.0
	Computer Science	5,836	3,045	34.3
	ITEC	67,220	39,040	36.7
	All	122,164	118,610	49.3
1987/88	Economics and Business Studies	56,769	37,416	39.7
	Mathematics	2,006	1,107	35.6
	Telecommunications Engineering	6,870	889	11.5
	Computer Science	6,568	3,087	32.0
	ITEC	72,213	42,499	37.0
	All	134,728	129,439	49.0
1988/89	Economics and Business Studies	59,058	45,776	43.7
	Mathematics	2,023	1,209	37.4
	Telecommunications Engineering	7,299	1,071	12.8
	Computer Science	7,522	3,407	31.2
	ITEC	75,902	51,463	40.4
	All	153,086	137,894	47.4
1989/90	Economics and Business Studies	72,101	54,196	42.9
	Mathematics	2,101	1,263	37.5
	Telecommunications Engineering	7,658	1,267	14.2
	Computer Science	8,545	3,602	29.7
	ITEC	90,405	60,328	40.0
	All	165,884	154,288	48.2
1990/91	Economics and Business Studies	72,986	57,950	44.3
	Mathematics	2,099	1,279	37.9
	Telecommunications Engineering	8,348	1,824	17.9
	Computer Science	10,004	4,043	28.8
	ITEC	93,437	65,096	41.1
	All	178,802	165,856	48.1

Source: Consejo de Universidades (1994) Anuario de estadística universitaria

[108] In the statistical tables that follow, figures that appear in brackets should be interpreted with caution because they reflect small sample size

Table 74: Graduates (1,000's) at ISCED Levels 5, 6 and 7 in Spain, 1992/93 – 1996/97

Total	1992/93	1993/94	1994/95	1995/96	1996/97
Mathematics and computer science	5.3		7.5	8.5	9.7
Engineering and technology	15.2		22.6	25.3	30.1
All Subjects	150.2		177.7	195.5	223.2
Male	**1992/93**	**1993/94**	**1994/95**	**1995/96**	**1996/97**
Mathematics and computer science	3.6		4.8	5.7	6.5
Engineering and technology	12.5		17.5	19.4	22.7
All Subjects	67.4		76.2	84.9	94.3
Female	**1992/93**	**1993/94**	**1994/95**	**1995/96**	**1996/97**
Mathematics and computer science	1.8		2.6	2.8	3.2
Engineering and technology	2.7		5.1	5.8	7.4
All Subjects	82.8		101.3	110.5	128.8
% Female	**1992/93**	**1993/94**	**1994/95**	**1995/96**	**1996/97**
Mathematics and computer science	34.0		34.7	32.9	33.0
Engineering and technology	17.8		22.6	22.9	24.6
All Subjects	55.1		57.0	56.5	57.7

Source: Eurostat (various years) Education Across the European Union, Statistics and Indicators

Table 75: Women in ITEC sector industries in Spain, 1997-1999

	1997			1998			1999		
	Male	Female	% Female	Male	Female	% Female	Male	Female	% Female
Manufacture of Office Machinery and Computers	11257	6591	36.93	19102	(4,582)	(19.3)	17975	5258	22.63
Electrical Machinery	53789	11563	17.69	66695	16767	20.09	69390	18065	20.66
Radio, TV and Communications Equipment	23878	6764	22.07	25358	(4,346)	(14.6)	24860	5760	18.81
Post and Telecommunications	107461	46976	30.42	108418	51250	32.10	121291	61519	33.65
Computer and related activities	36332	11120	23.43	49947	19152	27.72	66585	17595	20.90
ITEC Sector	232717	83014	26.29	269520	96097	26.28	300101	108197	26.50
Other, non-ITEC Sectors	7,935,118	4,357,997	35.45	8,163,963	4,531,916	35.7	8,404,801	4,844,642	36.56
All Sectors	8167835	4441011	35.22	8433483	4628013	35.43	8704902	4952839	36.26

Source: IES/Eurostat Special tabulation of the Community Labour Force Survey

Table 76: Participation in ITEC occupations in Spain, 1997-1999

	Male	Female	Both	% Female
1997 Q2				
ISCO 213 Computer professionals	39,071	9,347	48,418	19.3
ISCO 312 Computer associate professionals	27,794	7,352	35,146	20.9
ISCO 313 Optical and electronic equipment operators	20,362	7,016	27,378	25.6
ISCO 724 Electrical and electronic equipment mechanics and fitters	147,234	(2,858)	150,092	(1.9)
ITEC occupations	234,461	26,573	261,034	10.2
Other Occupations	7,933,374	4,414,438	12,347,812	35.8
Total	8,167,835	4,441,011	12,608,846	35.2
1998 Q2	Male	Female	Both	% Female
ISCO 213 Computer professionals	49,498	12,241	61,739	19.8
ISCO 312 Computer associate professionals	41,203	5,529	46,732	11.8
ISCO 313 Optical and electronic equipment operators	23,926	7,258	31,184	23.3
ISCO 724 Electrical and electronic equipment mechanics and fitters	164,932	(4,628)	169,560	(2.7)
ITEC Occupations	279,559	29,656	309,215	9.6
Other Occupations	8,154,224	4,598,357	12,752,581	36.1
Total	8,433,783	4,628,013	13,061,796	35.4
1999 Q2	Male	Female	Both	% Female
ISCO 213 Computer professionals	61,105	8,842	69,947	12.6
ISCO 312 Computer associate professionals	49,877	6,993	56,870	12.3
ISCO 313 Optical and electronic equipment operators	21,785	7,571	29,356	25.8
ISCO 724 Electrical and electronic equipment mechanics and fitters	170,593	–	171,095	–
ITEC Occupations	303,360	23,908	327,268	7.3
Other Occupations	8,401,542	4,928,931	13,330,473	37.0
Total	8,704,902	4,952,839	13,657,741	36.3

Source: IES and a special Eurostat analysis of the Community Labour Force Survey.

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