COMPUTING AND EDUCATION IN THE UK
The First Twenty Years

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Abstract: Computing arose as a numerically significant occupational area in industrialised nations after the Second World War. The right economic conditions for it to become established were met first in the US; the economies of Western Europe and Japan being about ten years behind. By the 1950s jobs in computing were perceived as occupations with some status but, by the Millennium, commentators had realised that computing had failed to professionalise.

Set against this background, this paper describes developments in computing education in the UK at further and higher education level from 1960 until the 1980s. It is from the perspective of the professional body for computing in the UK as recorded in the British Computer Society (BCS) publication, *Computer Bulletin.* This paper argues that three drivers impacted on the computing curriculum in the UK. First, the British Government was concerned about the health of the British computer industry and future skills shortages. Second, the educational establishments were responding to immediate demand, driven by the employers and potential students. Third, the BCS was seeking to establish itself as the professional body for computing in the UK.

In conclusion, this paper demonstrates that the evolution and growth of the system of computing education in the UK at further and higher education level, from the early 1960s to the late 1980s, was a synergistic response on the part of the educational institutions to the requirements of the British Government, industry and commerce and the professional body, the BCS.

Key words: Computing education; Further education; Higher education; Professional body; Government support; Industry; UK.

1. INTRODUCTION

Government support for industry may take several forms and those that meet favour vary with time and between nations depending, for instance, upon the political persuasion of the government in power and national culture. Educational programs may form one facet of industrial policy. (Brandin and Harrison, 1987) Most of the expenditure on computing technology in the US in the 1950s was for military objectives; the commercial computing sector in the US was sustained financially during this period by the US armed forces and defence industry, bolstered by the strength of the US economy (Cordata, 1997). During the 1950s Britain invested a fraction of the amount the US did in military contracts for computing technology, £12m as against £350m (Owen, 1999). In Britain, by the late 1950s, the developing computing industry was losing to US competition from IBM. The increasing dominance of the high technology sector by US multinational corporations prompted concern, so that when Harold Wilson won the British general election in 1964 he established a Ministry of Technology, Mintech, a key feature of the remit of which was to save the British computer industry (Campbell-Kelly, 1995). This was to be through British government support of a national champion, ICL. Throughout the 1970s and 1980s ICL was fighting for its survival against IBM, bailed out by a succession of governments, because of the perceived acute strategic significance of computing to the future of the British economy. Another facet of the British government's considerable support for its computing industry was its involvement in the education of computer personnel, the need for which became apparent in the early 1960s. For instance, the Robbins Committee on Higher Education reported to the British Computer Society (BCS) in 1962 that there was a serious shortage of qualified, advanced technicians able to maintain computer equipment (The Editor, 1962).

2. DEVELOPMENTS

In 1967 Buckingham (1967) reviewed the progress that had been made in computing education over the previous five years. He observed that, in that period, it had evolved rapidly from a position of no discernible widespread system to a nascent organisation based on numbers and types of personnel required and appropriate curricula. Earlier, in 1960, the remit of a two-day conference held at Hatfield Technical College, on the Computing Laboratory in the Technical College, was the effect of computing machines on the discipline of mathematics. Barritt (1960) defined categories of technical college students then as commercial background, scientists, electronic engineers, programmers, operators and various types of mathematicians.

- Students from commerce benefit from the lavish use of flow-charts;
- Scientists – immediate application to formulae drawn from their own work is helpful;
- Programmers – can safely work through the manufacturer's manual.

Wegner (1963), in reporting three years later, on another two-day conference on computer education held at Hatfield Technical College described the efforts at that time as *ad hoc.* He lamented that the most common attitude to computer education was that computers were a tool whose use should be learnt through vocational training at technical colleges, rather than their study in itself providing an intellectual challenge. Nonetheless, in the critical recognition of an industrial/commercial perspective, the situation had progressed from that of 1960. In the following year, a representative of the Royal Insurance Group, Hughson (1964) reported the difficulty he had experienced in finding suitable day release courses for computer staff employed in commercial data processing centres. He deplored the lack of courses provided by higher education (HE) that would provide "a good commercial/technical education with special attention to computers and associated business techniques".

In his review, Buckingham (1967) summarised a government report estimating the number of computer staff required by 1970. These figures refer to the needs of industry and commerce and ignore those of educational institutions.

Table 1. Projected increase in number of computer staff required by 1970 (From Buckingham, 1967, p. 6)

Type	Numbers in 1964	Additions needed by 1970
Advanced programmers	Not specified	200
Systems designers	3,600	500
Systems analysts	3,600	11,000
Programmers	4,800	19,200
Operators	3,000	16,000
Maintenance staff	2,500 – 3,000 (in 1965)	Not specified

It was assumed that advanced programmers and systems designers were of honours degree standard, systems analysts were of "graduate quality" and that the other types of staff were technical grades. Furthermore, despite the large increase required in the numbers of technical grade staff, it was felt that their training did not pose a problem as it could probably be dealt with by the computer manufacturers, such as English Electric-Leo. This company provided specialist training for their customers' staff as well as for their own needs, their major effort being in the training of programmers, operators and maintenance engineers (Gibson, 1964). The significant issue was seen by the government to be the education of systems analysts and designers. The government report produced a number of recommendations, emphasising that a high priority should be given to training systems analysts and the implications for universities, further education (FE) colleges and the National Computing Centre (NCC). For the universities, they recommended the involvement of the computer manufacturers in curriculum development, more computer facilities allocated for teaching purposes, rejigging some courses towards system design, and increased grant provision. For further education colleges the recommendations focussed on reviewing and augmenting existing provisions.

Buckingham (1967) reviewed the existing and estimated higher education and further education provision to meet this projected demand. At that time the development of post-graduate courses in computing was ahead of that of undergraduate. This was because it had until then been uncertain whether computer science represented an acceptable academic discipline. More exactly, computing related topics were perceived as evolving, experimental new fields of study, with indistinct boundaries and, as such, more suitably placed within postgraduate diploma or masters level courses. The majority of post-graduate courses had developed from the study of numerical analysis at older universities and by 1967 included such topics as theory of computation, symbol manipulation, compilers and data structures. Buckingham hoped that more than 500 students would have received such an award by 1970. He also estimated that there was an additional but significantly lower number of students who were undertaking post-graduate research in computer science or registering for new diploma and MSc courses in data processing and systems analysis.

By 1967, computer science was becoming established as an academic subject at undergraduate level. Six colleges of technology formed the majority of the vanguard in offering courses predominantly concerned with the theory and use of computers, in their case validated by the Council for National Academic Awards (CNAA) and incorporating an industrial year. This trend mirrored the establishment of engineering as an academic subject in Britain in the nineteenth century. Cambridge did not establish a chair in engineering until 1875 and Oxford not until 1907, despite fears of Continental superiority (Sviedrys, 1970), although the civic universities gained chairs earlier, endowed by industrialists, for example Manchester in 1867. Additionally, by 1967 eight universities were offering joint degree courses where computer science was the most significant component. Buckingham estimated that by 1970 undergraduate courses would be supplying more than 350 graduates per year, who had studied a course with a substantial computer science component, and that figure was increasing.

Table 2. Estimated supply of computer science graduates by 1970 (From Buckingham, 1967, p. 8)

Institution	First year 1965/66	First year 1967/68	Graduates by 1970
Colleges of Technology	104	213	250 – 300
Universities			100+
Total			350+

Samet (1968) contrasted the attitude of the universities with that of the technical colleges in meeting the educational requirements of personnel aspiring to become data processing managers. He believed that the universities were doing far too little, being concerned with teaching mathematically based topics. "Commerce and industry are not really respectable." He felt that the technical colleges were ahead of the universities as their courses possessed "a practical outlook" and "wide background".

Buckingham thought that the further education colleges should be meeting the need for technical grade personnel. The City and Guilds of London Institute (C&G) had been engaged in technical education since 1878. In 1962, the BCS requested its involvement in computer education for junior personnel within the existing further education structure. C&G's *Certificate for Computer Personnel,* a two-year part-time course, launched in 1964, was first examined in 1966, and is believed to be the first formal examination in computer studies held by a recognised body. The objective of the two-stage course, of which the Certificate formed the first stage, was to enrich the in-service training and experience of junior programmers, so that the knowledge they gained enabled them to program a computer more effectually. The second stage developed them to be fully competent programmers, ready to assume positions of responsibility. Colleges offering the course had to be approved by C&G; nine colleges gaining approval in 1964. By 1968 the number had risen to 60. (Stevens, 1969) In 1966, 62 candidates passed the Certificate, that number had risen to 368 in 1968 with 480 projected for 1969.

In 1967 part-time Higher National Certificate (HNC) and full-time Higher National Diploma (HND) courses were becoming established (Buckingham, 1967) so that by 1970 27 institutions were offering Higher National Certificate or Higher National Diploma courses in Computer

Studies at sub-degree level (BCS, 1970). Furthermore, encouraging noises had been made about an Ordinary National Certificate which would allow students to progress to a Higher National Certificate, as early as 1962 (Barritt, 1962) although these proposals were deferred until the 1970s. The establishment of the Technician Education Council (TEC) in 1973 and the Business Education Council (BEC) in 1974, under the auspices of the Secretary of State for Education and Science, led to the creation of the BEC/TEC Computer Studies Committee in 1977 with responsibility for "the development of a nationally recognised integrated framework of courses in non-degree further education and higher education leading to awards in Computer Studies". (Staple and Shaw, 1981) By September 1980, about 80 colleges were providing BEC/TEC National Certificate or Diploma courses in Computer Studies. When, in 1986, the course underwent a revision to take account of technological developments, there were more than 250 centres with an annual intake in excess of 4500. (Buckingham, 1986)

In 1975 Simpson and Kerridge (1975) reviewed part-time education in computing, which they classified as day release, evening courses for professional body qualifications, or at the level of computer appreciation, and specialist one week blocks requested by industry. Day release, for example for Higher National Certificate, was the least popular option. They concluded, based on their own experience, that producing a coherent system of part-time provision would be very difficult as such a system would have to cater for differences in technical level of the students, differences in their ability to attend college, as well as differences in their objectives in attending the course. It would also have to be able to incorporate intermittent requests from industry for special courses. This was despite a high national requirement for trained first entry computer personnel, a need to up-skill existing staff, and the desire by non-computer specialists for a computer qualification.

During the 1970s a process of consolidation took place at higher education level with some debate over the structuring of degree courses (Joubert and Stander, 1970) and the mathematical bias of university courses in computer science (Colin, 1971). Moreton (1977), in his review, noted that computer science had become recognised as an academic discipline with over 40 first degree courses. However, he drew attention to an issue that was then causing concern, lack of compatibility of many university courses of study with what employers expected graduates to know, but he argued that computer science courses were evolving to meet the needs of industry for skilled personnel. Day (1974) earlier described the "unsolved problem of computer science ... how are those who want practical training going to get it?" He was referring to university courses that, in aiming for academic respectability, were failing to teach programming techniques soundly, as programming was viewed as containing little intellectual content. Further he stated that undergraduates had no practice in applying their knowledge to large, real world problems.

Addressing this issue, Penney (1975) reported on the progress made by a BCS working party set up in 1972 to consider the curriculum of a degree in data processing, which prepared the graduate “to make an immediate contribution to the everyday work of a data processing department”, to provide management in business, commerce and administrative departments with reliable, timely and relevant information. The proposed curriculum contained technical topics such as computer systems and programming systems as well as areas like social and organisational studies. The proposals were criticised by King (1976) as representing a joint degree in the subjects of computer science and business administration. King suggested that students should study for a degree in computer science and take specialist routes later in their curriculum. Notwithstanding such criticisms, following the publication of the BCS report (Land, 1975) and as a result of it, a number of degree courses in data processing were established.

Bell and Robson (1985) reviewed a course in data processing which had been established at Sunderland Polytechnic in 1979 as a consequence of the BCS report, and concluded that the curriculum the report contained had been proved to be “both appropriate and robust”, merely requiring fine tuning. This was despite developments in microprocessor technology in the US in the early 1970s having provided the basis for the production of the microcomputer, and having initiated massive computer-based changes in business and society in the intervening years.

Another change, brought about by technological progress, that influenced the undergraduate curriculum, was the inception of software engineering (Cheetham *et al.,* 1988). The software crisis of the 1960s, marked by a meeting in Garmisch, Germany, in 1968, gave rise to the notion that the production of software should form an engineering discipline and this led to the development of courses of software engineering, although the movement was criticised as being a “bandwagon”. Indeed, another conference on the history of software engineering, held in 1996 in Germany, concluded that software engineering had failed to become established. (Ceruzzi, 1998) Meanwhile, in the late 1980s, the concept of advanced courses in Information Systems Engineering (ISE) was gaining currency (Buckingham and Land, 1987) based on earlier models provided by the Association of Computing Machinery (ACM) and IFIP. An information system was defined as a human activity, which may or may not use computer systems, and the definition thus emphasised the system’s socio-technical aspect, so that the training of an IS engineer would differ from that of a computer scientist.

Raymont (1986) of the National Computing Centre reported in 1986 on the then prominence of the debate about skills shortages in computing, including reports published by the Department of Trade and Industry, which had led to various educational initiatives. The Manpower Services Commission funded the Youth Training Scheme (YTS), which provided instruction in electronics and computing to school leavers in Information Technology Centres (ITeCs), the emphasis being on hands-on experience. (Griffiths, 1986) It also funded the Threshold Scheme, created in 1976, to train 17 – 19 year-olds to meet shortages for computing staff. The scheme, consisting of off-the-job training and work placements and operated almost entirely through further education colleges, handled about 1200 trainees annually. A parallel scheme was the Job Training Scheme, which the Manpower Services Commission funded from 1981; it included high level courses, run in higher education, in areas of "leading edge" technology, such as telecommunications, which annually handled about 400 trainees. A larger contingent, about 3500 annually took the basic entry-level skills training for the unemployed; trainees were selected on the basis of aptitude test and interview. Buckingham (1986) reported that a recent extension to the Youth Training Scheme as well as the new Certificate in Pre-Vocational Education (CPVE) and the Technical and Vocational Educational Initiative (TVEI) may provide a basis for development of careers in computing. CPVE was a one-year vocational course for 16 year-old school leavers. TVEI was a vocational curriculum for 14 – 18 year-olds.

Also providing input into the education of computing personnel during this period was the putative professional body for computing, the British Computer Society. Perkin (1996) advocated the notion of a professional, post-industrial society led by a wide range of experts, based on highly skilled human capital, which forms the main source of income-generating wealth. He described a professional ideal based on: trained and certified expertise out of the ordinary, selection by merit and by similarly trained experts, ascent through ability and education as well as mastery of a skilled service vital to fellow citizens (Perkin, 1989). According to Perkin's model, it is necessary for the professions to control the supply of specialised expertise into the labour market to safeguard their worth as a scarce resource and hence sustain the rewards, such as a secure income, enjoyed by their members. This protection would be through control of the market and exclusion of the unqualified. Closure occurs through restrictions on training and qualification, and acquisition of a state monopoly. (Perkin, 1989, p. 378) Perkin argued that the universities act as the "gatekeepers" to the professions (Perkin, 1989, p. 395). Between 1858 and 1960 all the large professions changed their training to the universities, instead of it being through apprenticeships and independent vocational courses. However, it behoved the professional bodies to maintain control, which they did through accrediting courses, offering exemption from professional exams and their academic members infiltrating the governing bodies of universities. Other models of the profession (Pavalko, 1971, p. 26; Moore, 1970) emphasise the importance of a long, specialised training period, with establishment of training facilities taking place during the process of professionalisation from an occupation to a profession (Millerson, 1964).

In the field of education, as well as creating, administering and reviewing its own system of professional examinations (Vickers, 1980; Ibbett, *et al.,* 1983; The Editor, 1983), the BCS, in the form of the Education Board, studied the qualifications to which members of the profession could aspire, and how appropriate they were. The Education Board was also interested in computing education in schools, international developments and the use of texts and training equipment (Bridger, 1968).

Actual input by the BCS into sub-degree courses, other than Higher National Diplomas offered by the polytechnics, appears to have been limited (Buckingham, 1981). The BCS was concerned, however, with education at degree level for the computing profession. From the inception of the BCS qualifying examination in the late 1960s the BCS accredited higher education courses. Until 1984 this was by means of simply examining the course documentation; from 1984 accreditation visits were carried out (Conway and Hooper, 1988). In 1981 the BCS proposed a Professional Development Scheme (PDS) for members in employment who wished to improve the standard of their work, particularly to assist their transition from Associate to full Member of the BCS (Sizer and Jackson, 1981). In 1986 Griffiths commented on the BCS PDS scheme and a government run equivalent which was in operation: the Computing Services Industry Training Council's Training and Career Development Programme. He believed that the latter encouraged a structured approach to in-company career planning, whereas he commended the PDS scheme, for its thorough determination of the relationship between different jobs in the computing area. (Griffiths, 1986)

3. CONCLUSIONS

In the field of education the BCS did a great deal of work in establishing the BCS professional examinations and a system of course accreditation at higher education level. It also created a Professional Development Scheme to improve the standard of workmanship of employees in the computing field. It reviewed and offered informed comment on all aspects of computer education, including sub-degree vocational awards, although these were managed by publicly funded bodies. However, it failed to achieve control of the training of computer professionals because employers were not bound to employ members of the BCS, and hence persons accredited by the BCS, for computer-related work. The British Government clearly influenced the content of courses at higher education and further education level, analysing and reporting on the projected staffing needs of the British computer industry, and creating bodies such as the Manpower Services Commissions to oversee government-funded developments such as the Threshold Scheme. Industry was involved in government or BCS-sponsored reviews, such as the 1970 Select Committee on Science and Technology. Industry was also the customer of the educational institutions, either directly, or indirectly, through its influence on potential students. Thus these three groups were responsible for moulding the content of courses in computing in Britain at degree and sub-degree level/technician level from the early 1960s to the late 1980s.

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