Integration of computer technology

into the medical curriculum: the King's experience

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King's College London has developed a new curriculum which prepares students to deliver a high-quality clinical service. A variety of active-learning techniques are utilized to produce a deep approach to learning with an emphasis on vocational needs in the domains of knowledge, attitudes and skills. Integration of academic and clinical studies, as recommended by the General Medical Council (GMC), poses a number of difficulties, particularly in terms of communication between disparate geographical sites. The new curriculum aims to take advantage of computer technology to supplement and enhance traditional methods of learning and to ensure that students are competent in a defined range of skills. To aid integration, all students joining the new course are offered notebook computers and enhanced access to desktop computers, both with facilities to link to the main network. This allows students to use multimedia material incorporated into the new curriculum and to access online services from remote locations. This paper reviews the integration of such computer technology into the new medical curriculum at King's.

Introduction

Recently, there have been major changes in the requirements of medical education which have set the scene for the revision of medical curricula (Towle, 1991; GMC, 1993). As part of the new curriculum at King's, the opportunity has been taken to integrate computer technology into the course through Computer-Assisted Learning (CAL), and to train graduates in core IT skills. Although the use of computers in the medical curriculum has up to now been limited, recent studies have shown encouraging steps forward (see Boelen, 1995). One area where there has been particular interest is the use of notebook computers to allow students increased access to IT facilities (Maulitz *et al*, 1996).

Medical education and computer technology

Studies have shown that the level of computer skill in medical students is variable, with a minority feeling confident in the use of computers (Oliveira *et al*, 1994; Osman and Muir, 1994), and the impact of computers on learning currently falls below the required critical mass to have a serious effect on learning in medicine (Harden and Smyth, 1994). Nationally there is insufficient integration of computers into the learning environment,

and CAL is rarely used beyond its place of origin with few packages surviving in the long term. In addition, information-dissemination on medical education and computer-supported learning is still in its infancy, although sites such as ASME, the CTI at Bristol and MADEN are addressing this problem. A major impetus to integration will be the ability to estimate costs, and thorough investigation of cost effectiveness is still awaited (CSUP, 1992). Moreover, technical issues are a major consideration. It is hard to judge whether technology for which material now being developed will be out-moded when the material appears, and it is as difficult to ensure the provision of an adequate hardware and software base. Although medical students' experience with computers is closely related to attitude, all rate computer literacy as important (Fox, 1996). Access is also an important factor, as medical students share the generic undergraduate circadian rhythms which require them to be up all night and to sleep most of the day.

As well as the specific issues surrounding medical education, higher education is ripe for natural inertia (Boelen, 1995) as changes are forced by external sources under the banner of 'value for money'. Institutional changes have centred around strategies linking computing services, support systems and libraries to provide an integrated learning environment.

The advantages of using computers to aid learning in medicine has been documented (Koschmann, 1995), and include self-paced learning and immediate feedback. The limitations include the possibility of passive interaction and lack of flexibility and control, although it can be argued that good interactive design and the use of modern authoring tools overcome many of these limitations. Recently, work looking at the efficacy of the software in the transfer of content as well as problem-solving skills has been carried out (Khadra and Guinea, 1996). Other work investigating students' attitudes in a medical environment in the UK, in the USA and in the Netherlands has shown that the majority of medical students find the use of computers not impersonal nor difficult, but challenging and motivating (see Plasschaert *et al*, 1995).

The effective integration of computer technology into the medical curriculum centres around a number of issues: the pedagogic gains which can be achieved need to be researched, the cost-effectiveness of the option needs to be answered, the resistance to the introduction of change needs to be understood, and the technical challenges posed have to be mastered.

Constraints within the medical curriculum

In the UK, medical education has traditionally comprised two parts: two years of basic medical sciences followed by three years of clinical training. For many medical schools, the science and clinical work are carried out on separate campuses. At King's, the two main campuses are three miles apart, and this presents logistical problems as these two components of the course are integrated into a single program.

Within clinical medicine there are further constraints. Students are expected to learn clinical skills from practising clinicians and through working with patients. This necessitates high staff-student and patient-student ratios. With the high degree of specialization seen in many teaching hospitals, together with the decrease in in-patient beds in favour of community and ambulatory care, there is an increasing need to find

placements for students outside their home teaching hospital. Some of these placements will necessarily be at a considerable distance from the main clinical site. Moreover, it is now recognized that students need to see health care provision and meet patients in settings such as community clinics, general practices and district general hospitals as well as the specialized environment of the teaching hospital. Thus contemporary medical students increasingly spend their time away from their fellows and their medical school. Such changes pose considerable challenges in establishing effective communications between students, tutors and the centre and in allowing students in distant locations access to the learning resources available at the centre; such changes are affecting all medical schools. King's believes that effectively implemented IT can substantially contribute to the solution of these problems

The King's new curriculum

King's new curriculum represents a radical change from traditional models of medical education. The analysis of the problems have been well set out in Towle (1991), and potential solutions identified in GMC (1993). King's new curriculum follows these recommendations closely, and pioneers new approaches in a number of areas. In designing the new curriculum, King's initially created a consensus document setting out a specification for the new doctor we wanted to 'create'. The statement *The King's Doctor* (Booton and Marshall, 1997) defines the attributes of a doctor in terms of the attitudes, skills and knowledge which the new graduate would require. This in itself is a major change from traditional curricula which are almost solely defined in terms of knowledge.

In planning the curriculum, to deliver the desired objectives, a structure was designed to ensure that science and clinical learning were addressed in an integrated fashion, and that skills-learning was carried out in a context appropriate to its eventual use. In particular, the skills programme addressed IT, recognizing the need for graduates to possess a series of core IT skills, and at the same time requiring students to use these skills to enable them to progress on the course. The programme was planned to be cumulative, building on the skills learned year by year in a logical manner and linking with the students' growing knowledge of other subjects, so allowing a proper context for their skills-learning.

Integration of computer technology into the King's programme

Students entering medical school have been found to lack basic IT skills, and the King's curriculum assumes little or no knowledge. The first days of the new students' introductory course is spent on basic IT-skills training, especially how to use the tools which will be employed to access and present coursework. There is a requirement to use IT and to be assessed on it. To enable deep learning, the student revisits the knowledge and skills learned in the introductory course by the incorporation of IT into the course itself. This approach is obviously applied in the use of CAL where possible, and also in the requirement to submit word-processed coursework, presenting peers and tutors with the use of common computer-based office presentation software and data-analysis using common spreadsheet and statistics software. Electronic reference material is made widely available and the students are required to use it to complete course modules. Students therefore do not just learn about computers but through computers and with computers, the objective being to create a constructive engagement with learning such that the

students actively find knowledge by the interpretation of results from hypotheses-testing (see Jacobs and Heath, 1995).

A problem identified by Harden and Smyth (1994) was that few programs were available at any of the medical schools. Moreover, as mentioned earlier, CAL is rarely used beyond its place of origin. It is for these reasons that King's has employed a full-time CAL co-ordinator with a background in the TLTP projects. The approach taken is to use what CAL is available (an approach well recognized by Laurillard, 1993) both commercially and from other UK and US medical schools. Only when such material does not fulfil the need, or match the quality requirements, of the course, are further CAL packages authored in-house. Although not vast, King's does have a library of CAL packages which have been developed in-house especially for the basic sciences content of the course. Part of the remit of the co-ordinator is to link with staff developing the new curriculum to ensure that the appropriate CAL materials are available.

To facilitate the integration of the IT approach to the new curriculum, all first-year medical students have been offered their own notebook computer. This has been made possible by the involvement of a large international commercial partner in the initiative. Each notebook has a colour screen, a 100 MHz Pentium CPU, 8 Mb RAM and an 800 Mb hard disk. Facilities have been made available to allow students to extend most components of the specification should they so wish. In conjunction with the commercial partner, it has been possible to ensure that the computers have standard application software pre-loaded, and the inevitability of technology advancement is catered for, in that every notebook will be upgraded to the most recent model after two years. Security has been a cause for concern: all students must ensure that the computers are insured, and there is a provision for secure lockers at each campus for each student.

To support these newly available facilities, King's is currently at the stage of extensive rebuilding of the local and wide-area networks. Within and between the campuses, a new fibre-optic network is being installed; and to support the community learning centres, facilities for dial-up network access are being made available, which will also allow remote access from many other sites, including the student's home. Online support over the new network is also being implemented: communication with tutors is made available via email, there are multiple choice self-test questions, and course evaluation is made using the World Wide Web at the King's College site.

Conclusions

The ultimate aim of the project is to embed the integration of technology into the medical curriculum. With this aim in mind, King's has initiated an evaluation programme that will assess the effects that the use of IT tools can have on students' approaches to learning and professional development.

From the King's experience so far, integration requires a comprehensive knowledge of the institution plus an infrastructure to support the change which has sufficient resources to allow a smooth transition. In addition, integration requires a multi-disciplinary team working in close collaboration and using seed projects as a focus for development. Above all, to carry this through, enthusiasm will be essential.

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