Preparing tomorrow's doctors: the impact of a special study module in medical informatics

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Background In response to the call for more informatics teaching in the medical curriculum, an elective special study module has been offered to first-year students at Queen's University since 1997.

Objectives To assess the impact of a medical informatics course in terms of the use of skills acquired and attitudes held about information technology (IT) in medicine.

Methods A postal structured questionnaire was sent to all 30 students who took the medical informatics special study module in 1997 and to all 29 students who took the module in 1998, plus an age and sex-matched group of controls in each year. Main outcome measures included attitudes to the role of IT in medicine and declared frequency of use of various software packages.

Results Compared with the control group, those taking the module felt less confident initially with computers. There was a high level of positive attitude to computers in medicine following the course, in both study and control groups. There was a significantly greater use of word-processing ($P = 0{\cdot}001$) and presentation packages ($P = 0{\cdot}0005$) amongst third-year students compared with second-year students, but there was no significant difference in this regard between those taking the module and controls.

Conclusions Students' use of computer technology and IT skills, is more influenced by the demands of the overall curriculum than by undertaking a single module in medical informatics. A special study module may, however, provide valuable support by performing a 'remedial function'. The authors found the module a useful first step in the process of introducing medical informatics to the core curriculum.

Keywords Attitude; attitude to computers; curriculum; Ireland; medical informatics, *education; postal services; questionnaires; students.

Medical Education 2001;35:62–67

Introduction

The need for greater competence in the harnessing of information and communications technologies by doctors and medical students is increasingly recognized on both sides of the Atlantic. The General Medical Council (GMC) in its document *Tomorrow's Doctors*[1] asserts that 'The new technology now applied to education has substantially increased the scope for self-directed learning'. It has also recommended that 'at the end of the course of undergraduate education the student will have acquired and will have demonstrated his or her proficiency in basic computing skills as applied to Medicine'. Annual workshops for medical educators in the UK, under the auspices of the Committee of Deans of Medical Schools, since 1995 have explored the issues of informatics education in the medical and dental curricula, and have concluded that any professionals who are not computer-literate will be disadvantaged, less professionally competent and even isolated. The workshops have highlighted the students' need to develop an understanding of the importance of high quality medical records, good communication, valid data collection and the use of information in the management of individual patients and the development of the Health Service.

Although it is our impression that increasingly students are emerging from secondary education with IT skills, they are unlikely to have significant insight into the handling of information in the health care setting. In the United States, the ACME-TRI report[2]

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Key learning points

The special study module is a useful route for introducing medical informatics into the curriculum

The main drive for students to increase their use of information technology comes from the core curriculum

Students taking the informatics module became more aware of the role of information technology in the care of patients

A dedicated informatics module may help some students to become more comfortable and confident with the use of computer technology in their studies

emphasized that students 'must be given a strong grounding in the use of computer technology to manage information, support patient care decisions, select treatments and develop their abilities as lifelong learners'.

To address some of these issues a course in medical informatics in the form of an elective, special study module in the first year, has been in progress since 1997 at Queen's University. The impact of the course on students' attitudes, comfort and awareness with respect to information science and technology in medicine, and the impact of the course on students' use of computer technology in their everyday studies, was examined and is reported in this paper.

Course structure and delivery

Special study modules (SSMs) were introduced for the first time to first-year medical and dental students at The Queen's University of Belfast in 1996/7. The medical informatics SSM is one of a choice of six electives offered during the second semester of the first year. Other modules offered include 'The anatomy of archaeological remains' and 'Emotion and cognition'. The medical informatics SSM is open to a maximum of 30 students. There are no special entry criteria. The SSM aims to help students develop appropriate knowledge, skills and attitudes with regard to communications and information technologies (C&IT) through exposure to a wide spectrum of computer applications and information systems in health care. Students learn to access medical information from remote databases and to use this in their general studies. They study information flows in clinical settings and how information systems can have an effect on the culture of organizations.

The module occupies three 2-hour slots per week over a 12-week period. The taught component includes lectures, short presentations, practical computer work and fieldwork. Half the allotted time however, is for students to carry out project work on their own and in groups. Table 1 shows how the course is divided into four components and demonstrates its practical, 'hands-on' nature. Students in groups of four or five go to see clinical computing systems in action, talking to the health care staff who use them and subsequently reporting their findings in formal presentations to their peers. Seminars highlighting key issues such as principles of software evaluation and the importance of security and confidentiality provide students with the necessary skills and knowledge required to carry out this fieldwork. The course Web page not only conveys information about the module but also accommodates topic-related discussion lists and acts as a vehicle for the submission and sharing of the two individual and two group-based assignments which form an integral part of the learning environment.

Methods

In April 1999 a questionnaire was sent to all 59 students who had participated in the first 2 years of the medical informatics SSM (1997 and 1998). The questionnaire was also mailed to a randomly selected control group, matched for sex and year of study. Participants in the course were therefore completing the questionnaire either 1 or 2 years after taking the module.

No specific reference was made to the SSM in the two-part questionnaire. The first section consisted of four attitudinal statements with a 4-point Likert scale ranging from 'strongly agree' to 'strongly disagree'. Students were asked about their knowledge of information technology prior to undertaking their medical course, changes in awareness about IT in medicine and in their sense of ease with computers since starting medical school, and their feelings about the importance of computers in medicine. The second part of the questionnaire consisted of seven statements relating to the usage of specific software packages: word-processors, spreadsheets, presentation packages, email: on-line information systems and the School's intranet. A 5-point rating scale ranging from daily usage to not at all was used.

The data were processed using SPSS and analysed using chi-squared tests.

Table 1 Course structure

Seminars
- Managing data and information in the medical context
- Knowledge engineering and decision support
- Communications and the Internet – contribution to medicine
- Data security and confidentiality in the medical context
- Evaluating clinical software and systems

Demonstrations and practicals
- Using PowerPoint for effective presentations
- Demonstration of working clinical systems in hospital and general practice settings. These include teledermatology, virtual reality laparoscopic training, decision support for pathological diagnosis of cancer, and electronic patient records
- Effective searching of on-line information sources including bibliographic databases

Fieldwork
- Observing the use of C&IT in the health care setting. Groups of students visit hospital units/general practices, interview staff and evaluate the technology and how the staff make use of it. Putting C&IT to use. Students design and carry out a patient survey in general practice, making use of the skills they have acquired

Assignments and presentations
- Students use on-line resources to research a topic chosen from their medical course. They post a commentary of this process and their findings to the course web page for other students to share
- Groups submit reports on their evaluation of a working clinical system and their patient survey and present their findings to the class

C&IT Communications and information technologies.

Results

The participants

In 1997 30 students (23 male and seven female) took the module and were in their third year of medical studies at the time of the survey. A total of 25 replies were obtained (20 male and five female). These were matched by 30 controls from whom 22 replies were received (16 male and six female).

In 1998, 29 students (16 male and 13 female) attended the SSM and of these 22 returned questionnaires (12 male and 10 female), and 29 replies were received from the 29 controls (16 male, 13 female). Not all students answered every question.

Attitudes to computers in medicine

In order to achieve adequate numbers for valid statistical analysis, the 'strongly agree' and 'agree' categories were collapsed as were the 'disagree' and 'strongly disagree' categories. Comparisons were made between those taking the SSM and controls (Table 2). There were no statistically significant differences between the study and control groups. However students in the study groups declared themselves to have been less familiar with computers and IT prior to entry to medical school. This was most marked in the 1998 cohort. In the 1997 cohort course participants declared themselves more aware since starting medical school of the role of computers in medicine than did the

Table 2 Numbers (percentages in parentheses) of students agreeing/strongly agreeing to statements about computers in nedicine. (No statistically significant results)

	1997 group		1998 group	
Statement	Study (%) $n = 25$	Control (%) $n = 22$	Study (%) $n = 22$	Control (%) $n = 29$
Already familiar with IT and computers before medical school	14 (56)	13 (59)	10 (48)	19 (66)
More comfortable using computers today compared with when starting medical school	22 (88)	21 (95)	18 (86)	27 (93)
More aware of the role of information technology and computers in the care of patients than when starting medical school	22 (88)	15 (62)	19 (91)	26 (90)
Believe computer skills and information science skills are vital to medical practitioners	24 (96)	21 (96)	20 (95)	28 (97)

controls. No other differences were evident in the comparisons.

IT skills

Since very few students indicated daily use of computers, responses to the skills-based questions were condensed into 'daily' and 'weekly' compared with 'monthly', 'rarely' and 'not at all' (Table 3). The differences between the control groups and those taking the SSM within each year were not statistically significant in any of the seven areas assessed. However differences were observed in three areas between the combined study and control groups for 1997 and the combined groups for 1998. There was a statistically significant rise in the declared frequency of use of word-processors between the second-year and third-year students in the combined groups ($P = 0{\cdot}001$). Similarly, the rise in the declared use of presentation packages between the second and third medical years was statistically significant ($P = 0{\cdot}0005$). The figures show, however, that the school website was visited less often by the third-year students ($P = 0{\cdot}001$).

Discussion

This is the first study to attempt an evaluation of an educational programme aimed at helping students to become more conversant with medical informatics. The medical informatics special study module set out to address some of the identified deficiencies in the medical curriculum with respect to communications and information technology and their application to health care. The inability to use this technology effectively is potentially as disadvantageous as the inability to read and write. Rapid developments, including the digitization of the medical record, globalization of communications and the Internet, mean that now, more than ever before, doctors need to be equipped with the mental attitude and intellectual tools to deal with and exploit these advances.[3] As Coeira points out, care must be taken in equating IT skills with medical informatics: 'Just as the ability to suture doesn't make one a surgeon, the ability to surf the Web does not imply that one understands the principled use of information.'[4] Koschmann suggests that early exposure of students to electronic information resources could help produce practitioners with a different orientation toward knowledge and learning and that teaching of medical informatics should begin early in medical education.[5] In addition, such exposure should bring students to an awareness of how computers and information systems affect day-to-day practice.[6]

The medical informatics special study module was designed to address these concerns but also, more immediately, to better equip medical students for their studies.

At first glance the similarity between the study and control groups is somewhat surprising with respect to their use of the technology and attitudes held. However, those electing to take the SSM declared themselves less familiar with computers initially. This was particularly the case in the 1998 cohort, where 66% of controls but only 48% of those taking the module claimed they were already familiar with IT and computers before starting medical school. Since there were high levels of declared ease with computers after the module in both study and control groups, it may be that this early module served an important 'remedial' function. Students who took the module may have made a more realistic appraisal of their own skills. Students' perceptions about their own IT skills may be flawed. In a 1998 survey of all Queen's University entrants, a marked difference was found between students' overall ratings of their IT skills and

Table 3 Numbers of students (percentages in parentheses) reporting daily or weekly usage of various software tools

	1997 group		1998 group		
Statement	Study (%) $n = 25$	Control (%) $n = 22$	Study (%) $n = 22$	Control (%) $n = 29$	Comparison between 1997 and 1998, P value*
Word-processing	18 (72)	18 (82)	6 (27)	10 (34)	0·001
Spreadsheets	2 (8)	1 (5)	0	2 (7)	
PowerPoint	15 (60)	10 (45)	0	1 (3)	0·0005
Email	1 (4)	2 (9)	1 (5)	8 (28)	
Online databases	5 (20)	8 (36)	4 (18)	9 (31)	
Search engines	7 (28)	6 (27)	4 (18)	9 (31)	
School website	5 (20)	3 (14)	4 (18)	9 (31)	0·001

*Comparison between 1997 and 1998 students using the study and control groups combined in each year.

their responses to questions about specific skills.[7] For example, over 80% of students in the University survey declared confidence in performing word processing tasks in general. However, when questioned closely about specific word-processing tasks such as mail merge and font styles, as few as 9% expressed confidence in their abilities in some of these specific tasks. As a result of this SSM, students may be aware of what they know, what they don't know and what they need to know about. The module was a relatively brief intervention in a large curriculum; consequently the expectation of measuring significant changes in student behaviour may have been unrealistic.

The 1997 cohort was more ready to declare greater awareness of the role of information technology in medicine than when they started medical school. We would expect these results; after all a major component of the course was exposure to clinical computing systems. What is surprising is the lack of difference between the two groups in the 1998 cohort.

The frequency of use of core IT skills does not seem to have been influenced by the special study module, except perhaps where less confident students may have been brought up to speed. It would seem that using computer technology is driven more by the requirements of the rest of the curriculum. This is borne out by our results where a statistically significant rise in the use of word-processing and presentation packages was declared between the second and third years of study in both the control and study groups. Although the module was about informatics rather than IT, inevitably the use of IT is an important vehicle for managing information, and consequently students' use of such software can be used as a marker.

Measuring the impact of one constituent part of a curriculum is difficult, but can be a useful exercise in the curriculum development process. The study relied on relatively crude markers of frequency of software use and responses to attitudinal statements about information technology in medicine. Of course not everything that is measurable is important and not everything that is important can be measured. The benefits from participating in the module may become more apparent as students progress further in the medical course.

Students were asked to report on their use of software packages as part of their coursework alone. This is highly dependent on the demands of the curriculum and we have seen the rise in software usage between years 2 and 3. In retrospect it might have been better to ask about general use of such packages.

Another limitation of the study might have been that the control groups were not in a position to properly assess how much they knew about IT in medicine and may have given unrealistically high ratings to their knowledge and skills. Students who completed the module may have been in a better position to realize how much they did not know.

Feedback from students was consistently positive in all areas. The module operates on a number of pedagogic levels including those of core knowledge and practical skills. Another important aspect might be regarded as a 'hidden curriculum' in which students are afforded cultural insights into how information and computers are perceived in the health care setting. For example, in one medical unit the leading physician was very enthusiastic about the use of technology. The students were able to discern a difference in opinion between nursing staff and junior medical staff about just how useful the information systems were on the ward. The incidental clinical contact in this early part of their course was highly valued by the students. They also gained experience in team working, presentation and communication skills, administering questionnaires to patients and appraising and using clinical systems.

End-of-course feedback demonstrates that the new SSM in medical informatics is well received. The input in terms of staff time is relatively large, involving several hospital units and family practices. It has therefore been important to examine critically the impact in terms of educational benefit. This study demonstrates that core IT skills will be acquired as necessary by students, and this acquisition probably depends more on the native curriculum and assessment techniques than anything else. However, learning about the use of information and information systems in clinical practice can be addressed very well in an informatics course, though we were only able to demonstrate a difference between participants and controls in the 1997 cohort. It could, however, be more efficient to integrate such learning into the rest of the medical curriculum. This would entail highlighting to both students and teachers, the informatics learning opportunities that probably already exist. We believe, however, that an elective special study module in medical informatics has important roles to play in promoting this discipline in the rest of the curriculum and in helping those who wish to study informatics topics in greater depth. The faculty is looking at ways of incorporating medical informatics learning into the core curriculum, building on the lessons learned from this module.

Acknowledgements

The authors wish to express their thanks to the following who taught in the special study module:

Dr P. Hamilton, Mrs A. Davies, Mr R. Telford, Ms G. Creighton, Dr P. MacNamee, Dr A. Gallagher, Dr C. Doherty, Dr J. Glasgow, Dr J. Brown, Mr L. Finlay, Mr J. O'Doherty, Mr M. Vincent and Mr C. Fox, and to Ms M. Boohan for reviewing the manuscript.

Dr McGlade would like to acknowledge the help and encouragement afforded by the Harvard Macy Program for Physician Educators in the initial development of the medical informatics special study module.

Contributors

Kieran McGlade contributed the original idea for the study, and was responsible for the study design and development of the questionnaire, overall supervision of the conduct of the study and data analysis, and production of the final draft. Catherine McKeveney helped with development of the questionnaire, carried out data collection and helped to produce the first draft of the paper. Vivienne Crawford contributed to drafts of the paper and was responsible for the design of the study and questionnaire and for data analysis. Paddy Brannigan contributed to questionnaire development, data analysis and drafts of the paper.

Funding

None.

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Received 3 *April* 2000; *accepted for publication* 12 *April* 2000