Application of a Problem-oriented Learning Package in Medical Education

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Abstract

Medici is a case-based, problem-oriented teaching package developed specifically for undergraduate teaching. The package was introduced as an adjunct to clinical teaching to provide material that was otherwise difficult to find for all students as part of their clinical learning. The program is fully interactive and text-based with photographs and video footage. Forty eight cases have been used by the students over a six month period. Each case was made available for three months with new cases added on a regular basis. The use of the program was voluntary for all years except the Fourth Year students, who were expected to log six hours a year. In the first six months of the year *Medici* had been used to complete 4409 cases mainly by students in their fourth year. The usage was spread equally throughout the months, suggesting that computer use is now being regarded as a learning resource similar to the more conventional material.

Keywords

problem-solving, case simulation, authoring systems, computer-aided instruction

1. Introduction

Despite two decades of development of the desk top computer and its associated technology, this potential educational resource is still in its infancy in undergraduate medical education. The reasons for this are many. First, teachers have been slow to appreciate the value of this learning medium and to see its broad scope. Second, much of what has been available up to now has been considered as little more than 'electronic page turning' and of novelty value only. Third, as opposed to books, there are few software programs that have the universality to encourage different faculties to use them.

In clinical medicine, teaching and learning is centred around the patient's bedside. However, for various reasons it is becoming more difficult to provide students with sufficient 'clinical material' to allow them to develop the knowledge and skills they will require for their professional lives. There are alternatives. It is accepted that learning by simulation is an effective and interesting way for students to acquire knowledge and skills in their chosen field. The computer is an ideal medium for the construction and use of clinical case simulation.

Skilled clinicians practise their craft on a sound base of knowledge integrated with problem-solving and pattern recognition. Whilst knowledge can be gleaned from books, problem-solving requires other resources. At the University of Adelaide a software program called *Medici* has been constructed to address some of these needs in the clinical curriculum (Devitt, 1993). *Medici* provides case-based clinical simulation and the cases within the program are produced to supplement ward-based teaching and learning. The program has been used as an adjunct the conventional teaching

resources until this year when it was formally incorporated into the clinical curriculum (Devitt and Palmer, in press).

A narrative account of this formal integration of *Medici* into the clinical curriculum is provided.

2. Methods

Medici consists of a 'shell' constructed in HyperCard and Toolbook into which cases can be placed. An authoring system allows Faculty members to produce their own cases (either in Word or Filemaker Pro) and then to transpose them into *Medici*. This means that the teachers are, to a large extent, free from dependency on a programmer to enter and run their data. The authoring system has sped up the production of content for *Medici* and 76 case-based modules now exist for the program.

The cases are built up as a series of blocks through which the students progress. The information from one block leads into the next and the path may either be sequential or branched. In the sequential structure the users are guided along one path, no matter what decisions they make. Feedback is provided at every step to inform them of the appropriateness of their decision-making. With the branched structure the users are free to roam down different paths and minimal feedback is given until the completion of the problem.

Cases have been constructed in 15 disciplines, including general medicine, general surgery, gastroenterology, trauma, and obstetrics. Each case is text-based and there is generous use of graphics, photographs and video footage. Yet to be constructed are cases with sound (eg cardiology), but *Medici* can cater for this.

Fourth Year students are expected to undertake at least six hours of computer-based work a year, and where possible other students are encouraged to use the program. This aspect of the Fourth Year students' self-directed study is an assessed part of the surgical component of the curriculum. The students can undertake these six hours at any stage of the course, and not necessarily during the surgical attachment. The students log on to *Medici* using their Student Number. The computer responds by telling them how many hours they have already accumulated.

Each case is mounted on the internal hard drive of the computers in the computer suites in the medical school and the two major teaching hospitals. Because of limited space, all associated images are kept on a central server in the medical school. The cases are rotated so that every four teaching weeks 7-10 new cases are put out for the students and made available for 12 teaching weeks.

Medici contains a monitoring system to enable the producers of each case to see how their problem has been tackled by the students, what decisions they made, and what paths they took.

At the beginning of the academic year all students were provided with information about the computer facilities that existed in the medical school and the teaching hospitals. In addition to this general information, the students were made aware that whilst use of all the computer material was voluntary, for those students in Fourth year, use of *Medici* was compulsory and assessable.

With limited computer facilities, priority was given to users from the Fourth year. This is in contrast to the previous year when all students were given equal encouragement to use *Medici.*

3. Results

Between February and August 1995, 48 cases were made available on *Medici*. The topics covered are shown in Table 1. Each case was left on the computer for student use for three months. The total use

of *Medici* according to the seniority of the students is shown in Table 2. The number of students in each year are between 120 and 145. Also included in Table 2 are the results for the first six months of 1994 when the use of *Medici* was not compulsory. In 1994 the Third Year students made considerable use of *Medici*, but the main users were Fifth Year students. In 1995, as might be expected, the major users of the program were those students in their fourth year. It should be noted that the number of non Fourth Year students who used *Medici* in 1995 are comparable to the numbers in 1994 although the percentages are quite different.

Discipline	No of cases	Examples of Topics
Anatomy	2	Parotid, abdominal CT
Gastroenterology	9	Peptic ulcer disease, cancer, reflux
General Medicine	2	Gout, breathlessness
General Practice	5	Melanoma, atheroma
General Surgery	13	Hernias, appendicitis, Crohn's disease
Gynaecology	2	Paediatric abnormalities
Head & Neck	5	Thyroid disease, branchial simus
Pathology	3	Gallstones, stomach cancer
Psychiatry	1	Depression
Radiology	3	Abdominal and chest X-rays
Urology	3	Bladder cancer, kidney stones

Table 1. Topics covered in *Medici* between February and August 1995.

Year	1994	1995
1	6.8	0.9
2	3.1	0.6
3	26.3	5.9
4	13.4	77.6
5	35.0	9.9
6	15.4	5.1
Total No. of Cases Completed	1272	4409

Table 2. Use of *Medici* by the six different undergraduate years. (percentage).

The number of cases available for students during each 4 week teaching period is shown in Table 3, and the total number of cases completed in that same period is shown in Table 4.

Period	No. of cases
1	8
2	17
3	24
4	25
5	31
6 (incomplete)	31

Table 3.The number of cases available each period. One period equals four teaching weeks.

Period	No. of cases completed
1	440
2	723
3	594
4	1272
5	920

6 (incomplete)	458

Table 4.Use of *Medici* by period. One period equals four teaching weeks.

4. Discussion

If computer-based instruction is going to be used effectively for undergraduate medical education it must satisfy several criteria. First, the content must be relevant and of good quality. Second, it must offer more than the conventional resources. If it cannot do this in terms of the design of the resource, then it must do so by the nature of the content (ie. it must provide material that the students are unlikely to get from other sources). Third, it must have a simple layout, be intuitive in use and the running of the program should not distract from the content. Rightly or wrongly the middle criterion is becoming easier to satisfy.

Worldwide, medicine is going through major upheaval. Many communities are coming to terms with the realisation that they cannot afford the health care that they want. From a practical aspect, the health dollar has to be spent more efficiently. This means that patients spend less time in hospital and more health care is delivered at the primary level. Unfortunately, medical education has yet to catch up with this change and most undergraduate teaching and learning still takes place within the confines of the University and teaching hospital. There is a practical reason for this: most of the teachers work in these institutions. This does not present a great problem for courses with pre-clinical curricula, as the learning of the basic sciences continues to be centred on the lecture theatre and the laboratory. However, clinical teaching is patient-oriented and if there are fewer patients in the hospitals, more students and fewer teachers - how do we solve the problem of diminishing resources?

Of the several solutions, computer-based clinical simulation has much to offer. Computers are relatively cheap and most students are now computer-literate (Kidd et al, 1993). Computer-aided instruction (CAI) can be found in many secondary institutions and students now enter medical school with the expectation of finding educational material in this form (Devitt and Palmer, in press). However, the layout of the program and its content must be done with care. Those programs that offer little more than instruction and tutorial will foster rote learning and the students will turn away in boredom (Piemme, 1988). The programs that allow conjecture and manipulation of data are well suited to the basic sciences such as physiology and pharmacology (Clayden and Wilson, 1988), but are less applicable to clinical problem-solving. The development of programs that produce clinical simulation with gradual revelation of data can allow the presentation of realistic scenarios that are instructional, stimulation and enjoyable. *Medici* has been developed to follow this latter educational philosophy.

One of the major drawbacks of computer-aided instruction is that production of the software and the content are labour intensive. It is likely to take many months to produce a satisfactory software shell and it has been estimated that it may take an author 40 hours of work to produce one hour of content (Piemme, 1988). The production of cases for *Medici* was no exception and the production of a complex multiple-branched problem would take over a week. The next hurdle would be to get the case into *Medici*, which would depend on the availability of the programmer. This necessity of using a skilled programmer to meld content with program has proven to be the shortcoming of many packages. We have overcome this with *Medici* by the production of an authoring system. This has allowed clinicians with few computer skills, apart from being able to use a word processor or database, to write cases for *Medici*. The authors can then transcribe their own cases into *Medici* and run them. This has led to a considerable speeding up in the production of material for the program.

The data in tables 3 and 4 show that a consistent number of cases have been completed in each 4 week teaching period. Not only is it used regularly by those who realise that it is part of the assessment process, but when there are sufficient resources, those students in other years also study

the material. Limited computers have meant that students have been frequently turned away from computer suites and it is expected that greater use of CAI would occur if the resources were available. What we have shown is that CAI in the Faculty of Medicine at the University of Adelaide is now well accepted by the undergraduates.

While much has been written on the suitability and acceptance of computer-aided learning for medical education (Khadra, Guinea and Hill, 1995; Kidd et al, 1992), little has been said on the efficacy of CAI as a learning tool. In its simplest form, CAI has been shown to be better than tutorials when used in an instructional format (Andrews, Schwarz and Helme, 1992), but little is known of its value as an aid to clinical learning in the ward setting. It is hoped that future studies will show that CAI can adequately supplement clinical teaching by the provision of simulated cases.

If CAI is to be accepted by the medical educational establishment, it must be shown to be an effective learning tool and to deliver material that cannot be easily provided by other means. However, despite all the technological advances in medicine and particularly in teaching, we must remind ourselves that these resources are there to augment and not to replace the diagnostic armamentarium (Goodwin, 1995). Nothing should be allowed to supplant the art of learning medicine at the patient's bedside.

5. References

Andrews, P.V., Schwarz, J. and Helme, R.D. (1992). Students can learn medicine with computers. *Medical Journal of Australia.* Vol.157. pp. 693-95.

Clayden, G.S. and Wilson, B. (1988). Computer-assisted learning in medical education. *Medical Education*. Vol. 22. pp. 456-67.

Devitt, P.G. (1993). *Medici* - A problem-oriented learning program for medical education. *Proceedings of the ASCILITE'93 Conference,* Lismore, Dec 1993, pp. 194-200.

Devitt, P.G. and Palmer, E. Assessment of computer-based learning in an undergraduate medical curriculum (submitted to *Med Aust*).

Goodwin J. (1995). The importance of clinical skills. *British Medical Journal*. Vol. 310, pp. 1281-82.

Khadra, M.H., Guinea, A.I. and Hill, D.A. (1995). The acceptance of computer assisted learning by medical students. *Australian and New Zealand Journal of Surgery,* Vol. 65, pp. 610-12.

Kidd, M.R., Cesnik, B., Connoley, G. and Carson, N.E. (1992). Computer-assisted learning in medical schools. *Medical Journal of Australia,* Vol. 156, pp. 780-82.

Kidd, M.R., Connoley, G.L., Cesnik, B. and McPhee, W. (1993). What do medical students know about computers? *Medical Journal of Australia,* Vol. 158, pp. 283-284.

Piemme, T.E. (1988). Computer-assisted learning and evaluation in medicine. *JAMA,* Vol. 260, pp. 367-72.