A randomized, controlled, single-blind trial of teaching provided by a computer-based multimedia package versus lecture

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Background Computer-based teaching may allow effective teaching of important psychiatric knowledge and skills.

Aims To investigate the effectiveness and acceptability of computer-based teaching.

Method A single-blind, randomized, controlled study of 166 undergraduate medical students at the University of Leeds, involving an educational intervention of either a structured lecture or a computer-based teaching package (both of equal duration).

Results There was no difference in knowledge between the groups at baseline or immediately after teaching. Both groups made significant gains in knowledge after teaching. Students who attended the lecture rated their subjective knowledge and skills at a statistically significantly higher level than students who had used the computers. Students who had used the computer package scored higher on an objective measure of assessment skills. Students did not perceive the computer package to be as useful as the traditional lecture format, despite finding it easy to use and recommending its use to other students.

Conclusions Medical students rate themselves subjectively as learning less from computer-based as compared with lecture-based teaching. Objective measures suggest equivalence in knowledge acquisition and significantly greater skills acquisition for computer-based teaching.

Keywords Education, medical/*methods; computer assisted instruction/methods; *lectures; teaching/*methods; education, medical, undergraduate; randomized controlled trial; single-blind study; England.

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Introduction

Problems of anxiety and panic are common in community and in hospital settings and often go undetected. They are associated with significant morbidity and have marked adverse social and economic effects.[1,2] However, many doctors are poor at detecting anxiety and rarely ask about or consider the presence of anxiety in their patients.[3] The General Medical Council's blueprint for undergraduate medical education, *Tomorrow's Doctors*,[4] has led many schools to seek to enhance training in the assessment, recognition and management of common mental health problems. Indeed, the ability to carry out a mental state examination is one of the few core skills specified by the General Medical Council (GMC).

The GMC also stresses the need to reduce the amount of information students are required to memorize and recommends a greater focus on acquisition of appropriate skills and attitudes.[4] Self-directed and problem-based learning approaches are encouraged, but although these methods are seen as increasingly relevant to medical education,[5] they can be expensive in terms of staff time. One alternative delivery method for self-directed, problem-based teaching is the use of multimedia teaching packages.

Multimedia computers equipped with sound cards, CD-ROMs and speakers are available at low cost and most learning centres now have suites of such computers. Despite the fact that the production of multimedia teaching materials can be expensive and

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Key learning points

A randomized, controlled trial assessed the effectiveness of a CD-ROM training programme when compared with a lecture as normally used in the teaching of anxiety.

Objective measures suggest equivalence in knowledge acquisition and significantly greater skills acquisition for computer-based teaching.

Students who attended the lecture rated their subjective knowledge and skills at a statistically significantly higher level than did students who had used the computers.

Students did not perceive the computer package to be as useful as the traditional lecture format, despite finding it easy to use and recommending its use to other students.

Subjective ratings of knowledge and skill acquisition by students may not equate to objective measures, and student feedback should not be the only factor considered when evaluating teaching, especially innovative teaching interventions.

time-consuming, more evaluations of computer-based teaching methods are starting to appear.[6–8] Multimedia packages offer particular benefits in psychiatry where moving images with sound can be used to demonstrate relevant mental state signs and symptoms – a still photograph of a client with depression is of little use to students. Computer-based packages allow students to interact with the computer as part of the learning experience (for example by allowing them to make their own decisions about the presence or absence of individual mental state symptoms). This puts control into the hands of the user and allows them to work as an active participant rather than a passive receiver of information. In spite of these attractions, few packages have been produced within psychiatry, and those that have been produced have rarely been evaluated.

In this age of evidence-based practice, evaluation of teaching and learning and the development of an evidence base to support the many innovative techniques being introduced into undergraduate and postgraduate training is a high priority.[9–11] However, many published reports of educational methods are retrospective and descriptive; the use of randomized, controlled trials is still relatively rare.[9] Where evaluation of teaching interventions does occur it is often knowledge-based and does not address the effectiveness of interventions in enhancing skills acquisition.

Method

The current study had two principal aims: to investigate the effectiveness of an interactive computer-based teaching module, when compared with a standard lecture, in altering students' knowledge and skills about anxiety and panic, and to assess students' attitudes about the helpfulness and ease of use of a computer-based teaching package.

Two null hypotheses were formulated and tested: (1) there will be no difference between measures of knowledge in the two teaching groups, and (2) there will be no difference in the ability to carry out a mental state examination on an unrelated video case between the two teaching groups (lecture or computer).

Students at the University of Leeds School of Medicine undertake an 8-week psychiatry attachment during the fourth year of their undergraduate course. Six groups of students rotate through this course each year. They commence their teaching with an initial 8-day 'core teaching' package that is based around small-group, interactive, workshop style and mini-lecture-based teachings, and then spend 6 weeks on clinical attachments. The teaching and learning described in this report took place on day 2 of the core teaching block, prior to any other formal teaching on anxiety and panic.

Study population

All medical students undertaking their psychiatry attachment for the first time in the academic year 1998–99 were included in the study. The only students excluded from the study were students who had been required to retake the attachment because of failure at the end-of-attachment assessment and who had therefore been previously exposed to teaching about anxiety.

The educational intervention

The objectives of the teaching sessions (whether lecture- or computer-based) were identical. They were that at the end of the session, students would be able to:

- identify and recognize common presentations of anxiety;
- describe how to assess symptoms of anxiety and outline how these symptoms affect the person's thinking, behaviour and bodily responses, and
- list the range of physical and psychiatric disorders which can present with symptoms of anxiety.

The teacher delivering the lecture was given the learning objectives described above, a set of structured lecture notes based on those objectives and a videotape

of a patient presenting with anxiety, panic and agoraphobia to use in the session as an illustration. The videotape covered a detailed history of the presenting complaint and a mental state examination. Excerpts from the same video were used in the computer-based package. The lecturer was required to show the videotape and to teach about the examination of mental state in a structured way which reflected the mental state examination on the tape. Components of mental state examination included were: (a) appearance and behaviour; (b) speech and formal thought disorder; (c) assessment of mood; (d) assessment of other mental state phenomena such as delusions, hallucinations, obsessions, health anxiety, suicidal ideas, hopelessness, and how the person sees themselves, others and the world, and (e) a test of orientation using the Hodkinson Abbreviated Mental Test score.[12] All lecturers were at lecturer status or above within the University and all had received formal training in effective clinical teaching.

Students receiving the computer package were taken to a room with a bank of computers. A teaching fellow (SA) briefly explained the process of logging on to and using the computers and the package, and then left the room. Students worked in groups of three or four around one computer workstation. Staff provided no additional information on the subject of anxiety, but were available to deal with technical queries relating to computer use.

The computer-based intervention uses case-based material to assist student learning. Video clips within the package show the referrer assessing the presenting problem (see Fig. 1) and the patient describing their own symptoms, and provide key background information. Students are prompted to seek further information by carrying out physical, social and psychological investigations, and further video clips allow the learner to carry out a structured mental state examination before making a differential diagnosis (see Fig. 2). Users of the programme can go at their own pace (although in this study, time was limited to match that available for students receiving the lecture) and navigate their own way through the package. Learners get regular feedback on the decisions they are making and are able to test their knowledge and skills in recognizing mental state phenomena.

Both teaching sessions lasted 55 minutes and occurred at the same time.

Immediately before the teaching on anxiety commenced, students' baseline knowledge of anxiety was assessed using 10 5-stem multiple-choice questions (MCQs). In addition, 7-point Likert-style rating scales, produced for the study, were used to assess the students' opinions and attitudes about their own perceived ability to assess, diagnose and manage anxiety (1 = very poor, 7 = excellent).

These measures were repeated immediately after the teaching and in addition, those who had used the computers completed further Likert-style rating scales produced for this study. These assessed how useful the multimedia material was felt to be (1 = very poor, 7 = excellent).

Finally, practical skills in mental state examination were objectively assessed by providing each student with a blank sheet of paper and asking them to carry out

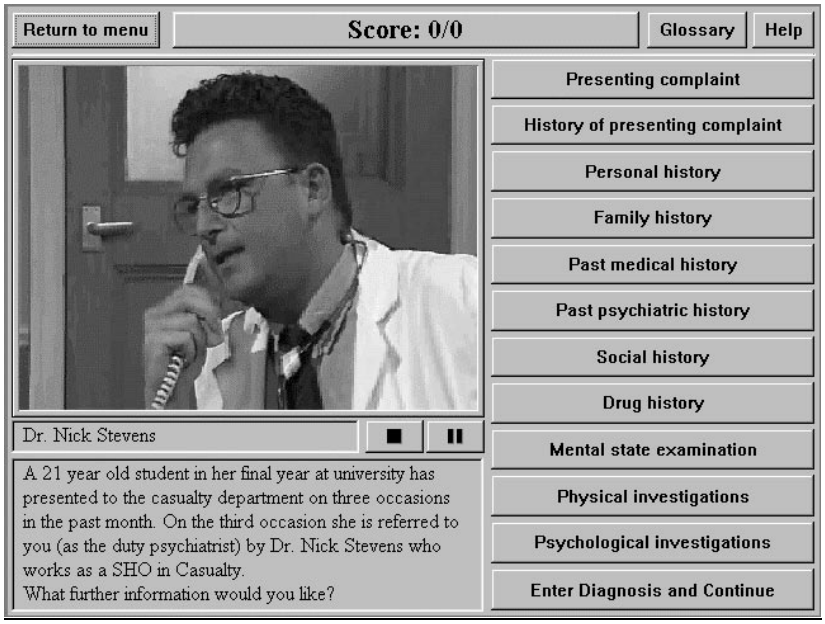

Figure 1 Screen print, showing a referrer describing the presenting problem and a menu of options for seeking further information

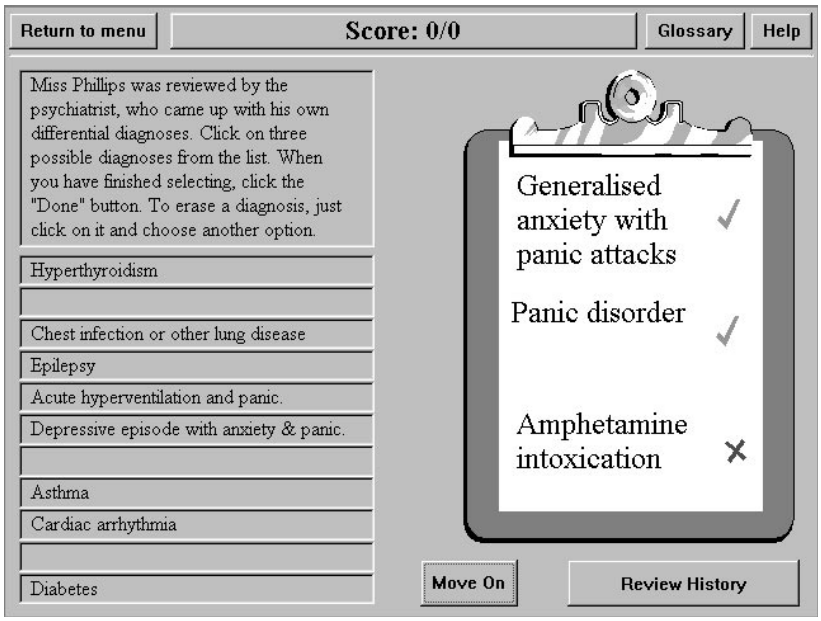

Figure 2 Screen print, showing the computer's response to a student's differential diagnosis

and structure their own mental state examination. Clinical material for this assessment was provided in the form of a videotape of a mental state examination carried out on a different patient with similar symptoms of anxiety and panic, using the same interview structure as that used in the previous teachings.

Multiple-choice questions were negatively marked and were summed to provide a total mark out of a maximum of 50. The mental state examination scores were rated (by CJW), blind to teaching condition, using a pre-agreed mark schedule based on an assessment of the structure applied to the mental state and the rating of individual symptoms as present or absent. This provided a total score of 0–20.

Assignment

At the start of the attachment, the students in each group were randomly allocated to either lecture- or computer-based teaching. Students were individually assigned an identifying number and these were randomly allocated to either the computer- or lecture-based arm.

Masking

This study employed a randomized, single-blind, controlled design. Obviously, students and teachers were aware of which arm of the study they were involved with, but the assessment of students' ability to carry out the mental state examination on videotaped material was done by a researcher (CJW) who was blind to student allocation.

Ethical approval

The study received ethical approval through the procedures set up by the School of Medicine for monitoring research on students. This included obtaining approval from the School's Undergraduate Medical Education Committee. Participants gave informed consent.

Results

Participant flow and follow up

The total number of students entering the year was 197, of whom 31 (15·7%) failed to attend the specific session on anxiety teaching. Those not attending the teaching session were excluded from the trial, leaving a total sample of 166 students (Fig. 3). Of these, 86 were allocated to the lecture and 80 to the computer-based teaching.

Analysis

Analysis was done of those students who attended the teaching, not on an intention-to-teach basis.

Knowledge

There were no significant differences in knowledge between the students in the two teaching conditions at baseline, as rated by mean scores on the MCQ (maximum score 50; mean for the lecture group 26·7, for the computer group 26·3; unpaired t test $P = 0{\cdot}744$). Scores on knowledge increased significantly for both

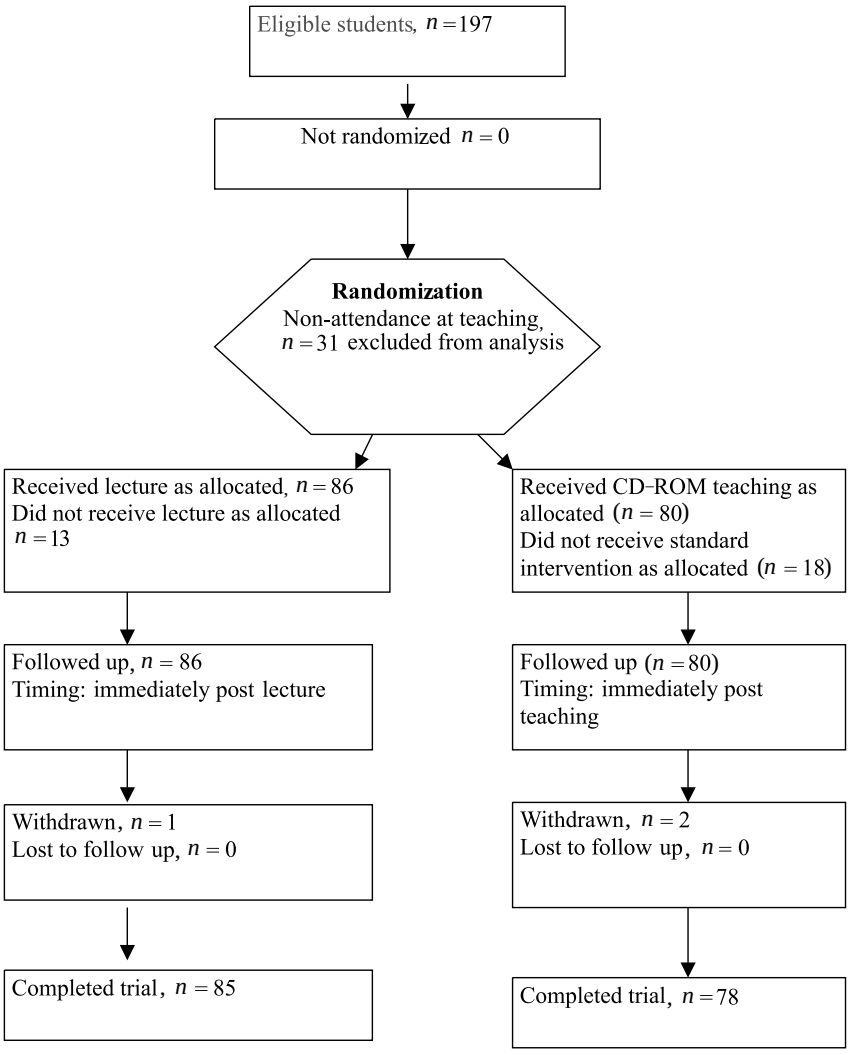

Figure 3 Participant flow and follow up

groups after teaching (lecture group, increasing from a mean of 26·7 to 34·4, 95% CI −9·1, −6·3; $P < 0{\cdot}000$; computer group, increasing from a mean of 26·3 to 33·1, 95% CI −9·17, −4·428; $P < 0{\cdot}000$). Post teaching, there was again no difference between the computer and lecture groups (mean for the lecture group 34·4, for the computer group 33·1; unpaired t test $P = 0{\cdot}45$).

Perception of knowledge and ability

After the teaching the students who had attended the lecture rated their subjective knowledge and skills in relation to the learning objectives at a higher mean level than did those students who had used the computers. In six out of the eight areas, the subjective ratings of those who had attended the lecture were significantly higher than those of students who had used the computers (Table 1).

Mental state examination skills

The mental state examination score was only available for the post-teaching assessment ($n = 163$, as three students had to leave early for job interviews). The mean score for the entire sample was 11·7 (range 4–19). The unpaired t test score was $P = 0{\cdot}003$, d.f. 161, 95% CI −2·514 to −0·533; computer mean 12·5, lecture mean 11·0.

Attitudes towards computer-based teaching

On a Likert scale (1 = very easy, 7 = very difficult) the median score was 2 for ease of use of the multimedia package. The usefulness of the video assessment material received a median score of 5 ($n = 79$, one missing), as did the quality of the written text (1 = very poor, 7 = excellent).

Table 1 Subjective ratings by students, $n = 166$

Subjectively rated area	Baseline comparison, *P* value	After teaching, *P* value	Mean score Lecture	Mean score Computer
Overall knowledge about anxiety and panic	NS	NS*	4·72	4·32
Knowledge about the causes of anxiety and panic	NS	0·000	4·65	3·75
Ability to recognise presentations of anxiety	NS	0·02	4·95	4·59
Ability to identify mental state symptoms of anxiety	NS	NS	4·58	4·36
Ability to describe how to assess symptoms of anxiety	NS	0·009	4·44	4·01
Ability to describe how anxiety affects thinking, behaviour and bodily responses	NS	0·000	5·19	4·61
List differential diagnosis of anxiety	NS	0·000	4·72	3·59
Describe management of anxiety	NS	0·000	4·66	3·27

* Likert scales: 1 = very poor, 7 = excellent. Comparison of means of Likert scores (Mann–Whitney *U* test).

Of students who had used the package, 80% recommended its use for other medical students ($n = 76$, data missing for four students) and 97% stated that they would recommend its use in libraries ($n = 78$, data missing for two students).

Discussion

Students who used the computer-based package rated themselves as having learnt significantly less on six out of eight subjective ratings of knowledge and skills related to the assessment and management of anxiety, when compared to those students who attended the lecture. However, objective criteria of gains in knowledge showed equivalence in both teaching conditions, as rated by 10 5-stem negatively marked MCQ questions. In marked contrast to the students' subjective assessment, those using the multimedia package showed statistically significantly greater skills in carrying out a mental state examination on an independent clinical video-based case. Scores on the knowledge-based assessment were in the 66–69% range for all students. This is equivalent to a good pass in end-of-placement assessments and all students would have passed with ease. Scores on the skills assessment were 55% and 65% of maximum for the lecture group and computer group, respectively. Again both groups would have passed but with the lecture group performing significantly less well.

The main strength of this study lies in its use of an experimental design to evaluate an educational intervention. In addition, the study involved relatively large numbers of participants, robust measures of outcome and an almost complete dataset for the key outcome measures. Comparisons of means were calculated using the unpaired *t* test for normally distributed data. Consultation with a statistician suggested that this would be the most appropriate test although consideration was given to a two-factor ANOVA with time and treatment as independent variables, and to an unpaired comparison of gain scores. In view of the lack of difference between the two groups at baseline, it was decided to use the *t*-test analysis. The approach to evaluation was student-oriented,[7] with the measures used reflecting the learning objectives of the teaching, and an attempt was made to measure acquisition of skills as well as knowledge.

Although no skills-based assessment of student ability to carry out a mental state examination was made at baseline, the randomization process makes it unlikely that any significant differences in ability were present at baseline between the two groups. The lack of difference between the two groups on baseline MCQ results supports this. Although the difference in mental state examination skills between the two groups was statistically significant, it might be argued that a difference of just 1·5 points is not clinically or educationally significant. In our view, the ability of one group to recognize, on average, one to two more relevant clinical signs is likely to represent a clinically significant difference.

A further problem is the lack of any monitoring of the lecture-based teaching to ensure that the lecturers did indeed adhere to the teaching plan and objectives outlined for them. Lack of resources prevented this check on intervention integrity. Another weakness is the lack of follow-up measures to assess whether any gains have been maintained over time.

The computer-based package outperformed the lecture-based teaching on the ability to learn mental state examination skills, even though both had the same learning objectives and used the same case materials. One possible explanation is that the computer-based session is very structured. Highly structured teaching sessions have been shown to enhance acquisition of

certain types of clinical skills in other experimental teaching evaluations.[13] In this study, those using the computer-based package were forced to respond to and interact with the clinical material. This is quite different from the more passive role within the lecture. The computer package also allows students to go back and repeat key sections of the session, although it should be noted that in this trial both teaching interventions were structured to take the same time. Although ideally each student would have had access to their own computer for the computer-based teaching, in practice, lack of computers meant that students worked in groups of three to four. This leads to the possibility that the gains made by the computer group were achieved in part, or wholly, as a result of the peer interaction between students, something not present in the lecture group. Whilst querying the underlying mechanisms for change, this does not invalidate the finding that, for whatever reason, the computer-based teaching outperformed lecture-based teaching in terms of skills acquisition. Further work is needed in this area but it does raise the interesting possibility that working in small groups with a computer-based teaching package may be an important component of the package's effectiveness. Students receiving the computer package may have given a lower rating to their own ability to assess anxiety because of their relative unfamiliarity with computer-based teaching, leading to the false assumption that it could not be as good a teaching method as the traditional lecture. This finding is similar to those with problem-based learning where students also do not feel as confident in their knowledge as do those who complete a more traditional curriculum. The computer-based intervention supports a more problem-orientated approach to learning.

Conclusion

Although students rated the computer package as being easy to use and recommended its use in libraries and as a teaching resource, in general their perception is that attendance at a lecture leads to a greater increase in knowledge and skills than using a computer package. This raises a very important point by highlighting the difference between subjective and objective ratings. This is particularly relevant at a time when student feedback is increasingly used in judging quality of teaching. It suggests that sometimes students do not know what is good for them. This may erroneously lead to the cessation of innovative teaching approaches that might otherwise have led to gains in knowledge and skills. Further work is needed both to replicate the finding that computer-based packages may enhance skills acquisition, and to explore the underlying mechanisms for this change.

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Contributors

All authors contributed to the educational design and content of the CD-ROM, and to the writing of the paper. In addition, CW was involved in the overall study design, design of the questionnaires, statistical analysis and blind marking of the mental state examinations. SA attended the teachings to supervise students, and collected and entered all data. PH was involved in programming of the CD-ROMs. DC contributed to the educational design of the study.

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