RESEARCH ARTICLES

Evaluation of a Multimedia Case-History Simulation Program for Pharmacy Students

Anun Chaikoolvatana, PhD[1] and Larry Goodyer, PhD[1]

[1]From the Department of Pharmacy, King's College London

Objective. The purpose of this study was to validate the effectiveness of a Multimedia Case History Program (MCHP) designed for pharmacy students to simulate a case-history taking session.

Methods. Seventy-nine undergraduate pharmacy students used an MCHP that presented an asthmatic or diabetic patient. Of these, 52 students also volunteered to interview a researcher in a face-to-face simulation of a patient case featured in the MCHP, but not the same case they previously had been allocated. Students completed patient profiles and pharmaceutical care plans for evaluation.

Results. In nearly all aspects, students produced significantly more complete patient profiles using the MCHP than they did from the face-to-face simulation. However, the pharmaceutical care plans produced were of a similar quality whether based on the MCHP or on a face-to-face interview.

Conclusion. The MCHP is a potentially useful system in supplementing a clinical pharmacy course that could provide a means of case history taking without the need for interviewing patients in a hospital. Further work is needed to identify the factors that might influence performance using a program of this type and also to compare the MCHP directly to real patient interviews.

Keywords: multimedia, simulation, case history

INTRODUCTION

Recent developments in technology have made it possible to incorporate digitized video into Computer Aided Learning (CAL) programs. One of the most attractive applications of this technology in the field of medical education is the use of videotaped patient interviews to simulate pharmacist-patient interactions. Computer simulation programs using digital video are more flexible than video simulations using analog video and enable a high degree of interactivity. Digitized video has already been employed in CAL programs in medicine[1,2] and nursing,[3,4] but very few[5] have used digital video to simulate a patient interview to obtain a case history.

A particular problem encountered in the pharmacy undergraduate curriculum of schools in the United Kingdom (UK) is the limited amount of time available for patient contact. In the majority of pharmacy programs in the UK there is no formal hospital placement system whereby students can interact with patients and gain an understanding of case histories, and little opportunity to interact with patients in the community setting. Instead, most courses allow students short periods of time when they can visit hospital wards, sometimes accompanied by a tutor, in order to interview patients and discuss their cases. With this arrangement it is not always possible for students to encounter the wide range of clinical conditions covered by the curriculum, and inevitably some students will miss out on this important experience. A CAL program may be useful for pharmacy programs in which this is a problem, and more generally in helping to prepare students in the earlier stages of the clinical pharmacy program, prior to contact with patients.

We have constructed a multimedia CAL program that offers a simulation of a patient interview to facilitate the forming of a pharmaceutical care plan. This study aims to evaluate the program by comparing the patient profile and pharmaceutical care plan obtained from the CAL program to that obtained through a simulated face-to-face interview.

Corresponding Author: Larry Goodyer, PhD. Department of Pharmacy, Kings College London, Franklin Wilkins Building, 150 Stamford Street London SE1 9NN UK. Tel: +44(0)207 858 4831. Fax: +44(0)207 858 4800. E-mail: larry.goodyer@kcl.ac.uk

METHODS

Design of Program

The CAL program used in this research, which we will refer to henceforth as the multimedia case history program (MCHP), was written using *Authorware* (Version 4. San Francisco: Macromedia, Inc.; 1997). This is a software authoring program that allows a number of icons to be incorporated into a logical flow chart to form interactive programs ideally suited to CAL. A particular advantage of *Authorware* for this project was that it allowed users to create, store, edit, and retrieve items of multimedia information (eg, audio and video) within an interactive environment.
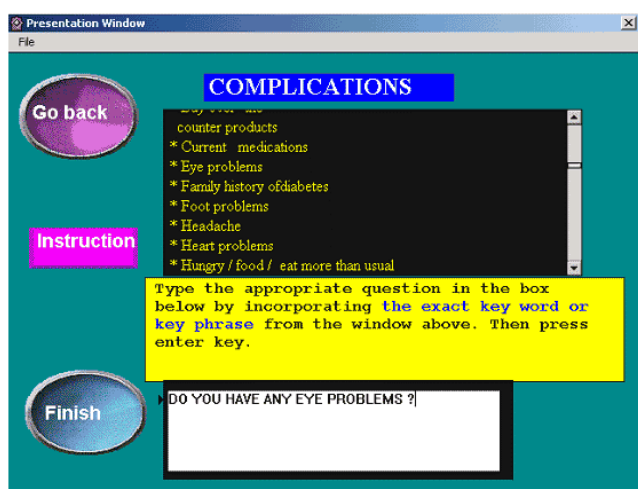

Figure 1. Question screen from MPS Program.

In order to obtain suitable video material for inclusion in the MCHP, 2 patients were interviewed in the outpatient clinics of the Chelsea and Westminster Hospital, London; one being treated for diabetes, the other for asthma. Both patients were asked for their signed informed consent and the project was approved by the ethics committees of King's College London and Chelsea and Westminster Hospital. They were interviewed using a standard set of questions and their replies were videotaped using a digital camera. The video was then compressed to Moving Pictures Expert Group (MPEG) format and edited. Each patient response was excerpted and saved as a separate video. The CAL program was then designed so that, when a student typed a patient history question containing a relevant keyword, the appropriate videotaped patient response would play. The keywords and program contents were peer reviewed by clinical lecturers and practicing pharmacists knowledgeable in the areas covered in the case history and relevant to under-

graduate pharmacy curriculum. Figure 1 shows a screen shot of the question page, with a list of some of the keywords for the diabetes case. The program itself was separated into the following sections for the diabetes case and into similar sections for the asthma case:

- Past medical history (other than diabetes)
- Current medication
- Medication history
- Family and social history
- Symptoms subdivided into hypoglycemic, hyperglycemic, and complications
- Monitoring

Within each section the students had to enter a question containing appropriate keywords or key phrases that were relevant to that area. For instance, in the section related to hypoglycemic symptoms there were 4 key words, 1 of which was "dizzy." If a question with this keyword was typed (eg, "Do you ever feel dizzy or lightheaded?"), the computer recognized the keyword and played the video in which the patient talked about hypoglycemia and when it occurred. If the student entered a question that did not contain at least 1 of the 4 keywords relevant to that section, then no video played and the student was given a message that the question was not relevant to hypoglycemic symptoms. After a defined number of tries at entering a question containing 1 of the keywords for that section, a clue would be given. A screen shot of the video playback is shown in Figure 2.
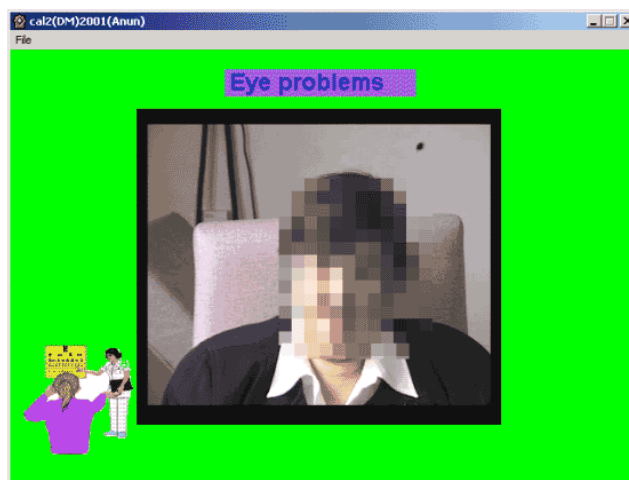

Figure 2. Video response screen from a multimedia case history program developed for pharmacy students

The first 2 sections of the CAL program were not presented as videos, but as written information on screen. Students were required to work through the entire section, typing questions that had to contain a relevant keyword chosen from a list of all the keywords available for the case. The questions were recorded on the computer's hard disk for analysis.

Evaluation

All final year pharmacy students at King's College London were required to use the MCHP program as part of the clinical pharmacy curriculum. This is a 4-year program leading to a Master of Pharmacy (MPharm) degree. Student training in clinical pharmacy and pharmaceutical care involving patient contact only takes place in the final year of this program. General principles of pathology, therapeutics, and pharmaceutical care are covered in earlier years. All of the students participating in the study had completed the necessary instruction in the subject area and in constructing pharmaceutical care plans.

The students were assigned alphabetically to one of 8 groups of 10 to 12 students for this course. Four groups used the diabetes program in the first semester, and the other 4 used the asthma program in the second semester. All students used the MCHP and completed the exercises individually. The teaching and classroom discussions on either asthma or diabetes had been completed before the students took part in the evaluations.

They were allowed up to 2 hours to complete the program and required to record the patient profile obtained on a standard proforma (Figure 3), none of the students spent less than 30 minutes using the program. The proforma consisted of sections similar to those in the MCHP, eg, past medical history, current medication, etc. The students then had 3 weeks to consider and form a relevant pharmaceutical care plan for the patient. A pharmaceutical care plan focuses on the medication management of the patient and should include: an evaluation of the patient's understanding of their medicines, suggestions to prescribers for reviewing or changing medication and monitoring of the patient. The patient profile was graded by a researcher using a rigid point system, with credit given for each aspect of the patient's history that was correctly identified. To check for bias, the grades were audited independently by a second researcher who was unaware of group allocation, and little difference in scores was found. The pharmaceutical care plans

Hyperglycemic symptoms (4 points)
Polydipsia: always drank a lot before diabetes diagnosed
Polyuria: never experienced this
Increased appetite/hunger: never experienced this
Tiredness: never experienced this

Hypoglycemia (6 points)
Dizziness: When meals missed, never lost consciousness
Palpitations: never experienced this
Shaking: Yes
Headache: Yes
Sweating: Yes (slight)
Blurred vision: Never experienced this

Complications (5 points)
Cardiovascular: hypertension, hyper cholesterolemia, IHD – resolved by angioplasty
Eye problems: retinopathy
Neuropathy: feet and arms
Foot problems/wound healing: currently relating to an insect bite

UTI: Only once

Figure 3. Excerpt of Proforma used to form Patient Profiles. Italics indicate the marking system used in assessing the profile.

Were evaluated by the clinical group tutors based on a model answer.

As explained above, it was possible to access the video segment for a particular section simply by typing a single relevant keyword. Thus, even forming nonsense questions would have produced a video. To assure that students had properly phrased their questions, the questions, which had been stored on the computers' hard disks, were retrieved and analyzed.

After using the MCHP the students were asked to complete a questionnaire regarding their impressions about the program in terms of usefulness and usability. The questionnaire was comprised of 17 statements requiring a response on a Likert-type scale

Students were also asked to volunteer to undertake a simulated face-to-face interview with a researcher in the second semester only, so all students had completed the MCHP before undertaking this exercise. If they chose to participate, they were remunerated both for the time spent completing the interview and for writing a patient profile/pharmaceutical care plan. Those who had used the diabetes MCHP undertook the simulated face-to-face interview of an asthmatic patient, and those who had used the asthma MCHP interviewed a diabetic patient. Students were provided with the same proforma used in the MCHP evaluation. The researchers took the

Table 1. Comparison of Scores Achieved on Patient Profiles and Care Plans Written by Pharmacy Students Using a Diabetes Multimedia Case History Program and Pharmacy Students Conducting a Simulated Face-to-face Interview

Topics (Maximum Score)	Diabetes (MCHP) N=39 Mean % (SD)	Diabetes Interview N=28 Mean % (SD)	P
Patient profile			
Patient symptoms (15)	92.0 (11.5)	34.8 (11.5)	< 0.005
Medication history (7)	61.7 (12.0)	54.1 (17.9)	NS
Social/family history (5)	99.5 (3.2)	82.1 (12.6)	< 0.005
Care plans (20)	68.20 (21.9)	57.8 (13.1)	< 0.05

part of the same patients featured in the MCHP program and gave the exact same replies. If an unexpected question was asked, the researcher informed the student that the simulation in the MCHP did not provide a response for that particular question. No time limit was set, but most students completed the session in less than 30 minutes.

Statistical analysis of the data was performed using Minitab, Version 7. The Mann-Whitney test was used to determine the significance of differences between group data.

RESULTS

A total of 39 students completed the diabetes MCHP program and 40 completed the asthma program. Twenty-eight students volunteered to take part in the face-to-face interview simulation for diabetes and 24 for asthma.

Table 1 describes the scores achieved for the MCHP and interview simulation for the diabetes case history. Students noted the replies received to their questions and used them to form a patient profile, each correct reply noted corresponding to a relevant question having been asked. One mark was then awarded for each point correctly identified. The maximum scores represent the total number of possible correct questions that could be identified for a particular section.

The 3 areas carrying the highest number of marks are shown in Table 1. The MCHP group performed significantly better in the sections on patient symptoms and social/family history. In the section concerning diet, only 10% of the students in the interview group correctly identified the 2 relevant questions, compared with 90% in the MCHP group, with a similar result obtained for the 2 questions relating to monitoring of diabetes. There was no difference in the scores achieved for questions regarding medication history. The MCHP group produced slightly but significantly better pharmaceutical care plans. Students did not need to type a question to receive the patient's previous medical history, which was instead provided on-screen at the beginning of the MCHP

Similar results were obtained for the asthma program (Table 2). In this case, significantly higher scores were obtained for the medication history section of the program. As in the diabetes program, there were other areas in which students achieved far higher grades using the MCHP. In the section in which potential triggers of asthma were discussed, 95% of students in the MCHP group asked 3 or more relevant questions compared with only 38% in the group that conducted face-to-face interviews. Similarly, in the section regarding monitoring of asthma, 95% of the MCHP group asked both of the relevant questions compared with just 17% in the interview group.

The results of the students' opinions of the diabetes program are presented in Table 3. The typical 5-point Likert scale has been collapsed to indicate agreement with, disagreement with, or no opinion of the statement. Overall, the opinions were positive in terms of ease of use of the program and usefulness in the curriculum. The 2 main negative points identified by students were that the program took too long to complete and the keyword system was somewhat cumbersome. Opinions of the asthma program were very similar except that more students (58%) believed the program took too long to complete.

Table 2. Comparison of Scores Achieved on Patient Profiles and Care Plans Written by Pharmacy Students Using an Asthma Multimedia Case History Program and Pharmacy Students Conducting a Simulated Face-to-face Interview

Topics (Maximum Score)	Asthma (MCHP) N=40 Mean % (SD)	Asthma Interview N=24 Mean % (SD)	*P*
Patient Profile			
Patient symptoms (10)	84.0 (19.9)	38.8 (10.8)	<0.05
Medication history (8)	90.2 (16.9)	68.8 (25.2)	<0.005
Social/family history (5)	88.5 (18.9)	65.5 (12.6)	<0.05
Care plans (20)	60.20 (20.4)	57.5 (10.7)	NS

Internal computer monitoring of the students' phrasing of questions revealed that in 90% of cases a grammatically correct sentence had been constructed.

DISCUSSION

The validation of CAL programs as learning tools can be problematic and few studies undertaken of CAL programs for medicine and nursing have been free of methodological shortcomings.[6,7] Most have focused on comparing scores achieved in tests after using the CAL program. Many studies have demonstrated that the same or better scores can be achieved when CAL is compared to traditional methods of teaching and learning.[8-13] A few studies have shown a worse outcome from using CAL packages.[14,15]

This study was subject to a number of constraints that limited the design and implementation of the evaluation. This was largely the result of attempting to conduct the study within a fixed curriculum timetable. These problems are discussed below.

The evaluation was conducted using a single cohort of fourth year pharmacy students, and had to be completed without increasing the students' workload or the number of course assessments, as specified by course regulations. It was decided that the MCHP exercise could be incorporated into the curriculum only if it replaced another case study exercise previously undertaken and was offered to all students. The advantage of this approach was that all of the students would use the program and thus maximize the amount of data available for evaluation. This was on the understanding that a positive outcome would result in future permanent adoption as part of the curriculum, as was subsequently the case. However, it was felt inappropriate to also ask the students to complete the

simulation as part of the course work, as this was being conducted purely as a research exercise. This resulted in the need to recompense students for their time in taking part in the interviews. A potential source of bias is that the students may have put in more effort to the MCHP as it contributed to their final grade, compared to the face-to-face interview which did not contribute and payment was given to participate no matter how diligently the interview was performed. This may explain some of the differences observed, but the pharmaceutical care plans, which actually required more thought and work by the students than the profiles, were performed to a similar standard.

A further constraint on study design was that students were required to have received all related course material and teaching concerning asthma and diabetes, by the time they attempted either the MCHP or face-to face simulation. All of the students had received training in pharmaceutical care principles in previous years. In addition some training in the process of taking case histories had been given early in the first semester, with the opportunity to practice the skill on real patients under the supervision of a tutor. By the time students completed the face-to-face interviews or MCHP, they had considerable exposure to pharmaceutical care planning, so these exercises would probably have had minimal effect on their training in this respect. Students complete their clinical pharmacy course either in the first or second semester. The program allows for diabetes teaching to be completed for all students within the first week of the semester and other subjects such as asthma only towards the end of the semester. For these and other organizational reasons it was not possible for student groups in the first semester to use the asthma MCHP, so a proper randomization to either of the 2 programs was not achieved.

Table 3. Pharmacy Student Responses on a Questionnaire to Assess a Multimedia Case History Program (N= 30)

Questionnaire statements	Strongly disagree / disagree n (%)	No opinion n (%)	Strongly agree / agree n (%)
Program instructions are easy to follow	2(7)	1(3)	27(90)
I enjoy using the program	1(3)	4(14)	25(83)
I need to learn more about computers before I can use the program	26(87)	4(13)	-
The program helps me understand how to take a patient history	3(10)	6(20)	21(70)
The program is difficult to understand as a whole	28(93)	2(7)	-
I would use the program frequently	4(14)	7(23)	19(63)
The program is too slow to respond	20(67)	8(26)	2(7)
The program should not be used to complement the clinical pharmacy course	25(83)	2(7)	3(10)
It is difficult to find the appropriate question to enter	19(60)	6(20)	6(20)
It is easy to move from one topic to another	-	3(27)	27(73)
It takes too long to complete the whole program	18(60)	7(23)	5(17)
Overall, the program is useful	-	1(3)	29(97)
Graphic designs and colours are appropriate	-	5(17)	25(83)
I would like to see modules on other clinical topics	1(3)	3(10)	26(87)
The MCHP was poorly organized	25(83)	5(17)	-
The MCHP did not facilitate my learning	28(94)	1(3)	1(3)
The challenge of the MCHP doesn't appeal to me.	22(74)	7(23)	1(3)

The MCHP is intended as a supplement to a clinical pharmacy course, to help overcome some of the problems associated with a lack of time and resources for adequate patient contact within the curriculum. It was also intended to help students gain some additional experience in case history taking. In this context, to simply test and score the students' knowledge of the subject areas would have been inappropriate, as the facts concerning the therapeutics and pathology of the cases would have been addressed in lectures and tutorials. Neither would it have been appropriate, as some studies have done, to assess end-of-year examinations, as this would have been a reflection of learning from the entire course. Others who have attempted to validate CAL programs based on case histories have recognized this.[5]

There are 2 key requirements of case history taking in the context of undergraduate clinical pharmacy courses: can the student identify the appropriate questions to form a patient profile, and can the answers to

questions be used to form a pharmaceutical care plan? It was these particular aspects that were validated in this study.

The students were required to interview either the virtual patient in the MCHP or a researcher in a simulated interview to gather the necessary background detail. Whether the appropriate questions were asked was ascertained from the number of correct points identified on a patient profile report form. The students were aware that the researcher conducting the face-to-face interview was a not a patient and would be likely to perform differently when interviewing a real patient in a hospital or clinic setting. A possible solution would be to employ a professional actor and to conduct the simulation in a setting where the students believed they were interviewing a patient, but this was beyond the scope and resources of the project.

Scores for the patient profiles are quite consistently higher for the MCHP compared to face-to-face interview. This is to be expected as the MCHP allowed repeated tries and provided some clues for constructing questions that contained the relevant keywords. Furthermore, the students were told how many points needed to be identified. The keyword system itself provided some help. Although the students conducting the interviews had the same proforma as the MCHP groups, this only outlined the general areas that should be covered in the interview. A further factor is the longer time spent on the MCHP compared to that spent on the face-to-face simulations. The times spent by students using the MCHP or conducting the interviews were not recorded, as no time limit was set. The timings reported in the results are based only on a casual observation by the researcher. He reported that no student left the computer terminals within 30 minutes of starting the MCHP, whereas very few students took more than 30 minutes for the face-to-face interviews. Exact times would need to have been taken to test the influence of this variable. However, a general advantage of the MCHP system is that it imposes no time limitation, whereas it is unlikely a patient would usually tolerate much more than a 20-minute interview with a student.

The differences in the quality of the interviews held true for both of the diseases covered. One could conclude that in a real patient interview, conducted without a tutor being present, important points in a case history might be missed and learning of the subject area less complete. The MCHP would therefore help overcome such problems. From an examination of the internal monitoring of questions, it was apparent that most students attempted to phrase their questions appropriately, as if interviewing a real patient. This further validates the approach as a training method for case history taking.

There is very little difference in scores for the pharmaceutical care plans, whether these are based on data gathered from the MCHP or face-to-face interview. The conclusion might be that although points are missed by interview, sufficient information is gathered for a pharmaceutical care plan. This segment of the exercise is a more true reflection of student ability, and the similarity of scores indicates that the MCHP could be a valid substitute for real patient history taking.

CONCLUSIONS

Due to the methodological constraints imposed by this study, it is not possible to conclude whether the MCHP offers advantages for case history taking by pharmacy students when compared to an interview with a real patient. These data indicate that the student may have the opportunity to gain a more complete case history using the MCHP; thus, the study should be viewed as a pilot to direct further work to test this hypothesis using interviews with real patients. Furthermore, additional work is required to investigate the factors that may have influenced the differences observed, eg, time spent, student motivation, etc.

Interviewing real patients is an important part of a clinical pharmacy undergraduate course. However, due to the constraints within the curriculum, the MCHP could be a valid addition, allowing for history taking of a wider range of patient cases than might otherwise be achieved

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