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Evaluating the Instructional Design of a Web-enhanced Educational Program for the Practice of Pharmaceutical Care

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Objectives: The objectives of this project were (1) to develop the instructional design for a web-enhanced educational program to teach the fundamental principles of pharmaceutical care practice, and (2) to evaluate the strengths and weaknesses of the design effort.

Materials and Methods: For the first objective, an Instructional Systems Design (ISD) approach was chosen to develop the instructional design. An expertise-oriented, heuristic evaluation was conducted as part of the instructional design to achieve the second objective. The heuristics were listed in a questionnaire format and were based on related research identified by a review of the professional literature. A total of 11 evaluators reviewed the software.

Results and Discussion: A practical web-enhanced tool for teaching the practice of pharmaceutical care was developed. Results of the evaluation suggest that the heuristic approach is an effective method for determining the merit of the instructional design of innovative technology-enhanced educational programs in the health sciences.

Keywords: Pharmaceutical care practice; Problem-based learning; Program evaluation; Technology-enhanced learning; Pharmacy education

INTRODUCTION

Technology and Health Professions Education

Although scientific knowledge has increased exponentially for more than a century, it was not until the middle of the twentieth century that advances such as quick printing and audio–video recording markedly influenced the delivery of instructional materials. The latest generation of associated delivery technologies includes interactive multimedia, Internet access to the World Wide Web (WWW), and computer mediated communication. With a computer, telephone line and modem, persons can now access seemingly unlimited amounts of information about any topic at anytime from anywhere.

As the delivery of health care services has increasingly relied on advances in technologies to generate, analyze, and disseminate information, the way health care professionals practice has changed as a result of technology. Accordingly, technology has become an important element of patient care. Most notably, this evolution has influenced the preparation of health care professionals as the delivery and management of information via distance education has incorporated the latest generation of delivery systems, such as computers, educational software, and interactive multimedia. Students benefit from the flexibility of technologies, access to the WWW, opportunities for increased decision making regarding the new knowledge they acquire, and self-selected rates of progress.

Pharmacy's Mandate for the Twenty-first Century

Until the early 1990s, pharmacy lacked a model of professional practice that was consistent with other health care professions. It became clear that the profession needed to dedicate itself to develop a practice philosophy that addressed patient needs. A White Paper by the American College of Clinical Pharmacy stated, "Inculcation of this new philosophy will require a rational, practical, and inclusive approach that engages all segments of the profession" (ACCP, 2000). Pharmaceutical care

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practice has since exemplified this approach: the primary responsibility in the practice of pharmaceutical care is for practitioners to help patients optimally manage their medications. Pharmaceutical care is the first rational, systematic, and comprehensive decision making process applied to a patient's drug therapy. According to Cipolle, Strand and Morley, pharmaceutical care practice refers to "how a practitioner with expert pharmaco-therapeutic knowledge works directly with patients to get the results they want and need from all of their medications, on a continual basis" (Cipolle *et al.*, 1998).

Professional associations have since mandated the implementation of measures to address shortcomings related to professional educational outcomes (AACP, 1993a,b,c; 2000; Nimmo and Holland, 1999a,b; Holland and Nimmo, 1999; Greiner and Knebel, 2003).

Pulling it Together

Few institutions, however, have used the enhanced interactive capabilities of the WWW to increase their offerings of pharmaceutical care courses. To date, a fully integrated, web-enhanced, teaching program for the practice pharmaceutical care has not been offered. In addition, it remains unclear whether the associated learning outcomes that have been investigated had been influenced by factors unrelated to a particular instructional approach. Findings may have been related more to the presentation of the instructional materials (e.g. different types of multimedia).

Software products and services that provide the functionality required to manage distance, web-enhanced, or hybrid education programs include WebCT, IntraLearn, FirstClass, and Blackboard. These instructional delivery systems have been designed to support a variety of teaching and training programs. Their appropriateness for use with mostly case-based, clinical coursework, how-ever, has only been assumed based on their proven effectiveness in managing other instructional environments.

Any instructional design effort should include an evaluative component to identify omissions or weaknesses in the instructional process as well as to identify successes and strengths. The purpose of such an evaluation is to determine whether the instructional design and learning materials afford students with an opportunity to attain establi-shed goals and objectives. The findings of this evaluation will provide the basis for revising the instructional design.

Based on a review of the professional literature regarding the use and effectiveness of various media, a formative evaluative step of the multimedia

selected was included in the instructional design of this course. Three domains were evaluated:

(1) the interface design, including its ease of use and the navigability of the software,
(2) the instructional design, including the arrange-ment of the content and activities to support an effective learning experience, and
(3) the pharmaceutical content.

MATERIALS AND METHODS

The method used for the instructional design has been described in the literature as instructional systems development (ISD). This method is a practical, step-by-step system for evaluating student needs, developing the program content and deter-mining the effectiveness of the instructional design. ISD describes procedures for designing education and training programs and to improve upon these efforts. ISD typically leads to higher learning achievement and lower per student costs (Hannum and Hansen, 1989). The basic ISD method consists of a five-step process that was followed in the development of the instructional design for this course (Table I).

Design, Development and Implementation

Once the students' learning needs had been assessed, all the results from this analysis came to fruition to create a blueprint for instruction during the second phase of the ISD process. The outcome of this phase was a design document that detailed the instruc-tional strategies, content and creative treatment of the course materials. This document was used as a benchmark for keeping the project on track and aligned to the defined goals and objectives.

The subsequent development phase in the ISD model of instructional design addressed the tools and processes used to create the instructional materials. The purpose of this third phase of the ISD process was to generate and validate the training materials that were perceived during the analysis and design phases.

TABLE I The five steps of the ISD method (Hannum and Hansen, 1989)

1. The *analysis* of the specific information needed in order to develop effective learning interventions.
2. The *design* phase to provide the opportunity to create learning materials.
3. The *development* phase in which the instructional materials and directions are written and produced.
4. The *implementation* phase that provides the opportunity to roll out the instructional program.
5. An *evaluation* that examines the effectiveness of the learning solution based on criteria determined throughout the first four phases.

The implementation phase of the ISD method was where the "rubber hit the road." All tools were implemented during this fourth phase of the ISD, which included making the learning environment adequate for the program content, putting all learning resources and software in place, and making external links (i.e. Internet) live.

The Course

In the following, the key design characteristics of the beta-version of the course are highlighted. Any learning environment should provide opportunities for learning by making content functional for students. Because content is accessed, constructed, evaluated, and used within a more complex project—that of becoming patient care providers— the usefulness of the content acquired must be apparent and students must understand the practical application of the new knowledge they learn.

Two main principles that underlie effective instruction guided the instructional design:

(1) content should connect to problems based in practice, and
(2) students should be given opportunities to generate content for themselves.

The multimedia component needed to provide opportunities for students to engage in planning, developing, and presenting projects. This was accomplished by including technologies to facilitate group interaction and the presentation of written instructional materials and course assignments. In addition, multimedia tools needed to accommodate and promote collaboration between students and the teacher and among students, providing opportunities for learning collaborative skills, such as incorporating group decision making, relying on the work of peers, integrating peer and mentor feedback and offering thoughtful feedback to peers. To enable this collaboration, the program offers a series of synchronous and asynchronous communication tools, e.g. a bulletin board and a variety of chat rooms. Further, real world connections are made using patient cases that relate to student lives or to their local communities.

As can be seen from Fig. 1, the learning materials were organized into seven distinct categories to be included in the navigation bar:

(1) Home and course content pages,
(2) Assignments,
(3) Glossary,
(4) Learning resources,

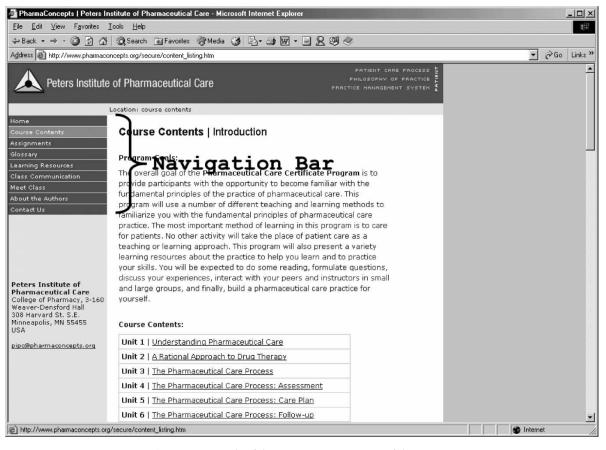FIGURE 1   Example of the course contents screen of the program.

(5) Class communication,
(6) Meet class, and
(7) About the authors and contact us pages.

The course content pages provide the learner with an overview of the general program goals and objectives, familiarize the learner with the functionalities of the web-enhanced learning materials, and represent a "starting point" to access the information of the eight learning units. This information is further advanced by a synopsis of hardware and software requirements as well as instructions on how to get help and download required software. Together with the home page, which functions as a "greeting place", these two pages are designed to establish the conditions for the individual learning experience. Learners can find the information necessary to effectively get started in the course on these pages. The navigation bar is visible and accessible at all times to allow quick access to the information that is available to the learner.

The program was designed with the flexibility of the learning environment in mind. Since learners' paths through the learning materials will vary greatly on an individual basis, it was important that the software and the interface design did not get in the way of learning, i.e. solving the problem on hand. Learners can switch between content areas at any time.

All instructional materials students need to complete the course are readily available. They are presented to students in a variety of formats and are accessible at each stage throughout the course so students can work at their own pace. The instructional materials provide a clear and consistent look and feel with subtle cues to ensure that students can navigate through the materials efficiently (e.g. colors and icons). The interface is simple, and a site map helps orient students easily.

Finally, the glossary, learning resources, and contacts pages were all considered resources to facilitate learning. Because individual learners need access to a variety of information based on their assignments and their small group interaction, it was necessary to ensure that learning resources are appropriate, plentiful and accessible throughout the course.

Evaluation

The final phase of the ISD model is an evaluation of the effectiveness of the instructional design and the focus of this manuscript. A formal predictive evaluation was performed to ensure that learning in the course would be authentic and to make judgments about the quality and potential use of the educational software package.

Most program and classroom evaluations with established educational objectives tend to utilize an objectives-oriented approach (Worthen *et al.*, 2001). Some drawbacks of this approach include the lack of standards for judging the importance of why objectives were or were not met, the failure to address the setting in which the project is occurring, and the fact that outcomes other than those that have been specifically stated are ignored. Expertise-oriented evaluations can address these problems and are conducted by an individual or team of professionals with acknowledged expertise in the subject of the evaluation. The subjective knowledge of the evaluator is important and desirable in this approach (Worthen *et al.*, 2001). Expertise-oriented approaches are also better suited to assess the design and feasibility of programs that are not well known in advance (Scriven, 1991a,b). Therefore, it was concluded that an expertise-oriented evaluation of the course materials needed to take place before the program could be released. The expertise-oriented evaluative method chosen for the evaluation of the instructional design is known as heuristic evaluation. Heuristic evaluation methods were originally described as a means to assess the usability of a software program using the judgment of expert evaluators in the usability domain. Usability refers to qualities such as users' satisfaction, ease of learning, ability to remember site organization and functionalities, effectiveness, efficiency and likelihood of errors while performing the tasks a website has been designed for. This method takes the complexity of the educational tool as well as development constraints into account and comprises four phases: Recruitment, Pre-evaluation training (briefing), Actual evaluation, and Debriefing (Nielsen and Molich, 1990; Nielsen and Mack, 1994a).

Experts in one or more of the three areas of usability, instruction and pharmaceutical care were identified and invited to participate in the evaluation during the recruitment phase. Initial contact with evaluators residing in the US and UK was made through e-mail, campus mail and/or US mail and took the form of a letter, which explained the purpose of the study and invited participation. Pre-evaluation training in the form of individual briefing meetings followed the recruitment. Since some of the evaluators knew too little about the domain to be able to use the system without help, the actual evaluation was preceded by short (60 min) training sessions. These training sessions were conducted in-person or over the telephone. The training was mostly intended to provide a shared terminology for referring to usability problems and to ensure that the evaluators considered a broad spectrum of usability concerns when judging the interface. Once the evaluators were briefed on the method, the actual evaluation took place, which included a severity

rating phase during which the evaluators assessed the severity of the problems that were found (the heuristics) on a five-point Likert scale (1 = poor to 5 = excellent). This process has been shown to provide valid estimates of the severity of the problems that were identified (Nielsen and Mack, 1994b). For the heuristic evaluation sessions, each evaluator conducted his or her evaluation individually and independent of the other evaluators. The evaluators were asked not to discuss the evaluation results until all evaluators had completed their evaluations. This procedure was intended to ensure unbiased evaluations from all evaluators. Each evaluator was given one hour to perform the evaluation and was asked to evaluate the interface in two passes: first, by stepping through a pre-specified usage scenario, and second by performing a more detailed analysis of individual dialogue elements. The usage scenarios represented a way to ensure that the evaluators reviewed the entire program.

Data collected from the heuristic evaluation are both quantitative and qualitative in nature. A heuristic evaluation generates a list of problems that covers practical as well as conceptual aspects of the program reviewed. In this study, data were collected using a questionnaire consisting of 29 items (including one open-ended question), asking questions related to three distinct domains, interface design, instructional design and content. The output from the heuristic evaluation was a list of problems

TABLE II   Nine instructional design heuristics

Clear goals and objectives
   The software makes it clear to the learner what is to be accomplished and what will be gained from its use.
Context meaningful to domain and learner
   The activities in the software are situated in practice and will interest and engage a learner.
Content clearly and multiply represented and multiply navigable
   The message in the software is unambiguous. The software supports learner preferences for different access pathways. The learner is able to find relevant information while engaged in an activity.
Activities scaffolded
   The software provides support for learner activities to allow working within existing competence while encountering meaningful chunks of knowledge.
Elicit learner understandings
   The software requires learners to articulate their conceptual understandings as the basis for feedback.
Formative evaluation
   The software provides learners with constructive feedback on their endeavors.
Performance should be "criteria-referenced"
   The software will produce clear and measurable outcomes that would support competency-based evaluation.
Support for transference and acquiring "self-learning" skills
   The software supports transference of skills beyond the learning environment and will facilitate the learner becoming able to self-improve.
Support for collaborative learning
   The software provides opportunities and support for learning through interaction with others through discussion or other collaborative activities.

TABLE III   Ten usability heuristics used in the evaluation (after Nielsen)

Visibility of system status
The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.
Match between system and the real world
The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.
User control and freedom
Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.
Consistency and standards
Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.
Error prevention
Even better than good error messages is a careful design, which prevents a problem from occurring in the first place.
Recognition rather than recall
Make objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.
Flexibility and efficiency of use
Accelerators—unseen by the novice user—may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.
Aesthetic and minimalist design
Dialogues should not contain information, which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.
Help users recognize, diagnose, and recover from errors
Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.
Help and documentation
Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.

in the three domains with references to those principles that were violated along with numerical severity ratings (Tables II–IV). Each heuristic is directed at a specific aspect of the instructional design. The concepts addressed by each heuristic were presented in form of a succinct statement as well as a short summary of the nature of each heuristic intended to give further direction to the evaluators regarding the heuristics if needed. The ten heuristics in the "interface design" domain were identical with the ones described by Nielsen for usability testing (Nielsen and Mack, 1994a). Heuristics for the two domains "instructional design" and "pharmaceutical care content" were developed by the author and had not previously been tested for their psychometric properties. The development of these two domains was loosely based on a similar questionnaire developed by Albion, titled "Integrating technology into teaching" (Albion, 1999). After the completion of all evaluation

TABLE IV Nine pharmaceutical care heuristics used in the evaluation process

Establishment of context
The assignments, documents and other materials related to the simulated cases create a sense of immersion in a simulated reality.
Relevance to professional practice
The problem scenarios and included tasks are realistic and relevant to the professional practice of pharmaceutical care.
Representation of professional responses to issues
The individual/group assignments represent a realistic representation of practitioner reaction to the issues and challenge users to consider alternative approaches.
Relevance of reference materials
The reference materials included in the package are relevant to the problem scenarios and are at a level appropriate to the users.
Presentation of audio/video resources
The audio/video clips of educational sessions and class activities are relevant and readily accessible to the user.
Assistance is supportive rather than prescriptive
The contextual help (incl. Glossary, Learning resources, Class communication tools etc.) supports the user in locating relevant resources and dealing with the scenarios without restricting the scope of individual responses.
Materials are engaging
The presentation style and content of the software encourages a user to continue working through the scenarios.
Presentation of resources
The software presents useful resources for the development of a professional practice in an interesting and accessible manner.
Overall effectiveness of materials
The materials are likely to be effective in increasing practitioners' confidence and capacity for applying the skills and knowledge gained in their professional activities.

sessions, an informal debriefing session was conducted. The principal content of this session was a discussion of the general characteristics of the interface as well as speculations on potential improvements to address some of the main usability problems that were found.

RESULTS

Evaluator ratings were gathered for 28 questions using a five-point Likert-type scale ranging from (1) poor to (5) excellent. Each item asked questions related to the subscales measuring the three distinct aspects of the instructional design, namely the interface design, the instructional approach, and the relevance of the content to pharmaceutical care practice.

Descriptive Statistics of Evaluator Ratings

The first subscale (interface design) had ten items; the second and third subscales (instructional design, content) had nine items each. Evaluator ratings were tabulated and analyzed using the SPSS statistical software package, Version 11.0. Evaluator ratings for the items ranged from one to five, with the lowest rating (one) assigned only in the instructional design and pharmaceutical care content domains.

TABLE V Interface design: summary of statistical data

Domain: interface design	Average rating	Number of responses	Min.	Max.
Scale: 1 (poor) to 5 (excellent)				
1. Ensures visibility of software status.	4.27	11	3	5
2. Maximizes match between the system and the real world.	4.27	11	3	5
3. Maximizes user control and freedom.	3.82	11	2	5
4. Maximizes consistency and match with standards.	4.56	9	4	5
5. Prevents errors.	4.36	11	4	5
6. Supports recognition rather than recall.	4.36	11	3	5
7. Supports flexibility and efficiency of use.	3.89	9	3	5
8. Uses aesthetic and minimalist design.	4.82	11	4	5
9. Helps users recognize, diagnose and recover from errors.	4.17	6	3	5
10. Provides help and documentation.	3.33	9	2	5

In the interface design domain, three out of 110 possible ratings (less than three percent) were assigned a rating of two (none was one). Ratings of two or lower ($n = 7$) represented six percent in the instructional design domain, and six percent ($n = 6$) in the pharmaceutical care content domain, respectively. Raw data were then summarized by calculating the means per item as well as per domain. These data are presented in Tables V–VIII.

Overall, the means for evaluator ratings ranged from 1.67 to 4.82. The average means for the domains were 4.19 for the interface design, 3.69 for the instructional design domain, and 3.82 for

TABLE VI Instructional design: summary of statistical data

Domain: instructional design	Average rating	Number of responses	Min.	Max.
Scale: 1 (poor) to 5 (excellent)				
11. Clear goals and objectives.	3.91	11	2	5
12. Context meaningful to domain and learner.	4.18	11	4	5
13. Content clearly and multiply represented and multiply navigable.	3.90	10	1	5
14. Activities scaffolded.	3.56	9	1	5
15. Elicit learner understandings.	3.50	10	3	5
16. Formative evaluation.	3.22	9	2	5
17. Performance should be "criteria-referenced".	3.25	8	1	4
18. Support for transference and acquiring "self-learning" skills.	3.38	8	1	4
19. Support for collaborative learning.	4.30	10	3	5

TABLE VII   Practice content: summary of statistical data

Domain: practice content	Average rating	Number of responses	Min.	Max.
Scale = 1 (poor) to 5 (excellent)				
20. Establishment of context.	3.67	9	1	5
21. Relevance to professional practice.	4.56	9	4	5
22. Representation of professional responses to issues.	4.00	9	2	5
23. Relevance of reference materials.	4.29	7	2	5
24. Presentation of audio/video resources.	1.67	3	1	2
25. Assistance is supportive rather than prescriptive.	4.30	10	3	5
26. Materials are engaging.	3.90	10	3	5
27. Presentation of resources.	3.78	9	1	5
28. Overall effectiveness of materials.	4.20	10	3	5

the pharmaceutical care content subscale, respectively. These data suggest, while quite high overall, that evaluators gave the highest ratings for the interface design and the lowest overall rating for the instructional design domain, which was also reflected in the analysis of evaluator comments on individual items.

Cronbach's alpha (α) was calculated to determine the reliability (or consistency) of items included in the scale used during this evaluation. Reliability calculations were performed for the completed dataset and analyses for individual subscales were included to ensure that any higher value for α was not attributable to the fact that reliability calculations involved a larger number of items, which has been known to increase α misleadingly.

While information regarding the scale's psychometric properties for the interface design domain was available from the literature (Nielsen and Mack, 1994a), the two subscales on instructional design and practice content represented an extension of the original scale and were developed by the author. It was therefore important to determine whether the same set of items would elicit the same responses if the same questions are recast and re-administered to multiple respondents. Table IX shows the scale reliability parameters.

The reliability for this scale was 0.87 and would indicate that this scale has a high degree of internal

TABLE VIII   Summary of evaluator ratings

Domain	Number of items	Domain mean	Min.	Max.
Interface design.	10	4.19	3.33	4.82
Instructional design.	9	3.69	3.25	4.30
Practice content.	9	3.82	1.67	4.55

TABLE IX   Summary of reliability coefficients of the scale

Domain	Cronbach's coefficient α	Standardized α
All 28 items.	0.8682	0.8755
Interface design.	0.8077	0.7814
Instructional design.	0.7236	0.7597
Practice content.	0.9186	0.9314

consistency. Moreover, Table IX shows that computing Cronbach's alpha for the three subscales led to acceptable and/or high levels of internal consistency as well with only one coefficient being below 0.8 (instructional design, 0.7236), which suggests that reliability calculations were not distorted due to a larger number of items.

Analysis of Evaluator Comments

The analysis of the evaluator ratings suggested that nearly all aspects of the instructional design received affirmative ratings. Evaluator responses to open-ended questions confirmed these results. Several hundred comments were received and organized into a list of recommendations. As with any prototype, numerous suggestions for improvements were made by the evaluators. Overall, the comments revealed that users were able to complete all tasks and did not encounter technical problems that would have made it impossible for them to access the information that was available for the purpose of the study.

Limitations

Inevitably, there were several limitations that lessen the generalizability of the findings. An apparent shortcoming of the heuristic evaluation method is that it identifies usability problems without indicating how they are to be fixed. Ideas for appropriate redesigns have to appear intuitively to the designers on the basis of their creative capabilities without special assistance from the method (Nielsen and Mack, 1994b). In practice, however, the identification of a usability problem frequently implies an appropriate solution. Purposeful sampling was utilized for this study to recruit acknowledged expert evaluators. The results of this study are therefore not generalizable to all computer users and every individual who has access to the course. It is perceivable that the external validity of the observed ratings might have been influenced by a number of factors. These include rating purpose, raters' typical role in the organization, and the cognitive processes of the raters. Impressions on one aspect of the instructional design might have influenced an individual evaluator's ratings of another domain, which is known as the "halo effect."

Even though much care was taken to ensure that perception differences did not affect participants' ratings through comprehensive briefings, rater viewpoints and past experiences might have perceivably had an influence on the ratings. Finally, the sampling method raises the question to what extent social desirability might have influenced the findings.

DISCUSSION

As a result of this project, an educational multimedia program for the practice of pharmaceutical care was developed in which learning can take place within the framework of education for understanding and where the learner acquires an intellectual capacity for concepts, principles, and skills that can be brought to bear on new problems and situations. Learning materials were consequently designed to effectively support task groups and activities that had previously been shown to produce learning.

The expertise-oriented evaluation found this program to be a practical and effective educational tool for teaching the fundamental principles of pharmaceutical care. Recommendations for fixing the problems and improving the usability of the design pertained to three categories: technical, convenience/ease of use, and content. Based on the results of the evaluation, it became clear that additional efforts would have to be made to increase the flexibility of use. An improved design would have to allow the learner to browse the learning materials more effectively by including more shortcuts and to tailor the functionalities of the program to individual learner preferences. A larger variety of multimedia enhancements would have to be made available and spread throughout the program. Some changes will have to be made to the overall interface design to reflect problems that involve the general effectiveness of the functionalities that the program has. Minor "debugging" will resolve the few run time errors that evaluators encountered while reviewing the site. Assessment methods were assumed to be effective and appropriate, however, the multiple choice test at the end of each learning unit was perceived as being too inflexible in the sense that learners should be allowed to proceed without taking it.

Results of the evaluation also show that the heuristic approach is a practical and efficient method for determining the merit of the instructional design of innovative technology-enhanced educational programs in the health sciences. It appears therefore promising to expand the use of this method to similar, future studies.

References

AACP (1993a), *American Journal of Pharmaceutical Education* **57**, 374–376.

AACP (1993b), *American Journal of Pharmaceutical Education* **57**, 377–385.

AACP (1993c), *American Journal of Pharmaceutical Education* **57**.

ACCP (2000), *Pharmacotherapy* **20**, 991–1020.

Albion, P.R. (1999) In: J., W., eds, *16th Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education* (Australasian Society for Computers in Learning in Tertiary Education, Brisbane, Australia), pp 9–15.

Cipolle, R.J., Strand, L.M. and Morley, P.C. (1998) *Pharmaceutical Care Practice* (McGraw-Hill Health Professions Division, New York).

Greiner, A.C., and Knebel, E., eds (2003) *Health Professions Education: A Bridge to Quality* (The National Academies Press, Washington, D.C.).

Hannum, W.H. and Hansen, C.D. (1989) *Instructional Systems Development in Large Organizations* (Educational Technology Publications, Englewood Cliffs, NJ).

Holland, R.W. and Nimmo, C.M. (1999), *American Journal of Health-System Pharmacy*, 56.

Nielsen, J. and Mack, R.L. (1994a) *Heuristic Evaluation* (John Wiley & Sons, New York, NY).

Nielsen, J. and Mack, R.L. (1994b) *Usability Inspection Methods* (John Wiley & Sons, Inc., New York, NY).

Nielsen, J. and Molich, R. (1990) In *CHI* Seattle, WA, pp. 249–256.

Nimmo, C.M. and Holland, R.W. (1999a), *American Journal of Health-System Pharmacy* **56**, 1981–1987.

Nimmo, C.M. and Holland, R.W. (1999b), *American Journal of Health-System Pharmacy* **56**, 2458–2462.

Scriven, M., ed. (1991a) *Beyond Formative and Summative Evaluation* (National Society for the Study of Education, Chicago, IL).

Scriven, M. (1991b) *Evaluation Thesaurus* (Sage).

Worthen, B.R., Sanders, J.R. and Fitzpatrick, J.L. (2001) *Program Evaluation: Alternative Approaches and Practical Guidelines* (Longman, New York).