Clinical Decision Making in Nursing Practice with Case-Based Reasoning

Associate Professor Som Naidu, PhD
Multimedia Education Unit, The University of Melbourne, Australia
e-mail: s.naidu@meu.unimelb.edu.au

Ms Mary Oliver, RN, M.Ed.
Department of Nursing, The University of Southern Queensland, Toowoomba, Australia

Andy Koronios, PhD
Department of Information Science, The University of Southern Queensland, Toowoomba, Australia

Abstract: This paper describes the development of a self-paced multimedia learning resource designed to facilitate the transition of graduating nurses into the workplace. The resource uses an authentic case to simulate the complexities of life in a typical hospital ward, and place graduating nurses in the role of problem-solvers. Problem solving in the simulation is based on a rich repertoire of cases and stories that have been extracted from the experiences of expert practitioners. This case-based reasoning architecture reflects a model of learning where graduating nurses are coached in the development of decision-making skills within the context of a contrived but an authentic presenting problem. Outcomes of formative evaluation carried out in a semi-structured format with individuals and small groups of nurse practitioners have revealed a positive disposition towards the resource and the approach to learning it utilises.

Educational Problem

Current practices in the preparation of nursing students for a successful transition into the workplace is reported as being ineffective. Meanwhile, the Graduate Nursing and Preceptor Programs offered by the hospitals (at least in the Australian context) to facilitate the transition of graduate nurses into the workplace are under tremendous strain. It has been suggested that in order to prepare better nursing graduates for the challenges of the workplace, there must be alternative ways of developing the decision making skills of graduating nurses in situ. This implies improved collaboration between the employing organizations and Nursing education institutions to develop additional strategies to formal classroom and clinical education processes that could be used by the graduating nurses in their workplace in a self-paced and self-instructional environment. Moreover, this alternative solution to the continuing concern for the successful transition of graduating nurses into the workplace had to be solidly grounded in the authentic problems and situations of their daily routines. The learning tasks had to be immediately relevant and meaningful to them, not contrived or removed from their workplace environment. The learning architecture used would be powerful if it benefited from the experiential knowledge base of practitioners.

Instructional Solution

In attempting to address this need, we developed a self-paced and self-instructional multimedia learning environment using the case based reasoning architecture. The material presented on this learning environment attempts to simulate the complexities of life in a typical hospital ward, and in so doing making the education of graduate nurses and students case-based and authentic.

Learning activities incorporated in the courseware require users to make decisions about the best course of action, and source of information regarding each case or problem. Users are also able to discuss the cases presented to them in the multimedia environment and reflect on how they might have addressed the situation. This learning architecture reflects a situated cognitive model of learning where students and graduating nurses are coached in the development of their strategies for recognizing learning opportunities and critical thinking with the help of authentic cases.

We have not recommended throwing out all the other resources and abandoning students in a welter of diverse information sources presented in this multimedia environment. On the contrary, we suggest leading students very carefully through unstructured problem situations from multiple perspectives and sources of
information, providing careful instructional feedback, not only on content mastery but also on the skills of information-processing, critical thinking, and clinical decision-making.

Implications for Advances in Learning

This project proceeded from the realisation that current practices in the preparation of nursing students’ successful transition to the workplace upon graduation are ineffective and deficient. Moreover, it was of the view that more of the same kind of education was not going to be very useful and argued for a radical shift in the approach to this component of nursing education. A shift which would combine powerful educational technologies and proven learning strategies to build a technology enhanced learning environment. This environment is innovative in two ways. First, it integrates powerful technology with case based reasoning in an integrated learning environment. This adds to the currently burgeoning enthusiasm in the use of interactive multimedia applications for enhancing learning and teaching effectiveness. Secondly, it comprises a significant shift away from current practices of teaching and learning towards one that is case-based. In this environment student assessment is situation-specific and as such authentic.

Theoretical Foundations

There is considerable support for the belief that learning and teaching is most efficient and effective when it is situated in realistic settings where learners are clear, not only about the reasons for learning but the context or the ecology of their learning environment. This view of learning is in contrast with the notion that subject matter content is something that can be represented in schemas stored in memory and retrieved in certain ways when needed. The foundations of these beliefs are derived from cognitive science and artificial intelligence, and trace back to Gestalt Psychology and the works of Wertheimer, Kohler, and Koffka, who were German Psychologists of the early 20th Century (Bower and Hilgard, 1981). Gestalt psychologists argued in favour of the role of insight, perception and reflection in the learning process as opposed to association based primarily on past experience, such as that proposed by Thorndike, Skinner and Pavlov (Bower and Hilgard, 1981). This philosophy of learning and teaching translates into the premise that to educate and facilitate learning we must create situations that are not only motivating and challenging, but that necessitate learning of facts, principles and procedures. One tried and tested way of doing this is through a Goal-Based Scenario (GBS).

A GBS is essentially a contrived situation in which learners assume a main role. Their “goal” as part of this role is to accomplish the mission or task associated with that main role in the scenario. In order to achieve this goal the learner will need to acquire particular skills and knowledge. This is where the learning is taking place. Goals in this context refer to the successful completion of the task at hand not the achievement of grades. A GBS serves to both, motivate learners and also give them the opportunity to "learn by doing". As long as a goal is of inherent interest to learners, and the skills needed to accomplish those goals are the targeted learning outcomes, we have a match and a workable GBS. The important idea here is that a GBS is organized around "performance" skills and the end result is a student who can perform the specified task.

Every aspect of human behaviour involves the pursuit of goals. Sometimes these goals are simple, like brushing your teeth to prevent decay; sometimes they are quite subconscious, like searching for similar experiences when you encounter a new experience. Sometimes they are quite complex, like trying to build high quality software to effect change in the education system. When goals are simple, we really don’t think about them much. When they are subconscious we don’t think about them at all. And, when they are complex, we may think about them, but find the going so rough that we hone in on the simplest ones and lose the forest for the trees.

But understanding how people pursue goals is a critical aspect of understanding cognition. For computers to really understand human stories, they need a complete model of the goals that people pursue, the plans, the use, and the complexities that arise. The issue is this. If goals underlie human behaviour to the extent that we cannot understand a story or what someone says or what someone wants, without a clear assessment of the underlying goals and the interaction of those goals, then it follows that goals are at the root of human learning. Why would anyone learn anything if not to help in the pursuit of a goal? Why would anyone try to understand anything if not because they had the goal of learning new information from what they were trying to understand? The desire to change one’s knowledge base, to comprehend what is going on about you, and to learn from experience, are all pretty much different ways of saying the same thing. And, all of these are goal-directed. If goals are at the base of the human thought process, then it follows that learning must be a goal-dominated arena as well.
The intent of a Goal Based Scenario is to provide motivation, a sense of accomplishment, a support system, and a focus on skills rather than facts. Facts can be deceptive. They give the sense of knowing without the significance of knowing. Understanding why you are doing something, having a clear goal that is more than the recitation of facts, truly knowing why and wanting to know more so that one can become curious about more “whys” is what learning is all about. Goal Based Scenarios, interrupted by good telling of important cases, offer a reasonable framework for courses that are meant to be the means of education.

Learning Architecture

Perhaps the most harmful misconception people have about intelligence is that being smart comes from knowing a lot of rules. Behind this notion is the sense that reading a lot of textbooks and absorbing what they say will lead one to become an expert. While it does make sense to say that intelligence comes from knowledge, most of that knowledge in practice looks quite a bit different than what you find in a textbook. The architecture of this learning environment follows from the premise that if we are to prepare better graduate nurses for the challenges of the contemporary workplace, we must shift our focus from a content-centred to a case-based reasoning approach. The case-based reasoning approach is based on the principles of a situated cognitive model of learning (Schank, 1997, 1990; Schank and Cleary, 1995). The primary propositions of the situated cognitive model of learning are outlined by Savery and Duffy (1995) as follows:

- understanding is gained through our interactions with authentic cases and in situ;
- cognitive conflict is the stimulus for learning, and also determines the organization and nature of what is learned.

In this multimedia learning environment case-based reasoning is used to improve current instructional practices in the education of nurses for their transition into the workplace (see Figure 1). The intent of this model is to present students with a contrived but an authentic scenario, which offers them an opportunity to learn in a safe environment, and by making mistakes without injury to real human patients. We argue that mistakes offer real opportunities for learning when these are accompanied by timely and potent feedback. We will now describe this model in some detail.

<table>
<thead>
<tr>
<th>Clinical Decision Making with Case-Based Reasoning</th>
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<tbody>
<tr>
<td>• Learners encounter the problem situation as they enter the learning environment.</td>
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<tr>
<td>• They deal with the problem (in a safe environment) with help from experts in the form of their experiences and stories, and also documentation and other resources available in electronic form.</td>
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<tr>
<td>• Their “goal” in this simulation is to develop an action plan for managing the patient’s situation.</td>
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<td>• This action plan is considered at the “case conferences” where feedback is provided.</td>
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**Phase I: Case Encounter**

- Learners encounter the case at handover where they are explained its history and pathology.

**Phase II: Understanding Problem**

<table>
<thead>
<tr>
<th>Precipitating event</th>
<th>Identifying its causes</th>
<th>Managing the situation</th>
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<tbody>
<tr>
<td>Learner encounters the precipitating event.</td>
<td>Learner seeks to locate the cause of precipitating event.</td>
<td>Learner attempts to manage the situation.</td>
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**Phase II: Seeking Solutions**

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<tr>
<th>Becoming aware</th>
<th>Asking questions</th>
<th>Reasoning</th>
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<tr>
<td>Learners listen to the stories and experiences of expert practitioners.</td>
<td>They ask experts questions about their work experiences.</td>
<td>Learners attempt to reason on the basis of the stories of experts.</td>
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**Phase III: At the Case Conferences**

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<tr>
<th>Raising issues</th>
<th>Asking questions</th>
<th>Reasoning</th>
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<tbody>
<tr>
<td>Learners explore new and related issues to the problem by reviewing sources of information.</td>
<td>They ask experts additional questions about their work experiences.</td>
<td>Learners develop their final action plan based on the stories of expert practitioners.</td>
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**Phase IV: Developing an Action Plan**

- Learners submit their action plans to supervisors and receive feedback on their decision making.

*Figure 1:* Clinical decision in nursing practice with case-based reasoning. The phases in the figure guide the procedure for attempting to use the repository of cases.
Case Encounter

As users enter this learning environment they are presented with a clinical case in the form of a scenario. A guide (which is always available) welcomes users and informs them of their immediate goal. In this scenario learners are required to make clinical decisions on the basis of information that is available to them. This information is presented in the form of documentation and expert knowledge (which are encapsulated as stories) to manage a crisis situation. Users begin by attending a handover, which is a regular event of a nurse's daily routine where relieving nurses are updated on the current situation of their patients and this is where the user encounters the case. As in a real hospital setting after handover the learners move on to attend to routine nursing care activities and meeting patients' needs by administering medications and ensuring patients' comfort. Soon after this users are met with a "precipitating event".

A precipitating event in this instance is an emergency situation that causes, or has the potential to cause a chain of events. It requires the learner to make complex decisions under the pressure of time. Within this learning environment though, time is not a variable because this is a contrived learning situation in which users have the opportunity to review relevant documentation and seek advice from experts if necessary, on the best practice before making decisions. This becomes the "goal" or mission of users, which is not to be confused with a "learning outcome". A learning outcome is a skill that learners will develop (such as decision making) as they seek to fulfil their goal or mission. In order to achieve this goal or mission, the first thing the learner must do is to understand the situation and control it because the situation has the potential to deteriorate, and then develop an appropriate action plan to manage the situation.

Managing the Situation

In the first instance, the learner must do everything that is necessary to manage the crisis situation before recommending an action plan. In order to do this, it is necessary that the learner understand the crisis, including its causes.

In this scenario the learner is presented with a situation in which Mr. George Parker (the patient) is experiencing an anaphylactic reaction to a drug administered and to which he has been previously sensitised. To diagnose this situation accurately, the learner needs to assess the patient's condition. In order to arrive at a correct diagnosis, learners can access a whole range of information including documentation on hospital procedures/protocols and video-clips of interviews with expert practitioners (experienced nurses) on appropriate procedures to follow or not to follow under such circumstances.

After diagnosis the learner must take appropriate action to manage the crisis situation by generating an action plan. But before the learner develops an action plan, they are prompted by the learning system during each step of the transaction to identify and sequence (from lists) appropriate actions that are necessary for correct diagnosis and management of the anaphylactic reaction.

For example, during diagnosis the system asks the learner, “What would you be looking for to confirm that George Parker is at risk of an anaphylactic reaction?” It allows the learner to choose from a list of past events or patient characteristics the appropriate triggers that would confirm that this patient is indeed at risk of an anaphylactic reaction that is about to take place. This action plan requires the learner to make decisions about prioritising and delivering care that is appropriate, given the circumstances.

Users are able to make these decisions after having listened to the experiences of expert practitioners. These experiences (reported as vignettes) are presented in the form of stories and made available to users as they make their decisions. This is where the learning is taking place for the learner.

In real life, nurses do not have the time in a crisis situation to consult anything because of the pressure of time associated with the situation. In this context however, they are allowed the opportunity to stop and reflect upon each possible action they can take, and seek advice and information, review the underlying pathology of the case, and policies and protocols governing such situations before including them as part of their action plan.

Reflecting at Case Conference I

When an action plan has been developed, users proceed to a case conference. This is a place where users have the opportunity to reflect upon their own action plans and that of others. There is the opportunity here to engage in collaborative negotiation of meanings, questioning, critique, and commenting on alternative approaches of care that is deemed appropriate to the case. There is the opportunity here for invoking cognitive conflict in the learner, which has the potential to lead to changing perceptions that result in learning.
Reflecting at Case Conference II

The second case conference offers an opportunity for learners to obtain feedback on their revised action plans. This has the potential to lead to further cognitive conflict for learners and lead to further questions and critique that can result in learning.

Developing an Action Plan

In the final stages, users ought to be in a position to develop an action plan that is based on informed decision making and one that is realistic and acceptable to their supervisors. By now it will be clear to users that the process of reaching this stage is more important than having the action plan accepted. The architecture of the model was designed to develop in learners clinical decision making skills. And it sought to achieve that by focusing and urging users to learn from the experiences of expert practitioners. Its expressed intent was to expose nurses to the process of clinical decision making and encourage them to make decisions on this basis so that this process is automated for them. Ultimately, within this case-based reasoning environment and through the use of critical thinking users should hone their problem solving skills and ability, in making appropriate clinical judgments concerning patient status.

Development

The development of this interactive multimedia courseware product adopted a user-oriented approach (Goodyear, 1995) which comprises ongoing testing and formative evaluation of the prototype by experts in multimedia courseware development, content experts and a selected sample of intended users. This multimedia environment is being developed using Asymetrix's Multimedia Toolbook™, a quasi-object-oriented, event-driven development system for Microsoft Windows™. Toolbook™ combines database functionality, text manipulation, hypertext, drawing capabilities as well as a full-featured programming language called OpenScript™ which allows the developer to program object behaviour. Toolbook™ offers all the advantages of a prototyping tool and is best suited in projects where user initiated changes need to be made during the development process.

This prototype is currently undergoing a series of iterations of progressive development. The highly modular nature of object-oriented programming allows the developer to test each object and its behavioural characteristics. This learning system contains both generic content about the diagnosis and management of anaphylaxis as well as specific procedures and protocols that are specific to St Vincent’s Hospital in Toowoomba, Queensland, Australia, which has served as the reference site. Furthermore, in order to achieve the most realistic nursing clinical decision making environment possible, all participants in the video clips used in this multimedia courseware are nursing practitioners who have volunteered their time.

Procedure

Much of human reasoning is case-based rather than rule-based. When people solve problems, they are frequently reminded of previous problems they have faced in similar situations. Most people have experienced problems brought about in their daily life. For instance, you are in a queue at the ATM to withdraw money and you realise that you forgot your PIN number, you are reminded of other times you have been in similar situations. While rushing to catch a train you realise that you do not have the right change to purchase a pass from the ticket machine, you are reminded of other times when you have been similarly caught out. People constantly experience such "remindings", comparing one experience to another so as to learn from both.

Often we believe that our mind is wandering, as it seems to flit from thought to thought, leading us in directions that often seem irrelevant to our needs at the time. But the reminding process is reflective of our mind's constant search for past information to help in processing new information. In effect we are creating theories about the minute details in the world around us, trying to create a theory of banking procedures that will help us to select the right one and better function in the world. We are constantly accumulating cases and comparing those to the cases we have accumulated in an effort to understand the next case that will appear.

In line with this process, the first step in the development procedure for this project was to develop and shoot the precipitating event. The experiencing of anaphylaxis was chosen as the event because it represents a reasonably complex occurrence in a hospital as well as a common scenario in the community, for example, children receiving immunisation at the clinic, or being stung by a bug etc. Except for the patient experiencing anaphylaxis, all other participants in this video shoot were educators and health professionals. The next major
task was to capture a large enough repository of the experience of nurse practitioners in the form of stories. Gathering this repository was no mean task. Interviewing, filming, and editing of these stories took up much time. Indexing of the database of these stories was an ongoing exercise.

The model of learning outlined in Figure 1 guided the development of the learning transaction. This unfolded in several phases. Within the multimedia simulation, users could move easily from activity to activity towards their ultimate goal, which was the successful management of the presenting problem. Some of these activities comprised selecting from a number of decision options, dragging and dropping them in appropriate boxes, deciding to administer a particular treatment or not, deciding to call for help or not, choosing to consult expert video clips for advisement or not, and making decisions. Resources apart from expert's stories such as procedures and other reference manuals had to be identified and collected for the reference of users.

Evaluation

Our approach to the monitoring and evaluation of the outcomes of this project was utilisation focussed. As such our focus was on the use and utility of the instructional innovation for nursing students, their lecturers, graduate nurses, and other stakeholders such as the employing institutions. Evaluation of the courseware prototype is continuing. Formative evaluation of courseware has been carried out with small groups of potential users including a small group (n=3) of subject matter experts who were asked to validate, among other things, the authenticity of anaphylaxis. A semi-structured Expert Group Checklist has been used for gathering the comments of the expert group. A semi-structured questionnaire including an Interface Rating Scale has been used to collect data from the group of potential users. A larger scale implementation evaluation of this courseware is planned. This will involve observations, focus groups and use of semi-structured questionnaires.

Results of the formative evaluation carried out so far show that:

- users found the learning program easy to use and navigate,
- the majority did not find the information overwhelming, and the content pitched at an appropriate level for the target group,
- the curriculum was well balanced.

With regards to interface design:

- users felt that the screen design was pleasing and appropriate use of graphics was made,
- the clarity of information presentation was high.

On the whole they found the program enjoyable. Subjects were asked how interesting did they find the material on each one of the sections on the CD? Material on the CD was itemised to include: Handover, attending to patient, listening to stories, making decisions, and preparing the report.

- The majority reported each one of these sections either interesting or very interesting.

Subjects were also asked to rate the usefulness to them of these same attributes.

- All of them rated these attributes either useful or very useful.

In summary, what did they like most about the multimedia-based simulation? These included simple access to different components, more interesting and retained information in comparison with reading a journal article or book, realistic presentation, interactive patient observation.

References


Acknowledgments

This project has been funded by *The Committee for University Teaching and Staff Development*, The Federal Department of Education and Youth Affairs, Australia.