

***A Problem-Based
Learning approach to
Nursing Informatics for
undergraduate students***

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in partial fulfilment of the requirements for the degree
of Master of Science in health informatics

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Declaration

I declare that the work described in this dissertation is, except where otherwise stated, entirely my own work, and has not been submitted as an exercise for a degree at this or any other university.

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Summary

Nurses are one of the main users of Information Technology systems in healthcare. Their understanding of the information tools at their disposal is a key element in their professional development as individuals, the development of nursing as a profession, and the improvement of the health services and quality of healthcare.

Nursing education is probably the most suitable point in the professional path of nurses to develop a clear understanding of the possibilities offered by the information tools available to them.

Nursing is a profession that involves dealing closely with people. Many nurses do not feel confident with computers or computer-related concepts and terms. Training in this subject through familiar concepts is a key element in enabling them to gain this knowledge in the most effective way.

To achieve this, Problem-Based Learning is an invaluable learning method for students in health sciences. Problem-Based Learning is a teaching method which represents a paradigm shift from "teaching" to "learning". It encourages students to develop critical thinking skills and to apply their knowledge to real world problems

A modular programme was developed in this dissertation. The materials developed for this included scenarios that represent informatics situations with relevant nursing involvement, questions to prompt student learning, and a guide to assist on the delivery of the module.

It was not possible to introduce this programme in a real-life undergraduate nursing course as part of the work in this dissertation due to time constraints and the unavailability of a nursing student group. Nevertheless, the materials produced were reviewed by nurses, health informatics and Computer Sciences professionals, amongst others. The feedback from these people has been positive, and it would be appropriate to introduce this approach in an undergraduate nursing training programme on a pilot basis. The delivery of this course to nursing students and its assessment remains as future work.

Table of Contents

Chapter 1. Introduction.....	12
Chapter 2. State of the art in nursing informatics and Problem-Based Learning.....	15
2.1. Health and nursing informatics.....	16
2.1.1. What are nursing and health informatics.....	16
2.1.2. History of health and nursing informatics.....	17
2.2. Nursing informatics in undergraduate nursing training curricula in Ireland.....	22
2.3. Problem-Based Learning.....	24
2.3.1. History of Problem-based Learning.....	25
2.3.2. Learning process.....	26
2.3.3. Learning contents and learning outcomes definition in Problem-Based Learning.....	26
2.3.4. Group discussion and roles.....	27
2.4. Summary.....	32
Chapter 3. Proposed programme.....	33
3.1. Description of the proposed module.....	33
3.1.1. Aims of the module.....	33
3.1.2. Module prerequisites.....	34
3.1.3. Module design.....	34
3.1.4. Scenarios: content and discussion.....	40
3.1.5. Other teaching strategies.....	43
3.1.6. Session planning.....	43
3.1.7. Scenario and facilitator guide writing.....	44
3.2. Problem 1: “Making patient scheduling easier”.....	44
3.3. Problem 2: “I need something better for drug prescription”.....	49
3.4. Problem 3: “What will be the best for me and the hospital?”.....	51
3.5. Problem 4: “I remember when I was in...”.....	57
3.6. Analysis of the scenarios.....	57
3.7. Informal evaluation of the problems designed for this module.....	60

3.8. Summary.....	61
Chapter 4. Student assessment and module evaluation.....	62
4.1. Student assessment.....	62
4.1.1. Learning outcomes, levels of learning, and student assessment.....	63
4.1.2. Performance assessment.....	63
4.1.3. The role of the facilitator in the assessment.....	64
4.2. Module Evaluation.....	65
4.2.1. Acting on findings.....	65
4.2.2. Questions for the evaluation of the module.....	66
4.3. Summary.....	68
Chapter 5. Conclusions and future work.....	69
5.1. Review of this dissertation.....	69
5.2. Summary of dissertation contributions.....	71
5.3. Future work.....	71
References.....	72
Appendix.....	80

Index of Tables

Table 1 Informatics in undergraduate nursing education (from websites)	23
Table 2 Differences between Traditional Learning and PBL (adapted from Tseëlon, 2003)	31
Table 3 Differences between the roles of Traditional Facilitator and PBL Facilitator (adapted from Tseëlon, 2003)	32
Table 4 Relation between scenarios and learning outcomes	59
Table 5 Relation between levels of cognitive learning and scenarios	63
Table 6 Sources of information in nursing undergraduate programmes	81

Index of Diagrams

Diagram 1 Roles in the PBL process (Woods, 2003) 29

Diagram 2 Designing and implementing a curriculum module using PBL supported
by other teaching methods (Woods, 2003) 36

Abbreviations

- *CNM*: Clinical Nurse Manager
- *EHR*: Electronic Health Record
- *FOSS*: Free and Open Source Software
- *GPL*: General Public License
- *IMS*: Information Management and Services
- *IT*: Information Technology
- *MIMS*: Monthly Index of Medical Specialities
- *PBL*: Problem-Based Learning
- *PC*: Personal Computer
- *SHO*: Senior House Officer
- *WIMP*: Windows, Icons, Mouse and Popdown menu

The last project that I worked on with Richard [Feynman] was in simulated evolution. I had written a program that simulated the evolution of populations of sexually reproducing creatures over hundreds of thousands of generations. The results were surprising in that the fitness of the population made progress in sudden leaps rather than by the expected steady improvement. The fossil record shows some evidence that real biological evolution might also exhibit such "punctuated equilibrium," so Richard and I decided to look more closely at why it happened. He was feeling ill by that time, so I went out and spent the week with him in Pasadena, and we worked out a model of evolution of finite populations based on the Fokker Planck equations. When I got back to Boston I went to the library and discovered a book by Kimura on the subject, and much to my disappointment, all of our "discoveries" were covered in the first few pages. When I called back and told Richard what I had found, he was elated. "Hey, we got it right!" he said. "Not bad for amateurs."

From 'Richard Feynman and the connection machine' – Hillis, 1989

CHAPTER 1. INTRODUCTION

Nurses are a key group in healthcare, working in hospitals, the community, workplaces, amongst others. The roles performed by nurses are also very diverse, including the provision of care, education and counselling, advocacy for patients and their families, change agents, managers and researchers (Koch, 2002). In all these roles, accurate, relevant and timely information is not an optional extra but is essential (Department of Health and Children, 2004): decisions are taken according to the information available at the time. Incomplete or inaccurate information leads to decisions which may have dangerous implications for patients, managers, policy makers, and all the roles that nurses assume.

Focusing on nurses practising in clinical areas, we can see that nurses are constantly dealing with information. In fact, nurses spend around 30% of their time in activities related to the coordination and management of patient care (Jinks et al, 2000; Kanda et al, 2002), many of which involve dealing with information. This figure is similar to the time spent by nurses in direct care delivery (Jinks et al, 2000; Kanda et al, 2002). Clinical nurses generally have an overall perspective of the patient care given by all the professionals (Jinks et al. 2000): physicians, pharmacists, and others. Due to the large amount of time that information management takes in the overall activity of the nurse, it is important that this is done effectively, to maximize the time nurses spend in the delivery of direct care activities.

Dealing with health information is challenging. Health information is complex, multimedia, constantly changing, often uncertain and/or incomplete (Grimson, 2001). It deals with concepts such as 'well' and 'unwell', 'happy' and 'sad', 'dull' and 'sharp' 'pain', etc. (Cesnik, 1996). In contrast to other sectors such as banking, information is very diverse and complex:

- with different items in different formats (e.g. text, still images, video),
- with a certain degree of uncertainty,

- located in a vast area of work (compare the nurse who walks several miles per shift with the clerk who sits at desk in a bank all day).

This complexity reflects itself in the many difficulties encountered in designing healthcare information systems (Grimson, 2001).

Currently, there is an international trend to move towards the implementation of computerized information systems in healthcare settings. Research has shown that the introduction of these information systems in clinical areas results in a reduction of the time spent in documentation activities and an increase of the time spent in direct patient care, as well as an increase of time available for nursing care planning (Pabst et al, 1996). From the management point of view, it is also seen as an element that may help to decrease the pressure due to staffing shortages. However, the introduction of technology would not allow for an increase in the workloads on its own (Pabst et al, 1996, Saarinen, 2005).

From these facts we can deduce the importance of training in the process of change. Nevertheless, this seems to be poorly addressed in the literature (van der Meijden et al., 2003). A significant number of training programmes in nursing informatics seem to focus on computer literacy for nurses, covering topics such as Internet access and word processing (McNeil et al, 2003; Cole, 2004).

This trend may be adequate for certain purposes (see Griffith, 2001, for an example of this), but it does not represent the real character of nursing informatics, which is *not* equivalent to computer literacy for nurses.

It is important to ensure that nurses learn to deal with health information as early as possible in their professional career. The undergraduate curriculum would be an appropriate place for this process to begin, to empower nurses to take their role in the introduction and development of information systems that will allow for a better handling of the information (Grimson et al, 2000). Nevertheless, a significant predictor of the success of nursing informatics in the curriculum is its *perceived usefulness* of the material presented (Jayasuriya, 1998; Ireland et al, 1998). Problem-Based Learning (PBL) aims to increase this perception of usefulness by drawing on the student's practical experiences during their nursing training. The use of these ex-

periences should increase the perception of usefulness of the subject, since it would be related to clinical practice and experiences. By following this philosophy of education, students learn to understand their environment, make sense of their experience, and develop knowledge from both.

This dissertation proposes a modular programme to deliver nursing informatics targeted to undergraduate nursing students, using a PBL approach. The assumptions taken for the design of this module are that it would be placed in a context of a non-PBL curriculum, and that it is placed on the final year of the nursing training programme.

After this dissertation, the formal assessment of the module developed will remain as future work. This is due to time constraints and the unavailability of a student group to test the module. However, the module has been informally evaluated by knowledgeable professionals with positive results.

Chapter 2 presents an overview of the state of the art in nursing informatics and PBL, their history and general characteristics. These are the two fields in which most of the learning programme rests. Chapter 3 presents an introduction to the module proposed, including an outline of the module plan and the scenarios used to promote student learning. Following this, chapter 4 discusses module evaluation and assessment, and finally chapter 5 deals with the conclusions and future work arising from this dissertation.

CHAPTER 2. STATE OF THE ART IN

NURSING INFORMATICS AND

PROBLEM-BASED LEARNING

Health information is increasing in volume and complexity. For instance, knowledge in scientific disciplines (including healthcare sciences) is doubling every 6 years (Grimson, 2001), while humankind generated more information in the 1990s than in its whole prior existence (Grimson et al, 2000). The amount of health information being generated has been influenced by developments in health sciences, the increased availability of different kinds of tests and procedures, and an increased awareness and knowledge on the part of the healthcare professionals of what technology may offer them. Furthermore, the nature of the information has changed to become much more multimedia. The problem of managing an ever increasing amount of information, and developing methods to help keep in line with the state of the art, already seen in other fields of endeavour and knowledge, is especially relevant for those working in healthcare (Hovenga, 1996). Because of this increase in the volume and complexity of information, the importance of good quality information management practices increases in a parallel trend. These enable nurses and healthcare professionals to handle a piece of information in a larger context, and to take all relevant pieces of information into consideration.

The work contained in this dissertation is the development of a problem-based programme to teach nursing informatics to undergraduate students. To understand the proposed material and approaches, it is important to have an awareness of the current state of the art in nursing informatics and in PBL.

This chapter approaches both fields, analysing what they are, their historical background and development, and their characteristics and implications.

2.1. Health and nursing informatics

From the author's point of view, nursing informatics rests on the development of several fields of knowledge, with health Sciences, Computer Science, and Management being the main ones. Some of these fields have quite a long history, while others have developed much more recently. All of them shape what nursing informatics is at present, as well as the direction that it will take in the future.

2.1.1. What are nursing and health informatics

According to Graham (1994), cited by Hovenga & Kidd (1996), health informatics is “*an evolving socio-technical and scientific discipline that deals with the collection, storage, retrieval, communication and optimal use of health related data, information and knowledge. The discipline utilises the methods and technologies of the information sciences for the purposes of problem solving and decision-making thus assuring quality healthcare in all basic and applied areas of biomedical sciences for the community it serves.*”

Although it is usual to see the terms *medical informatics* and *health informatics* used as equivalent concepts, it is worth noting that the term initially used for this field was that of *medical informatics* (Cesnik, 1996). Currently, however, *health informatics* is the more prevalent term. This seems to capture better the diversity of professionals involved in healthcare, both in the clinical and the management settings. Medical informatics currently has a more limited set of connotations, relating to the medical profession. This is also the case of nursing, dental or veterinary informatics (Cesnik, 1996). All of these may be seen as subsets of the wider field of health informatics.

Nursing informatics can be defined as “*the integration of nursing, its information, and information management with information processing and communication technology, to support the health of people world wide*” (IMIA-NI, 1998). Nurses contribute to this goal by bringing their clinical experience to all areas in which they assume their professional roles.

State of the art in nursing informatics and Problem-Based Learning

A key benefit of the involvement of nurses in this process is the development and availability of information tools that fit nurses' needs most accurately (Hasman, 1998). It is also good practice from the systems design point of view to involve directly the future users of these systems (Grimson et al, 2000), and nurses need to have a good understanding of the issues involved in nursing informatics to be able to play their part in this process (Hasman, 1998; Hasman & Albert, 1997), which will ultimately benefit them in their work, as well as those whom they look after. Therefore, it seems appropriate to introduce this issue in the undergraduate nursing curriculum, to promote the acquisition of the required skills and knowledge (Hasman, 1998).

Examples of systems currently available, and that may benefit from the participation of nurses and their feedback are (adapted from Thomas, 2002):

- *Clinical areas*: Patient Administration Systems (for admissions, discharges, transfers), bed management, clinical notes, and drug prescription / administration record
- *Nursing education*: drill and practice of acquired knowledge, tutorial programmes, simulations of real-life situations
- *Nursing research*: increase the scope of the research and the data sources available, simplifies the collection and analysis of data, and assists in the dissemination of information
- *Nursing management*: staff management tools, rostering systems and workload measurement

2.1.2. History of health and nursing informatics

Health informatics began as medical and nursing informatics during the 1970s, a period of exponential development in computer science. This development was due to the growing availability of steadily less expensive hardware, more powerful software and the advent of microcomputers (van Bemmelen & Shortliffe, cited in Cesnik, 1996). A gradual process of change from electronic data processing in medical care to health informatics occurred. This can be seen from the papers presented at the three yearly World Congresses on medical informatics, or Medinfo. The first of these meetings took place in Stockholm, in 1974 (Cesnik, 1996).

State of the art in nursing informatics and Problem-Based Learning

During the 1980s, there was intense research on the use of computers to support medical decision making. During the late 1980s, the linkage of systems developed into the creation of integrated systems that were using new database technology and networking. As a consequence of this, the development of synergistic applications, where the whole was greater than the sum of its parts started to appear. In later years, the development of complete Electronic Health Records, including text, figures, images, video, and the integration of different technologies such as decision support, voice recognition, seem to be the most prevalent interests (Grimson, 2001). The vision for these systems aims to integrate them beyond a single healthcare setting, coordinating and sharing health information, with the aim to reduce duplication and ensure the completeness of the information (Grimson, 2001). This information may then become useful for clinical and healthcare research purposes.

Nurses are the largest body of professionals in the healthcare field providing clinical care to patients (Saba & McCormick, 2001), and as such they also are the biggest single clinical user group of Information Technologies (IT) in healthcare. Also, nurses deal with a huge amount of information, and often act as an information node between other professionals and relay information to the patient and relatives. This means that nurses are key users and players in the introduction of IT systems in hospitals and in the healthcare sector, and their involvement is crucial (Grimson et al, 2000).

Evolution of computers and Information Systems in nursing and Healthcare

The introduction of computer systems in healthcare settings is not a new phenomenon. The concept of representing human behaviour in a codified manner is already present in the 17th century, with Wilhelm Von Leibnitz, who advocated the idea that it might be possible to represent the entire nature of human behaviour in some codified form. This principle still forms the basis on which many software developers, especially in medicine, view coding: if a fine enough coding system was developed, then it would be possible to classify everything. Nevertheless, these classifications required much more advanced tools than Leibnitz had (Cesnik, 1996). A later example of this trend for classification would be the codification of diseases ac-

State of the art in nursing informatics and Problem-Based Learning

coding to set tool, such as ICD (International Classification of Diseases). ICD 10 is the latest revision of this system, and is currently in use for HIPE/Casemix purposes in Ireland (in its Australian Modified version), since January 1st, 2005.

A first example of the tools required by Liebnitz could be identified in Charles Babbage, in the 19th century, who created what may be considered the first computer: a mechanical device designed to solve mathematical problems, although this device did not work as expected, and Babbage ran into economic difficulties for lack of funds (Cesnik, 1996).

These concepts and early developments were put into practice by Herman Hollerith in the 1890's to manage the census data of the United States, showing the effectiveness of the technical concepts and developments up to that time. This system was based on the use of punch cards to store and control the information (Cesnik, 1996).

During World War II, similar projects were carried out, in an effort to protect information, and to break the codes used to protect this. Around this time, the first electrical computers were created. These had large requirements of space and electrical power, and thus, the concept of a centralized computer that handles the information, and communicates with the users via 'dumb' terminals was born. This was called Mainframe computing, and it enabled the centralisation of computing services (Cesnik, 1996). Nevertheless, this approach did not seem to fit well in healthcare settings (Cesnik, 1996).

During the 1950's, there was a period of marked development in nursing and computer science. Computers were initially used in healthcare settings for basic business office functions, and their user interfaces were based on punch cards, paper tape, teletypewriters and card readers (Saba, 2001).

The 1960's saw a rich period of reflection and debate over whether there were any benefits to be obtained from the introduction of computers in clinical situations, and what were the boundaries of this process going to be. Development of early Hospital Information Systems (HIS), to deal with financial, billing and accounting functions. Some HIS attempted to document limited amounts of medical

State of the art in nursing informatics and Problem-Based Learning

orders and nursing activities. Because of technology limitations, lack of standards, and diversity of paper-based patient care records, progress was slow (Saba, 2001). It was during this period that the birth of the concept of 'personal computer' occurred. These developed first in the form of Minicomputers, making it possible to work without the connection to a mainframe computer, since they were, essentially, a stripped down version of mainframe aimed at situations with a small number of local users (Cesnik, 1996). Healthcare organisations did introduce information systems during this early period, but their main functions were administrative, financial and managerial functions, rather than the actual delivery of healthcare (Grimson et al, 2000). It is also worth noting, however, that Clinical Laboratories were also early adopters of information systems.

During the 1970's, nurses began to recognize the potential of computers for improving the documentation of nursing practice, the quality of patient care, and the repetitive aspects of managing patient care. Nurses assisted in the design and development of nursing applications for HIS and other areas where nurses can be found. Computer applications for the financial and management functions of patient care systems were seen as cost-saving technologies. Further, several mainframe hospital information systems were developed (Saba, 2001), while a further step in the evolution of computers brought the arrival of microcomputers, such as Tandy, Commodore, Zenith or Apple II; the later being the first that encouraged average users to get involved in programming activities (Cesnik, 1996).

In the 1980's, the continuous development of software and computers brought new possibilities, which allowed for a further development of healthcare and nursing software. These developments highlighted the need that nurses had for standards, not just the existing ones for clinical practice, but also data standards, taxonomies and classification schemes that could be coded to reflect patient information and nursing activity (Saba, 2001). It is also around this time that nursing informatics started to differentiate as a speciality within nursing, with an initial number of approximately 15 nurses identifying nursing informatics as their main field of professional interest in the United States (Saba & McCormick, 2001), and with the publication of the first journals devoted to nursing informatics, such as 'Computers in

State of the art in nursing informatics and Problem-Based Learning

Nursing' (currently being published as 'Computers, Informatics, Nursing) (Saba, 2001). There were also developments in the software, such as the creation of systems that documented several aspects of the patient record. These included drug prescription, results reporting, vital signs, and word-processing packages geared towards recording narrative nursing notes (Saba, 2001).

The early 1980's saw the introduction of both Apple's Macintosh, and IBM's Personal Computer (or PC). Macintosh made popular a breakthrough in the field of User Interface developed in Xerox PARC, with the substitution of the command line/teletype metaphor (i.e. commands needed to be typed in) for the Graphic User Interface paradigm and the desktop metaphor (Stephenson, 1999). This breakthrough in the way users could interact with computers consisted in the introduction of *Windows*, *Icons*, the use of *Mouse*, and the availability of *Pop-down* menus. This set of innovations is what has become known as the WIMP interface (Cesnik, 1996). The Personal Computer (PC) was also introduced during this time in healthcare settings. Nurses were able to use them as terminal for mainframes, as well as independently from these (Saba, 2001).

During the 1990's, nursing informatics finally gained the status of speciality in the United States. The need for standards continued to be an issue during this time, extending to nursing data sets, and continuing work on taxonomies, vocabularies and classifications. The development of networking technologies, with the implementation of Local and Wide Area Networks, the development of wireless technologies, and the increased computing power made recording patient information in IT systems possible for professionals. Also, the popularisation of the Internet and email enabled a much more efficient way of communication and sharing of information. As well as the clinical and management areas of nursing, others such as education or research have greatly benefited from the availability of these technologies (Saba, 2001).

2.2. Nursing informatics in undergraduate nursing training curricula in Ireland

Nursing in Ireland is currently taught at degree level. These take place in 13 Higher Education Institutions in association with 56 main Healthcare Agencies (Hospitals/Clinical Sites). These institutions are (Nursing Careers Centre, 2005):

- Athlone Institute of Technology (AIT)
- Dublin City University, (DCU)
- Dundalk Institute of Technology (DKIT)
- Galway-Mayo Institute of Technology (GMIT)
- Institute of Technology Tralee (IT Tralee)
- Letterkenny Institute of Technology (LYIT)
- National University of Ireland Galway, (NUIG)
- Royal College of Surgeons in Ireland, (RCSI)
- St Angela's College
- University College Cork (UCC)
- University College Dublin (UCD)
- University of Dublin Trinity College (TCD)
- University of Limerick (UL)
- Waterford Institute of Technology (Waterford IT)

These institutions have some information regarding their nursing training courses on the World Wide Web (WWW). From the analysis of their webpages referring to their undergraduate nursing curricula for the academic year 2005-2006, we can obtain the information shown in Table 1.

Name	H/NI in B.Sc. Nursing – General	Year
Athlone Institute of Technology (AIT)	No	
Dublin City University, (DCU)	Computer literacy	1 st year
Dundalk Institute of Technology (DKIT)	No	
Galway-Mayo Institute of Technology (GMIT)	No	
Institute of Technology Tralee (IT Tralee)	No	
Letterkenny Institute of Technology (LYIT)	No	

State of the art in nursing informatics and Problem-Based Learning

Name	H/NI in B.Sc. Nursing – General	Year
National University of Ireland Galway, (NUIG)	Basic IT skills	not specified
Royal College of Surgeons in Ireland, (RCSI)	No	
St Angela's College	No information of curriculum content available on the web	
University College Cork (UCC)	IT skills for nursing	1 st year
University College Dublin (UCD)	No	
University of Dublin Trinity College (TCD)	No	
University of Limerick (UL)	No	
Waterford Institute of Technology (Waterford IT)	No information of curriculum content available on the web	

Table 1 Informatics in undergraduate nursing education (from websites)

In this table we can see that most institutions don't have any informatics content in their nursing curricula, while 2 institutions do not have any information available on their website regarding curriculum content for undergraduate nursing studies. There is 3 schools of nursing that do offer some level of IT training, but the information in their websites seems to indicate that this is mainly focused on IT literacy and its application to nursing.

It is essential to note that this table shows the information made public by each institution about their nursing programmes in their webpages. The actual addresses for the webpages viewed are included in Appendix, at the end of this dissertation. These conclusions may reflect the current information level given on their websites, rather than actual course content. Many of the websites checked do mention that the programme information available for orientation purposes only, and may differ from their actual curriculum content.

Nevertheless, this information seems to show that nursing informatics is currently given a low priority within the curricula for undergraduate B.Sc. of nursing in

Ireland, with only a few attempts to add IT literacy to undergraduate curricula. This seems to fit with current international research (McNeil et al, 2005).

2.3. Problem-Based Learning

Problem-Based Learning is *an instructional strategy in which students confront contextualized, ill-structured problems and strive to find meaningful solutions* (Rhem, 1998). In the same article, Rhem (1998) also describes it as “learning that results from working with problems”. Nevertheless, the concept of problems is somewhat controversial in nursing education. Some authors consider that this denomination puts emphasis on a particular kind of nursing intervention, has negative connotations, and does not reflect the reality of nursing (Wilkie & Burns, 2003). This has prompted the usage of other denominations, such as 'Enquiry-based learning', 'Context-based learning', 'Task-based learning', or 'Case-based learning' (Wilkie & Burns, 2003). Regardless of the name, though, the essence that remains is that of a process within education that attempts to mirror the real life situation in a simulated and safe educational environment. This simulation results in the development of real life knowledge and skills through the process of research and investigation. Students are challenged by PBL in a unique way, since they start with the 'problem', and without the knowledge to solve it (Wilkie & Burns, 2003).

PBL curricula consist to a large extent of problem scenarios. The quality of the scenario used to focus student learning is an important consideration in PBL (Lee & Uys, 2005). There is a consensus amongst scenario authors on what they believe the characteristics of a good case are (Hafler, 1997):

- good cases are written from professional and personal experiences
- developed from either real situations or written to reflect a real situation. This gives the scenario relevance and makes it a powerful teaching tool
- good cases contain a puzzle which help the students develop problem-solving skills

Due to the focus being on the learning process carried out by the student, and the integration of knowledge in the student workgroup, this method is very suitable

State of the art in nursing informatics and Problem-Based Learning

to help students to become life-long learners (Hasman, 1998). By learning through their own self-directed research and efforts, they learn the skills that will enable them to develop their knowledge in other subjects in the future, once they leave the guidance of formal teaching institutions, and become self-reliant professionals. These skills also enable them to focus on the knowledge they need to learn in any new situation during their professional life, and how to achieve the knowledge they lack, by applying the self-directed learning skills that PBL helps develop (Hasman, 1998).

The following is an overview of the key points that are characteristic of PBL as educational approach:

- using guiding material to help students discuss an important problem, question or issue
- presenting the problem as a simulation of professional practice or a 'real life' situation, through the use a scenario
- appropriately guiding students' critical thinking and providing limited resources to help them learn from defining and attempting to resolve the given problems
- having students work cooperatively as a group, exploring information in and out of class, with access to a facilitator or tutor (not necessarily a subject specialist) who knows the problem well and can assist the group's learning process
- getting students to identify their own learning needs and appropriate use of available resources
- reapplying this new knowledge to the original problem and evaluating their learning processes

These points will be analysed and explained in the following subsections.

2.3.1. History of Problem-based Learning

Although the concept of learning through discussion is a very old one, with some authors, such as Rhem (1998), linking it to Socratic (dialectic) and Hegelian (thesis-antithesis-synthesis) approaches, modern PBL was developed within the

State of the art in nursing informatics and Problem-Based Learning

medical curriculum during the second half of the 20th century, at Case Western Reserve University in the late 1950's, and McMaster University of Canada during the 1960's. From these institutions, it spread within medicine and related areas worldwide during the 1970's, appearing in medical schools such as Maastricht, in the Netherlands, or Newcastle, Australia (Tseëlon, 2003).

This dissemination continued during the 1980's, with some medical schools converting their entire curriculum to PBL, such as the University of Hawaii, the University of Harvard, and the University of Sherbrooke in Canada (Wilkie & Burns, 2003; Rhem, 1998; Tseëlon, 2003). In the 1990's, PBL started to be adopted by professions outside the healthcare field (Mills & Treagust, 2003; Tseëlon, 2003). In Ireland, it is currently used in the Dental School and the School of Speech and Language Studies, both in Trinity College Dublin (TCD). There are also other groups interested on PBL within other Irish universities, including University College Dublin (UCD), Dublin City University (DCU), and the Dublin Institute of Technology (DIT), to name but a few.

2.3.2. Learning process

PBL is based in modern cognitive psychology theory (cognitive constructivism) which suggests that learning occurs when the learner actively constructs *new* knowledge on the basis of *current* knowledge (Tseëlon, 2003).

The key to PBL is group work. Each of the groups of students assesses the current knowledge of their members on a given subject, and identifies their learning needs. Research is conducted by these students to fill the gaps identified, and may include different sources, such as literature review, interviews with experts, direct research, etc. The results are shared within the same student group, and a final common knowledge is reached within the group (Wilkie & Burns, 2003; Tseëlon, 2003).

2.3.3. Learning contents and learning outcomes

definition in Problem-Based Learning

Learning outcomes are “*statements of what is expected that a student will be able to do as a result of a learning activity*” (Jenkins & Unwin, 1996).

State of the art in nursing informatics and Problem-Based Learning

There are two main approaches to curriculum development in PBL, taking into account the degree of control that students are allowed on the content of their learning and the order in which this learning takes place. These methods are called Open and Guided Discovery (Swanson et al, 1997).

In the ***Open Discovery*** approach, students are responsible for the choice of their learning contents, as well as the timing and the way this learning takes place. This approach emphasises the student's exploration in the learning process, with minimal guidance from instructors. It generally takes into account and encourages the development of variables such as self-directedness, motivation, effort, problem solving and attitudes. Nevertheless, assessment of learning outcomes may be difficult, since this approach encourages every individual student to follow their own particular version of the curriculum (Swanson et al, 1997).

The ***Guided Discovery*** approach relies on the identification of learning objectives by curriculum developers for each problem. These objectives are used by the instructors to organize group discussion and student learning. This does not imply that students are actually aware of this structure and the specific objectives. In fact, depending on the approach taken to course delivery, their experience may be quite similar to that of students in an Open Discovery context. Assessment in this approach may be less difficult, since the learning objectives can guide the development of the tests. Nevertheless, it is still a challenge to measure some of the problem-solving skills. This means that some of the assessment needs to be focused on the learning process and skills that students have developed in the learning process (Swanson et al, 1997).

These approaches influence the way the course is designed, as well as the actual scenario development process.

2.3.4. Group discussion and roles

A PBL class is run by the students, not the tutor/facilitator. Each session is guided by a rotating discussion leader, aided by a scribe who takes notes. These are generally taken on a white board, or some other support easily visible for the whole group (Tseëlon, 2003).

State of the art in nursing informatics and Problem-Based Learning

The process students generally follow to tackle the problems is divided into 7 steps, based on the methodology developed at Maastricht medical school (Wood, 2003, Tseelon, 2003):

- *Step 1 – Clarifying terms:* Identify and clarify any unfamiliar terms presented in the scenario, asking for or giving explanations. The scribe lists those that remain unexplained after discussion
- *Step 2 – Defining the problem:* Define the issue or issues to be discussed. The students may have different views on these, but all should be considered. The scribe records a list of agreed problems
- *Step 3 – Analysing the problem:* “Brainstorming” session to discuss the problem or problems, suggesting as many explanations on the basis of prior knowledge as possible. Students draw on each other's knowledge and identify areas where this is incomplete. The scribe records all discussion, listing relevant aspects and questions.
- *Step 4 – Systematic clarification:* Review steps 2 and 3, creating links between listed aspects and explanations and arrange explanations into tentative solutions. Scribe organises the explanations and restructures if necessary, classifying themes that emerged at the brainstorming into higher order groupings
- *Step 5 – Formulating learning objectives:* group reaches consensus on the learning goals in unambiguous, well-defined and concrete terms. The chairperson ensures the learning objectives are focused, achievable, comprehensive and appropriate
- *Step 6 – Self study :* All students gather information related to each learning objective, establishing keywords, checking sources and synthesizing relevant material
- *Step 7 – Reporting :* The group shares the results of the private study (students identify their learning resources and share their results

From these steps, we can see the roles of the different kinds of participants in the PBL process as described in Diagram 1 (Woods, 2003).

State of the art in nursing informatics and Problem-Based Learning

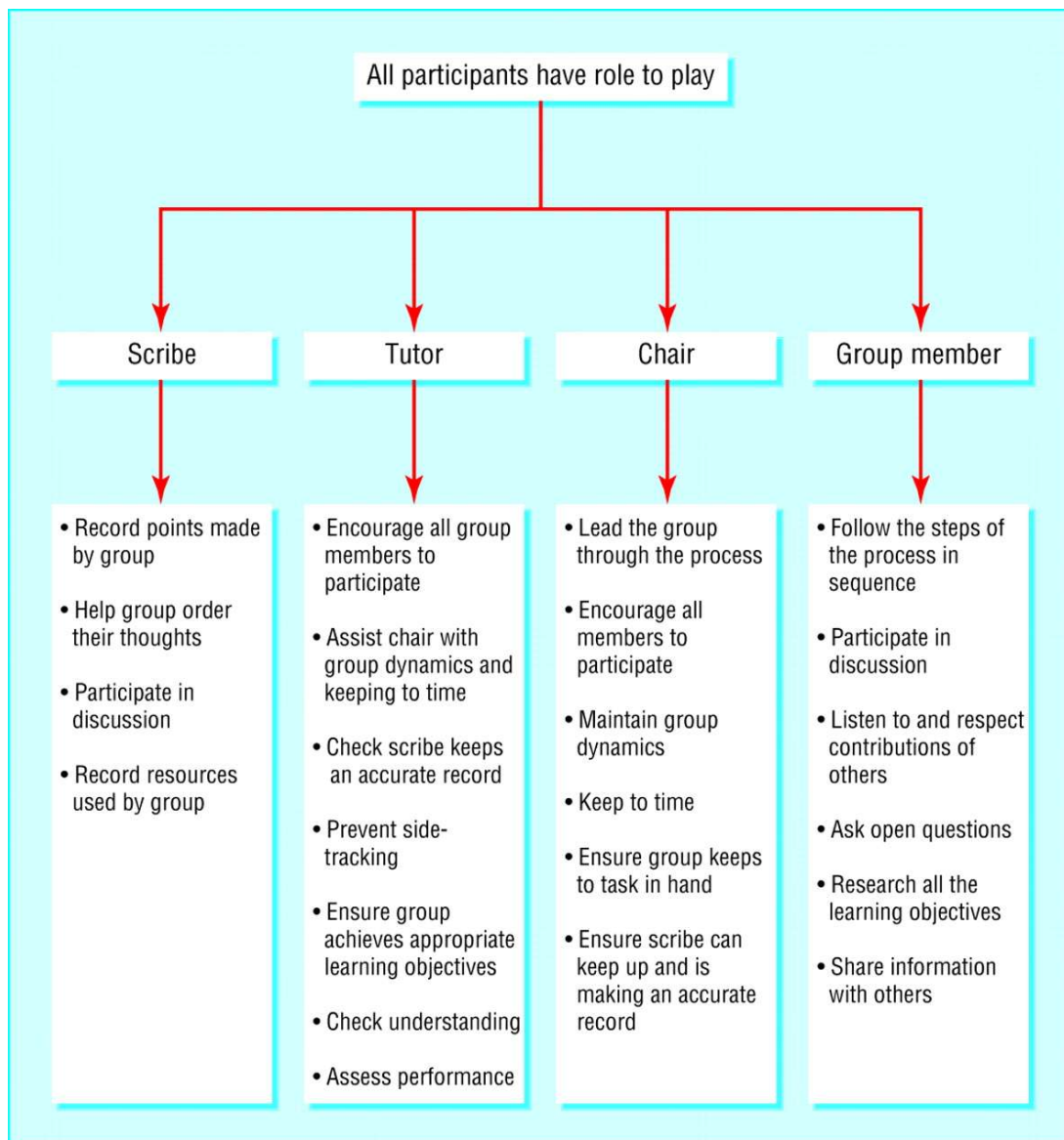


Diagram 1 Roles in the PBL process (Woods, 2003)

The following table (Table 2) illustrates some of the main differences between the traditional model of learning and PBL (based on Tseñlon, 2003).

<i>The Traditional Method</i>	<i>The PBL Method</i>
Fact-collecting	Meaning-making.
Facilitator-centred: knowledge is transmitted by a facilitator through facilitator-driven lectures, seminars or assignments	Knowledge is acquired by the students through a self-directed search

State of the art in nursing informatics and Problem-Based Learning

The Traditional Method	The PBL Method
Passive process	Active process
Individualistic process	Collaborative process: students work in groups, and are exposed to the viewpoints and knowledge of fellow students
Learning is based on repetition, rehearsal and memorisation, rote learning, and pattern-matching of content-specific tasks	Learning is based on problem solving skills which combine factual knowledge with the use of methods to achieve goals: <i>Goal setting</i> (where am I going to learn it?), <i>Strategy selection</i> (how am I going to learn it?), and <i>Goal evaluation</i> (did it work?)
Teaching is subject-based: it works from a body of knowledge to applications	Teaching is problem-based: it works from a problem to define the (interdisciplinary) frameworks required
Teaching is disciplinary and disjointed	Teaching is multi/inter-disciplinary: it integrates and connects across disciplinary boundaries
Students learn how to pass exams, and are given specific direction (of sources, topics etc.) on how to search for the correct answer	Students learn to identify what information is needed to solve (or make sense of) the problem, how to frame questions about this information, formulate problems, explore alternatives, where and how to search resources, how to organise the information into a meaningful conceptual framework, and how to communicate the information
The learning that takes place is mostly context-specific and short-lived. It is not adequate to prepare the students for encountering new applications or formulations	The methods learned during Problem-Based Learning <i>are not context-specific</i> . They allow students to transfer knowledge to approach new and different problems. They establish life-long habits of self-directed learning
'Problems' in traditional teaching method, when used to illustrate a topic, they are usually well-defined, with parameters that lead to predetermined outcomes with one preferred answer	A good PBL problem is open to many applications. Thus it enhances a skill of transferring the learning to novel situations
When problems are used as a vehicle for learning, they are used as concrete illustrations of abstract concepts. They are introduced <i>after</i> relevant knowledge has been acquired	Problems are encountered <i>before</i> any new relevant knowledge has been acquired

State of the art in nursing informatics and Problem-Based Learning

<i>The Traditional Method</i>	<i>The PBL Method</i>
The facilitator poses the questions, the tasks and the means of finding the solutions (reading lists, hand-outs etc.)	Students are empowered to take charge of the learning process: identify knowledge needed to resolve the problem, generate questions (learning issues) that target the kind of knowledge they want to acquire, and proceed to search for it using a variety of resources
Evaluation emphasises the quality of product, based on some elaboration of the material given or directed by the facilitator	Evaluations emphasise the process of the learning and the quality of the integration of knowledge reflected in the "solution"
Traditional assessment is dominated by an exam or an essay type assignment	PBL is assessed by "a portfolio" which contains one's diary of contribution to the PBL process, self-evaluation, and evaluation of fellow team-members along several criteria. These may include attendance, degree of preparation for class, listening and communication skills, ability to bring new and relevant information to the group, ability to ask questions that further group understanding, etc. Exam questions resemble the PBL process. Students are given a problem to analyse by resolving self-identified learning goals

Table 2 Differences between Traditional Learning and PBL (adapted from Tseëlon, 2003)

Groups are assisted in their work by one or several facilitators. These facilitators may or may not be experts on the subject (Wilkie & Burns, 2003). In both situations, students are required to do all the research, and the role of the facilitator is mainly to keep the student groups focused on their stated function of learning and knowledge sharing.

The role of the facilitator in Problem-Based Learning

The following table (Table 3) illustrates some of the main differences between the roles of the traditional facilitator and the PBL facilitator (based on Tseëlon, 2003).

<i>A Traditional facilitator</i>	<i>A PBL facilitator</i>
Setting the agenda	Only setting the problems: students set the agenda through defining learning goals

State of the art in nursing informatics and Problem-Based Learning

A Traditional facilitator	A PBL facilitator
Facilitator responsible for learning	Students take responsibility for their own learning
Facilitator provides solutions and "right answers"	Facilitator does not tell "the right answer" or "what to do": students are expected to provide the answers. They are given space to experiment, make mistakes, and go to original sources to get information
Facilitator is directive: giving lectures (or mini-lectures), asking questions, giving answers	Facilitator is non-directive: a coach, a learning manager, a guide, a supportive activator of students' learning initiatives, providing guidance.
Facilitator is an authoritative expert	The facilitator's (infrequent) input is to keep the process on track and proceed towards task objectives (facilitator may probe students' reasoning processes, or question their logic and beliefs)
Facilitator specifies bibliographic references	Students are encouraged to explore a variety of resources in seeking the information they require. These resources may include library reference sources (paper and electronic), and the Internet

Table 3 Differences between the roles of Traditional Facilitator and PBL Facilitator (adapted from Tseëlon, 2003)

2.4. Summary

Up to this point, we have explored the fields in which a PBL approach to nursing informatics education are grounded. Nurses need to know about nursing informatics for their own benefit, as well as that of their profession and their patients. This seems to be currently receiving a low priority by academic institutions in Ireland. It is suggested that a suitable way of introducing nursing informatics in the undergraduate curriculum is using a PBL approach, which may give the adequate relevance to this subject. This relevance is crucial in the integration of this knowledge for nurses. In the following chapter, these disciplines will be blended to develop the appropriate training materials to achieve this goal.

CHAPTER 3. PROPOSED PROGRAMME

Up to this point, we have seen the background in which the module that shall be described in this dissertation is grounded. In this chapter, we shall see an outline of the characteristics of the module. Following this, we shall see the actual course materials, including four problems and references for a workshop on health information. Finally, a discussion of each scenario will be presented.

3.1. Description of the proposed module

The module here described aims to bring an understanding of nursing informatics to the undergraduate nursing students who undertake it. In order to achieve this, it links their clinical experience to the changes that follow the introduction of IT in the clinical environment. As discussed earlier in this dissertation, PBL is considered to be an appropriate strategy to achieve this goal (Hasman, 1998).

3.1.1. Aims of the module

The main reason for using a PBL approach to nursing informatics is to go beyond computer science theory for nurses, which may not be perceived as relevant or useful by nurses, and go into the part of the process of implementing information systems in which their clinical experience and their informatics knowledge may meet and become useful. This would increase the relevance of the module content which, as it was already discussed earlier in this dissertation, it is one of the main predictors for the success of nursing informatics in the nursing curriculum.

Another learning objective of this module is the development of an understanding of the issues involved in dealing with information systems, and the ability to assess the quality and benefits of individual systems.

The actual use of information systems is beyond the scope of this module, since each systems has different training requirements, and the author feels that the principles behind these systems are the ones that are required.

Some students will remain staff nurses throughout their career, while others will move on to management, research and teaching positions, or indeed specialise on nursing and health informatics. In any of these circumstances, whether they are the ones who make the decisions or they are just asked for an opinion, it is important that nurses are able to use their own criteria on assessing these systems and voice what they need from them.

3.1.2. Module prerequisites

As well as clinical prior knowledge and experience that may be reasonable to expect from nursing student in their final year, they would be required to have a minimal level of computer literacy that would include:

- Identifying general computer parts and peripherals: keyboard, screen, mouse, external storage
- Turning a computer on
- Using the mouse
- Click, right-click, double-click, and click-and-drag
- Using the keyboard, special keys, upper and lower case letters, and other characters
- Accessing and selecting options from menus in graphical environments
- Manipulating files and folders, and understanding the concept of file formats
- Using the world wide web to research, access information, and downloading different file formats
- Using email

These prerequisites would enable the students to follow the discussion on any topics that may occur during the student group work, as well as communicating with their peers and facilitators.

3.1.3. Module design

As it has already been mentioned, the assumptions taken in the design process of this module were that:

Proposed programme

- this module is addressed to final year students of undergraduate nursing studies. This way, students will be able to integrate the knowledge obtained in nursing informatics with prior knowledge of other areas obtained by the student during their placements, and through other subjects
- the module is designed within a non-PBL curriculum context

Further to this, it is necessary to mention that the module is assumed to last only for the duration of a semester. While it would be very desirable to be able to incorporate this throughout the full curriculum for undergraduate nurses (and indeed, this would be possible in a context of a full PBL curriculum), time pressures for all the subjects are assumed, specially in the final year of the students. This also implied that certain issues, such as change management, while relevant in the scenarios and in practice, have not been included within the scope of the learning objectives of this module. These issues are generally analysed in other modules of the curriculum.

The language level used to describe these scenarios is intentionally non-academic, and some colloquialisms such as “OK”. This decision has been taken by the author in an attempt to keep the simplicity of the scenario presentation, and its proximity and perceived relevance.

There are also some concepts in the scenarios which are not introduced to the student. The students should either be familiar with these from their previous clinical experience (e.g. the different levels of medical and nursing staff, or different kinds of prescriptions), or will be expected to research these new concepts for themselves (e.g. the General Public License, user interface). This includes also the use of certain abbreviations without their prior introduction in full.

The process of module design is outlined in Diagram 2. This illustrates an example of this process in PBL applied to healthcare education (from Woods, 2003).

In the module developed by the author, the process followed by the author covered the first 7 levels of this diagram, including feedback from knowledgeable professionals in nursing, computer science and health informatics instead of academic staff. The process in this dissertation does not include the last 4 steps, since there was not any student group available. This remains as future work.

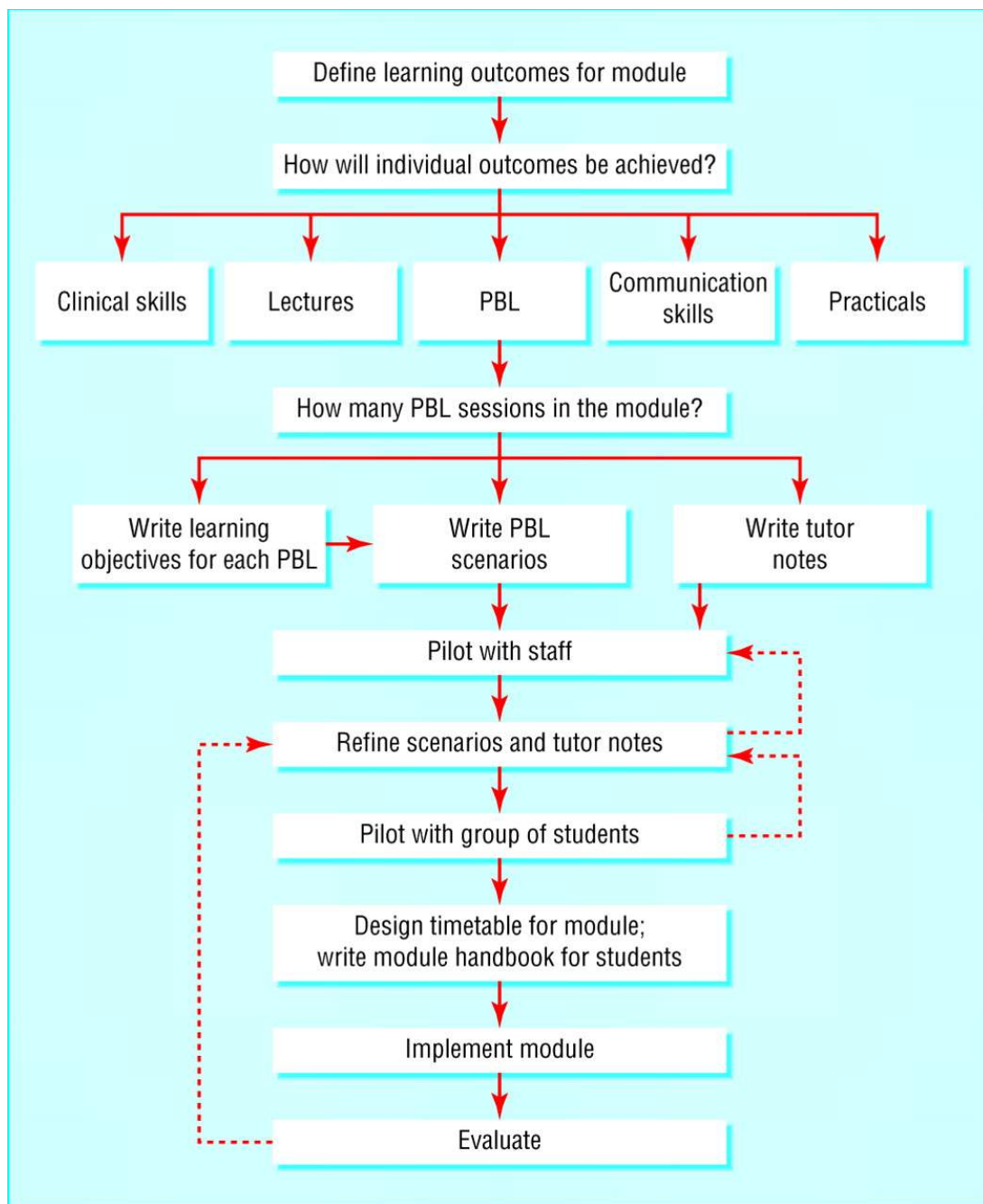


Diagram 2 Designing and implementing a curriculum module using PBL supported by other teaching methods (Woods, 2003)

Learning outcomes

The initial step in module design was the decision of whether to follow an *Open* or *Guided Discovery* approach to the programme. This would have consequences on whether learning objectives should be defined.

Proposed programme

According to Jenkins & Unwin (1996), learning outcomes help facilitators to tell students what is expected of them. By doing this, educationalists assert that they:

- help students learn more effectively
- make it clear what students can hope to gain from following a particular course or lecture
- help instructors to design their materials more effectively by acting as a template for them
- help instructors select the appropriate teaching strategy, for example lecture, seminar, student self-paced, or laboratory class
- help instructors more precisely to tell their colleagues what a particular activity is designed to achieve
- assist in setting examinations based on the materials delivered
- ensure that appropriate assessment strategies are employed

In the context of the module presented in this work, it is the author's belief that *Guided Discovery* is a more suitable option, since it may adapt better to the assumptions taken in the creation of this module. As it was already mentioned earlier regarding the context of this module, this is designed to fit in a non-PBL nursing curriculum. Due to this fact, students may not be familiar with the PBL process, and the use of a Guided-Discovery approach may aid the students in achieving the pre-defined learning outcomes.

Once the need for learning outcomes has been ascertained, it is important that these are written in the most effective manner. Jenkins & Unwin (1996) suggest some ways to tackle this problem:

- think of what you expect students to be able to do / to know before reading your material
- think of them after they have read it. What should they now be able to do as a result of reading it?
- always try to use active verbal forms, that relate to the different *levels of learning*

- try writing them, and then ask a colleague who is not a specialist in the area or students whether they know what is expected of them

Levels of learning

Following the 1948 Convention of the American Psychological Association, Benjamin Bloom headed a group of educational psychologists who developed a classification of levels of intellectual behaviour important in learning. This taxonomy was divided in three overlapping domains: the cognitive, psychomotor, and affective (Kearsley, 1994).

Cognitive learning is useful in writing learning outcomes. It consists of 6 levels: knowledge, comprehension, application, analysis, synthesis, and evaluation. For each level, specific learning behaviours were defined as well as appropriate descriptive verbs that could be used for writing instructional objectives (Kearsley, 1994).

The levels and their relationship with learning outcomes are outlined below (Carneson, Delpierre, Masters, 1996):

1. *Knowledge*: This is defined as the remembering of previously learned material, and includes the memorization of facts, language, concepts, principles, theories
2. *Comprehension*: This is defined as the ability to grasp the meaning of material
3. *Application*: This refers to the ability to use learned material in new and concrete situations. This may include the application of such things as rules, methods, concepts, principles, laws, and theories. Learning outcomes in this area require a higher level of understanding than those under comprehension
4. *Analysis*: This refers to the ability to break down material into its component parts so that its organizational structure may be understood. This may include the identification of parts, analysis of the relationship between parts, and recognition of the organizational principles involved. Learning out-

Proposed programme

comes here represent a higher intellectual level than comprehension and application because they require an understanding of both the content and the structural form of the material

5. *Synthesis*: This refers to the the ability to put parts together to form a new whole. Learning outcomes in this area stress creative behaviours, with major emphasis on the formulation of new patterns or structure
6. *Evaluation*: This is concerned with the ability to judge the value of material for a given purpose. The judgements are to be based on definite criteria. These may be defined by the student, or they may be given to them. Learning outcomes in this area are highest in the cognitive hierarchy because they contain elements of all the other categories, plus conscious value judgements based on clearly defined criteria

Writing learning outcomes

Following the guides outlined above, the following learning outcomes were produced:

At the end of this module, the student should be able to:

- Describe health information
- Identify the different media in which health information can be found, and describe the characteristics of each medium.
- Discuss the importance of information re-use, and the problems of information duplication
- Summarize the importance of user interfaces in healthcare information systems
- Discuss the importance of stability and reliability of healthcare information systems
- Describe the importance of taxonomy in the implementation of health information systems
- Illustrate the importance of security in a Healthcare information system, and the implications that computerization of the healthcare record has for patient privacy

- Illustrate the importance of conforming with health informatics standards and open source models if available
- Illustrate the implications of maintenance of the system and design with durability and flexibility in mind
- Demonstrate a global understanding of the issues involved in nursing and health informatics

These learning outcomes are quite limited in comparison to some of the advice from the literature (i.e. Hasman & Albert, 1997). The reason for this is the fact that this is the limited duration of the module,

3.1.4. Scenarios: content and discussion

PBL has been identified as the appropriate educational strategy to achieve the planned learning objectives. In order to deliver a problem-based module, scenarios are required. The design of these will be described in the following sections.

Module macro-structure: Problem flow

Problems are presented on a difficulty sequence, going from the simplest scenario to the most complex of the four.. There are several reasons for this:

- Students become familiar with concepts related to informatics during the first and second scenarios
- The first and second scenarios are set in more familiar situations for nurses, while the 3rd scenario introduce new concepts and perspectives
- Scenarios aim to develop progressive levels of learning. This concept will be discussed in Chapter 4
- The scenarios aim to represent the complete Systems Development Life Cycle

The idea of using the systems development life cycle as conducting thread for the dissertation comes from conversations with several healthcare professionals who had been involved in information systems procurement and implementation processes. From the experiences of these people, it seems that their involvement in this process was a powerful drive for learning. Since PBL and nursing informatics

education seem to benefit from the use of real and realistic situations, it seemed appropriate to use this to introduce the role of nurses in nursing informatics.

This cycle consists of 7 steps (Douglas, 2000):

- Step 1: Requirements definition
- Step 2: Analysis
- Step 3: Preliminary design
- Step 4: Detailed design
- Step 5: Coding
- Step 6: Testing
- Step 7: Implementing

Nurses may feel certain familiarity with this cycle, as it is similar to the nursing process (Douglas, 2000):

- Observation
- Assessment
- Plan
- implementation
- Evaluation

For nursing students, some parts of the systems development life cycle, such as requirement definition or analysis, may prove easier to follow, since they directly relate to their clinical experience. Nevertheless, it is necessary to engage with the complete cycle, to be able to assess systems beyond their clinical characteristics, including technical, legal and financial aspects since all of these have an effect on nurses.

Module micro-structure: Problem structure

Problem scenario development for PBL poses a great challenge. It is of paramount importance that each scenario should help students to achieve the key learning objectives for a particular module. To meet this challenge, problem scenarios should ideally be developed by an interdisciplinary team of school faculty, and then presented to the entire faculty for review and approval (Akinsola, 2005).

Proposed programme

In order to develop effective scenarios for PBL, there are four guidelines that need to be observed (Lee & Uys, 2005):

1. *The design of the problem should be intentional*: the problem scenario should reflect the aims and objectives of the curriculum and lead the student to opportunities for learning essential concepts for a practitioner at the level at which the learner is studying
2. *The problem should be realistic*: The problem scenario should reflect a problem or issue that could actually arise in professional practice. This strategy has the potential to facilitate students to move from understanding abstract concepts to application of these concepts in their practice, effectively *bridging the theory-practice gap*, and increasing student engagement and motivation
3. *Adequate information should be provided*: students must tackle any information gaps that they may have, and failing this, the facilitator should help students to do so
4. *A facilitator guide should be provided*: in order for the supervisor to be able to assist the students most effectively, especially taking into consideration that the facilitator may not be an expert in the field

In the development of the problems here described, these principles were applied, using prior experiences of the author to give them realism, with the aim of guiding students to achieve the learning objectives, through the information provided, both to the students and to the facilitator. It should be noted, however, that none of these scenarios are the description of the current situation in any particular institution, but rather a jigsaw made of several different experiences obtained during the course of the author's professional career as a staff nurse in several different hospitals in Ireland and in Spain.

3.1.5. Other teaching strategies

As well as the problems and scenarios, there is a plan for a workshop. This would be placed on the first session, and would allow students to reflect on several issues, such as:

- Nature of healthcare information
- Volume of information
- Combination of free text and data, subjective and objective information
- Wide contrasts within healthcare settings: theatre, wards, outpatient departments, emergency department
- Different information requirements in different specialities
- Role of nurses in regards to healthcare information, and its similarities and differences with the roles of other professionals: doctors, pharmacists, physiotherapists, etc.
- Integration of the information collected by different professionals, and cross-usage and utility of the information collected by other professionals, regardless of the medium used to record this information
- Technology as enabler versus technology as doer, and the impact of these concepts in nursing practice
- User Interfaces: The development of the graphical user interfaces, such as the WIMP interface, is crucial for the introduction of computers in the healthcare setting. The communication between the user and the computer commonly occurs through physical devices such as the mouse or the keyboard. These are useful devices that serve their purposes of communication, but work is being done in the area of user interfaces to develop better ways of interaction with the computer, such as the improvement of handwriting and speech recognition (Cesnik, 1996).

3.1.6. Session planning

A minimum of 10 sessions would be necessary to deliver this module. The first session would be the workshop on healthcare information, while each scenario would require 2 sessions, and a final session for module evaluation. If more sessions

were available, it would be advisable to introduce PBL itself through a problem, to develop an understanding amongst the students on how are they going to be working. This would be useful, since the module would be taught to students who in all probability had never been exposed to PBL before. It would also be advisable to add an intermediate session for each scenario, to allow for further discussion within the student group.

3.1.7. Scenario and facilitator guide writing

Problems were written taking into consideration the learning outcomes for the module. These were related to each scenario, as well as the module as a whole. The facilitator's guide contains references that facilitators can use when assisting students in their learning.

A discussion of each problem individually will follow after these have been presented to the reader.

3.2. Problem 1: “Making patient scheduling easier”

Scenario

Helen, the CNM II of the Haematology Day Ward, has a problem: every time a new member of the staff joins the team in her ward, they face a steep learning curve to use the paper-based system to schedule patient's appointments. Furthermore, a member of the staff is often tied up checking paper charts for up to 2 hours during the morning. This is done in order to track any changes in current patients, and to be able to find out about patients recently discharged from the wards and their requirements when they come to the Day Ward.

Nevertheless, current staff are used to it, and have voiced their concerns over any possible changes from their current paper-based scheduling system for patients to a new computerised version. These concerns are that the new system may not be as easy to use as the current one, that it may be cumbersome to make any changes in the schedule, that there may be times in which the system becomes unavailable or infected with viruses and that they would have to learn a new system. They are also worried that

Proposed programme

nurses will have less time available for patient care as they are not used to this new system. When they talk about introducing the computer-based system, staff tend to forget all the complaints that they usually have regarding the paper system. Helen has often heard them saying that the current paper notes are time-consuming and lack proper information, while other times information has to be written several times. They also tend to overlook some of the advantages that they could obtain by using a computerized system, such as getting proper and relevant information about any patient when this is needed, regardless of whether this was a scheduled or unscheduled case, or reminders and recurring prescription for certain treatments given once a month (while the current drug charts only allow prescribing of two weeks in advance).

The current paper system consists of a large sheet of paper with a table printed on it. In this table an axis represents the chairs in which patients are seated during their treatments while the other axis represents the times, divided in slots of 30 minutes, from 9:00am to 5:30pm. In this chart, the name of a given patient is written to allocate a particular chair at a particular time, with some marks in the following cells that indicate the estimated length of time the patient is expected to stay in the ward, according to the planned treatment (the length of time is decided by senior staff, taking past experiences into account). Generally, there is also a very short description (one or two words) of why the patient is coming into the Day Ward for (such as "Fluids", "Bloods", or "AmBisome").

In this paper schedule, there isn't any other information available about the patient. Any further information is found in the main medical chart. This means that information such as background condition, medical history, allergies, past and present treatments, including medication and chemotherapy, are in a different source. Due to problems of lack of space, paper-based charts are usually stored in a room at the other end of the ward.

Many patients need to see a doctor the same day they come to the Day Ward, but coordination of times is difficult due to the fact that this information is not generally relayed between medical and nursing members of the staff. As a result, coordination relies on senior members of the nurs-

ing staff having to detect that both appointments happen the same day, and schedule accordingly.

Such a heavy reliance on senior staff for appointment scheduling is the source of some discontent, which is compounded by the departure of two senior nurses about three weeks ago (one of the posts hasn't been filled as yet), which has meant an increased pressure on the remaining senior nursing staff.

Helen has requested the introduction of a new *patient scheduling system* for her ward, in order to deal with all these challenges. In order to analyse the needs of the ward and assess the feasibility of this change, a meeting has been arranged with members of the IT department of the hospital.

Prepare Helen's notes for the meeting:

a) User needs

- From Helen's point of view, what is the system supposed to do? Prepare a check-list of things Helen would need to see in the system, which she must ensure will be present.
- What are the concerns of the staff regarding the system? Analyse these, and assess whether they are realistic or not. Discuss how to proceed with each concern, realistic or not. Is there anything that staff do not mention as a concern, but that Helen should consider? If so, name the concern/s, and analyse how to deal with it/them.

b) Analysis

- What are the current practices on paper? From the information given, are there any IT systems already in place?
- Analyse the information requirements. What kind of information is being handled?
- Analyse the information flows related to the scheduling record, regardless of the medium in which this is held: what information is introduced

in this? What information is extracted from it? Where does the information come in from and go to?

- Who are the users of the record? What do they use it for?
- Who will be affected by the introduction of the new system?

c) Requirements

- What are the requirements for a computerized system to support this application?

Facilitator's guide:

It may be required to have more than one single person to ensure that the system meets all the requirements. This may mean the creation of a steering/working group to oversee the project implementation process. Nevertheless, Helen should still be able to assess whether the system meets *her* requirements and those of her staff, from *her* point of view, in order to become an active part of the implementation process, rather than depending on others.

1. Support of clinical and administrative decisions

- How much time to allocate to each appointment
- What seats are available at what times
- What times are better suited for an appointment in the Day Ward, taking into account any given medical appointment
- Blood tests required as a matter of course should be taken into account by the system
- Drug prescription should include a check for incompatibility of different drugs administered together or consecutively.

2. Usability

- Entry of appointments must be simple and straightforward, as well as changes and cancellations
- Information must be visible without excessive clutter
- Patient location must map the current layout in the ward
- Patient's medical appointment information should be displayed

3. Information re-use

Proposed programme

- Students should consider what kind of information systems are currently in place. These are implied in the text, and they should be able to infer what is the relevant functionality currently present in this
- The information handled in current and new systems may be numeric, text-based, etc. Students should be able to discuss the nature of the information required for this particular system
- Information may be introduced by people (nurses, doctors, ward clerks, etc.), or obtained from systems currently in place
- Information about each patient must be made available from current information found already in the system
- Drug information and prescription should be available from the system, including chemotherapy and other treatments/procedures due on the date

4. Confidentiality

- System must make it possible to keep patient confidentiality, and lead nurses and other users of the system to maintain it

5. Security

- System must ensure security of patient information.

6. Functionality

- The system must provide the functionality that end-users require, in a way that adapts to staff workflows.

Summary: Outpatient's patient scheduling system

- Assign location
- Assign time
- Integrate background information on the patient
- Integrate drug information (including allergies) on the patient
- Integrate activities to be performed with the patient in appointment (i.e. give blood/chemotherapy/fluids...)
- Detect drug prescription on discharge
- Schedule blood order reminders
- Schedule chemotherapy

- Integrate doctor's appointment information

3.3. Problem 2: “I need something better for drug prescription”

Scenario

Paul is tired of checking yet again whether everything is OK with the prescription for the new patient. On top of that, the two discharges that happened earlier today have been quite disorganized: one of the patients didn't get his prescription until 16:30h (the doctors were at a conference since early this morning, and no SHO/intern was around for most of the day). The other patient had his prescription written last night by the intern on-call, but it contained Cyclosporin, which should be prescribed using a High-Tech prescription. This meant that a new prescription had to be issued, and the pharmacist in the ward had to notify the pharmacy department, and fax the prescription to the patient's own pharmacy. Because of the meeting already mentioned, this has also been delayed.

A group has been formed to work on the computerisation of the prescription system. Paul has heard that they would like some nurses to get involved, and he thinks he might find it interesting, especially if that means that he won't have to live with these inefficiencies forever.

Help Paul to prepare his notes for the meeting with the members of the IT department, so that he can let them know what the requirements are for any system that may take the place of the current paper system. In this, you should keep in mind how the different professionals interact with the information in the system, and how to maximize the usefulness of the information contained in the system, trying to minimize duplication of any piece of information. Also, it should lead the clinical staff to maintain their duty of confidentiality towards the patient.

- a) User needs

Proposed programme

- From Paul's point of view, what is the system supposed to do? Prepare a check-list of features Paul would need to see in the system, and items he must ensure are present.
- What are the main risks in this situation? How would you address them?

b) Analysis

- What are the current practices on paper?
- Analyse the information requirements: what kind of information is being handled?
- Analyse the information flows related to the record analysed, regardless of the medium in which this is held: what information is introduced in this? What information is extracted from it? Where does the information come in from and goes to?
- Who are the users of the record? what do they use it for?

c) Requirements

- What are the requirements for a computerized system to support this application?

Facilitator's guide

The issue of approval of the application by a single person or a group is also present in this scenario. See comments on this subject in the facilitator's guide in Problem 1.

1. Information sharing across professionals

- Medication is prescribed by doctor, but accessed by nurses and other professionals, as well as doctors
- The prescription has to be accessible to staff other than the prescriber

2. Information re-use

- Generation of discharge prescription from inpatient drug chart. This information should also be available in the automatically generated discharge letter

3. Automatic generation from information

Proposed programme

- Upon discharge, the pharmacist should receive a notification of any medication that requires a High-Tech Prescription. This prescription should be generated automatically
- The system should contemplate a direct link with pharmacies, to be used once a link system is put in place

4. Confidentiality

- Control of access to the information contained in the prescription.

Summary: Drug prescription and administration record system

- Medication
- Prescription
- Retrieval
- Incompatibility check
- Medical Formulary
- Fluids
- Chemotherapy
- List patients per medication, with dosage
- Medication prescribed by doctors (although it may change in some instances), and administered by nurses and doctors

3.4. Problem 3: “What will be the best for me and the hospital?”

Scenario

In the previous scenario, we met Paul, a staff nurse working in a clinical area. Paul decided to do something about the problems he was facing regarding prescriptions, which influenced other areas of his practice.

After Paul has discussed his wishes with the IT team, this team does some research on the products currently available, to analyse them, and see if there is any solution that would fit the requirements described.

Proposed programme

After some time, the IT department selects two candidates that seem to match the requirements described by Paul.

Before taking their final decision, the IT department wants to take into account a clinical opinion, and Paul seems to be a fitting candidate, as he has already met the IT team involved in this issue before. Another meeting is arranged, in which a short demonstration of both products takes place, which he follows with the requirements produced at the previous meeting. Following this, a summary description of the characteristics of each product is handed over to Paul, so that he can analyse it, and decide which one suits the needs of the hospital best. Both products meet the requirements, but they show differences in the way they achieve these requirements. These differences, technical and beyond, may influence the chances of success on the introduction of the required solution in the hospital.

Paul is very interested for this introduction to be successful. Therefore he decides to get as much information about each program as possible.

a) The first product is called **Socrates**

Socrates is an Open Source application, under a license similar to the General Public License (GPL). This application has been deemed stable by the developers, although a new version is under active development for a second version. Security upgrades are adapted to the current stable version, but otherwise, there aren't any modifications planned for the stable version until the new one is released, which is planned for the last quarter of next year.

Due to the model of licensing and development, the IT department does not foresee major licensing and purchase costs involved, since the product itself is free of charge.

There is very little expertise in the IT department with the implementation and maintenance of this application (although it is hoped that this will be gained during the implementation process). This means that it will be necessary to use the support offered by a small company specialised in the installation and maintenance of *Socrates*. Also, this application

Proposed programme

has been deployed successfully in several hospitals, both at a national and at an international level, and a community of hospitals has formed to support each other with any issues that arise. This group has already successfully detected and corrected a good number of security problems, usually in less than 48 hours from the time that these were first reported, with the improvements fed back to the whole community of hospitals. Nevertheless, for critical fixes, maintenance and support contracts can be arranged with the support company, offering a solution in less than 3 hours.

Socrates solves some of the clinical challenges as follows:

- There is a specific module for blood products, accessible from the main prescription module. With this, full traceability of blood products is possible from the time the product leaves the lab, to the time this product is administered to the patient. This includes when was this administration completed, and if there was any adverse reactions, a record of these. In fact, if a different module for clinical notes (Open Source as well) is also installed, observations may also be recorded and accessed from the blood administration view.
- There is also the possibility, in the future, to get these two modules to work in the main medication charting. This would allow staff to check that the observations fall within the advisable range for a particular medication.
- *Socrates* can be configured to incorporate different on-line information resources. These could be located on hospital servers, and clinical staff would be able to access this information to solve any queries regarding medication. The purchase of this information would be the hospital's responsibility, independent from *Socrates* itself.
- The module also has the capability to check for incompatibilities between medications, but the knowledge base is not supplied by the application. Instead, it needs to be completely configured by the hospital from current pharmacy policies and current research. However, it may be possible to start from the implementations of other hospitals, if they wish to share it.

b) The second product is called *Plato*

Plato is a product of ReallyTrulyBig.com, a software company, diversified across several fields of knowledge, including healthcare, banking and printing. This company has been around for the last 10 years, and opened a sales office in Ireland 2 years ago. The main support centre for Europe is in the UK, from which their support staff travels to and from. These resources will be available for the implementation and early support of the application, until such a time that this has been deemed stable and fitting the description of the product to be delivered. After that, any major problems will be dealt on-site, while minor maintenance problems will be dealt with remotely, or by some of the hospital IT staff trained to do so.

Plato is on its 5th version, and the company is confident that it has reached a level of stability well beyond its competitors in the market. It is currently in use in several hospitals around the country and abroad, with a strong base in the US. Nevertheless, there is a separate *European Plato Reference Centres* group, for the European hospitals. This group has a limited capability to assist each other, but the main support is provided by ReallyTrulyBig.com. As part of the program, a certain amount of knowledge transfer is planned to allow the IT department of the hospital to deal with some of the issues that may arise with the use of the system, but support for the more complex problems relies solely on the ReallyTrulyBig.com.

Security problems are mostly solved within 48-72 hours of notification to ReallyTrulyBig.com, although they do not guarantee any fix below 7 days from the time of the time of problem notification. The exception are the critical fixes, for which they commit themselves to offer a solution in less than 2 hours from the time the problem is reported to them, by remote support. This support is agreed by contract, which is negotiated on a per-patient basis. This means that the rates are calculated according to the capacity of the hospital during the year, without taking into account bed and ward closures.

This follows the same principles that are used for the licensing of the software itself, negotiated also under the same per-patient basis. The hospital may have to consider a limited roll-out on a first stage, to accommodate the expense over several budget-years, due to current budget and expenditure constraints.

Proposed programme

Plato solves some of the clinical challenges as follows:

- There isn't a separate screen for blood products. These are currently seen within the main medication view, although they are marked with a different text colour and formatting. If a clinical notes module from ReallyTrulyBig.com is purchased, it would be possible to record and access observations during blood transfusion. Full traceability is not a feature at present, but the next release of the system is due in 3 months, and there are already demos available for this. Due to the implementation time, this new version would be the one that the hospital would be using, and thus, this traceability may then be in place.
- Access to a locally installed computerized version of the Monthly Index of Medical Specialities (MIMS) would be available from *Plato*. This would be updated, as part of an agreement between ReallyTrulyBig.com and the editors of MIMS, and it is included as an extra, free of charge for the hospital.
- Incompatibility checks are provided by ReallyTrulyBig.com, and this can be customized by the hospital during the installation process, to cater for local policies and new developments in pharmacological research. This can be maintained locally, without requiring the intervention of ReallyTrulyBig.com.

Both systems use the most current international standards for health informatics in their implementations (such as HL7), and SQL-based databases (Oracle for *Socrates*, and Sybase for *Plato*). Both systems claim to conform to CEN/tc 251 standards where available.

Also, both systems are able to run in the current hardware and operating systems currently in use in the hospital, without any major purchases or changes in the hospital IT strategy.

-
- Compare the characteristics of *Socrates* and *Plato* products, and choose which one is the best for the hospital, from your point of view.
 - Explain the rationale behind your choice, taking into account
 - each characteristic separately,
 - each product as a whole

Facilitator's guide

Open source applications have a much stronger incentive to conform to available standards whenever these are available. On the other hand, proprietary software has a history of developing incompatible features to obtain a competitive advantage over their competitors. The concept of *Vendor Lock-in* should be explored if arises, but a full exploration of all the concepts related to official and “de-facto” standards falls outside the scope of this problem. See Weber (2004), McVoy (1993), De Moor & Van Maele (1996), and CEN/tc 251 (2005) for discussion on some of these issues.

1. Development and licensing models

- What is the influence that licenses have on end-users
- Major and minor changes in the software, and the influence this may have in clinical practice
- Direct and indirect costs of software. Total Cost of Ownership (TCO)

2. Installation and support

- Comparison between support by the software developer, and support available by third parties. Concept of support market vs. support monopoly
- Installation and maintenance support
- Usefulness of developing in-house expertise
- Customization of software to adapt to local practices

3. Integration of functionality

- Modularity, and integration of these modules
- Integration of external sources of information, mimicking current practices

4. Software design and Legislation

- Do both products conform to the Lindsay tribunal recommendations regarding the traceability of blood products?

3.5. Problem 4: “I remember when I was in...”

Please choose a paper-based clinical information record from your previous clinical experiences (i.e. Observations, Lab info, etc...), and analyse the requirements to computerize the same, both from the point of view of nurses and of the information itself.

a) Current information workflow analysis

- Analyse the information requirements, what kind of information is being handled
- Analyse the information flows related to the record: what information come in, and what information go out, where does the information come in from and go to
- Who are the users of the record, what do they use it for

b) What are the requirements for a computerized system to support this application?

3.6. Analysis of the scenarios

The author has developed the four scenarios, relating them to the learning objectives mentioned above. The progression of these scenarios is designed to accommodate the progress of the students, as they become familiar with the subject. As these progress, the complexity of factors to be taken into consideration is also increased.

Problem 1: “Making patient scheduling easier”

The first Problem is fairly simple and self-contained. The objective of this scenario is to get students to become familiar with the outlook required to analyse health informatics requirements. It touches on end-user perception and views, as well as some technical capabilities of a hypothetical system implementation, while presenting a reasoning for the requirements.

Problem 2: “I need something better for drug prescription”

The second scenario has a smaller introduction, but the subject is quite familiar to any nursing student in the last years of their training: medication charts. After having seen in the previous problem an example of the information required from a system, the student is led to think about the same principles, but using their experience in the process. They are asked to think about what they already know on medication charts. The objective of this is to stimulate the student to integrate knowledge gained in different areas, while remaining focused on the clinical information as the integration point.

Problem 3: “What will be the best for me and the hospital?”

The third scenario is probably the most complex one. The problem aims to consolidate the knowledge gained previously, by offering two systems. These options need to be analysed, and a decision needs to be taken, according to the characteristics of each product. Through this process, the student may develop the ability to analyse and compare information systems.

Some technical concepts are introduced in this scenario, such as system modularity and integration of different systems. It is important for nurses to understand systems not just as isolated pieces, but as whole formed by several related systems. These should be able to interact in a synergistic way, to obtain the maximum benefit from them. This integration also brings the students to the issues of standards that enable this synergistic interaction. While standards are an important concept, it is currently outside the scope of the module, for the purposes of learning objectives. Nevertheless, the discussion of these issues should be encouraged if the students raise the subject.

There are also references to legal and business aspects of computer systems. Concepts such as software licensing, support agreements, the development of new versions of systems have important implications for the healthcare institutions, which can sometimes be felt even on the clinical areas. Issues such as out-of-hours support, or the number of users allowed to use a system concurrently tie to these aspects of computing.

Furthermore, Free and Open Source Software (FOSS) is an emerging concept that is currently having implications both on the software industry and on the wider society. For a discussion of these developments, see Dodson (2005) and Weber (2004).

Problem 4: “I remember when I was in...”

The last case draws mostly on the student experience, leaving the choice of subject with the student. In this instance, the target is to stimulate the student to reflect on their own practice and the information they handle, and to give them some insight on how to bridge the gap between a perceived need and looking for a solution to their problem. Critical thinking is necessary to carry out this last case, as well as an understanding of health information and health informatics.

The creation of a scenario requires the student to develop further understanding of the issues involving nursing informatics, showing an understanding of the issues that may need to be addressed.

Table 4 shows the relationship between the learning outcomes defined earlier, and each of the problems.

<i>Learning Outcomes</i>	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Healthcare information in itself and the medium used	*	*	*	
Information re-use, and the problems of duplication	*	*		
User interface in HIS	*	*	*	
Stability and reliability of HIS	*	*	*	
Taxonomy in HIS	*	*		
Security and Privacy in HIS	*			
Design and maintenance issues	*	*	*	
Software licensing and support issues			*	
Software design and legislation			*	
Global vision of informatics in nursing				*

Table 4 Relation between scenarios and learning outcomes

Please note that scenario 4 may actually involve any of the other learning outcomes, but the specific outcome for this one is to demonstrate a global vision and understanding of the field of nursing informatics, beyond that of the actual system described. Please note also that any of the previous scenarios may also allow the student to demonstrate a global vision of this field, but it is the last one that is specifically designed to prompt students in relation to this global view.

3.7. Informal evaluation of the problems designed for this module

During the preparation of this work, there wasn't any nursing student groups available to conduct a formal evaluation of the programme prepared. Nevertheless, contact was made with some professionals for an informal evaluation of the programme: nurses, health informatitians, computer science professionals, a psychologist and a philosopher.

The problems have been read by nursing and computer science professionals, who had a good reaction.

Problem 3 was found by one of the nurses to be difficult to relate to, specially in comparison to the previous ones. This may be related to the fact that Scenario 3 is longer and has smaller clinical background associated. On the other hand, this scenario is richer on management and legal background, and introduces new concepts for nurses that go beyond their previous clinical practice.

This is an appropriate outcome, since their role extends beyond that of asking for a solution from a clinical perspective only, and goes into developing a criteria to find the right solution taking their characteristics in multiple levels into consideration.

3.8. Summary

In this chapter, we've seen a module on nursing informatics prepared using a PBL approach. This consists mainly of problems, although there is also an introductory workshop on health information.

The chapter contains the learning outcomes of the module, and the scenarios are analysed and linked back to these. Finally, the reports from informal evaluation of the problems obtained by the author are included.

The next chapter will analyse aspects relating to student evaluation and module assessment.

CHAPTER 4. STUDENT ASSESSMENT

AND MODULE EVALUATION

An important part of the learning process is the assessment of the knowledge gained by the students, and the evaluation of the module content. These processes involve students and faculty, and both are crucial to ensure that students obtain the biggest benefits from their efforts. Unfortunately, it was not possible to deliver this module to real student groups. Due to this fact, a format process of student assessment and module evaluation was not possible within this dissertation.

While a full module was produced for this work, there are too many factors that may influence the actual design of the assessment, such as the number of students undertaking the module and the number of facilitators. Because of these issues, the reader will benefit more from an overview of aspects of assessment relevant to PBL, since this will allow the implementation of such a programme in a real situation without the constraints of the assumptions taken for design purposes in this dissertation.

For similar reasons, it was difficult to prepare material to evaluate the module. Nevertheless, a set of questions relating to this process was created, trying to focus on the known factors that may be relevant for this process.

4.1. Student assessment

According to Tseilon (2003), PBL is assessed by "a portfolio" which contains one's diary of contribution to the PBL process, self-evaluation, and evaluation of fellow team-members along several criteria. These may include attendance, degree of preparation for class, listening and communication skills, ability to bring new and relevant information to the group, ability to ask questions that further group understanding, etc. Evaluations emphasise the process of the learning and the quality of the integration of knowledge reflected in the "solution".

4.1.1. Learning outcomes, levels of learning, and student assessment

Once the learning outcomes have been written, the next step is to design an assessment method to test whether students have achieved the intended outcomes (Jenkins & Unwin, 1996).

The different problems presented in this work are designed to trigger different levels of learning seen earlier: *Knowledge, Comprehension, Application, Analysis, Synthesis* and *Evaluation*. The relation between the problems and the levels of learning is shown in Table 5.

<i>Levels of cognitive learning</i>	Scenario 1	Scenario 2	Scenario 3	Scenario 4
1. Knowledge	*	*	*	*
2. Comprehension	*	*	*	*
3. Application	*	*	*	*
4. Analysis	*	*	*	*
5. Synthesis				*
6. Evaluation			*	

Table 5 Relation between levels of cognitive learning and scenarios

4.1.2. Performance assessment

According to Wilkie & Burns (2003), during the student assessment, part of the process should focus on team members' performance, including:

- contribution of individual students to the overall work of the team,
- behaviours that are helpful or unhelpful,
- reflection on performance,
- assistance to develop desirable behaviours and the application of learning to the practice setting.

This focus should be directed towards each team and its members, rather than the whole class, and it should take into consideration the differences and specificities of each team member

Student assessment and module evaluation

These differences should be considered by the facilitator already from the formation of the group (Wilkie & Burns, 2003):

- the different backgrounds, skills and knowledge of each of the members of each team, and
- their ability to interact and integrate effectively in the student workgroup.

These differences have consequences on the balance of the group and their chances of successfully achieve a development in their knowledge (Wilkie & Burns, 2003).

Other aspects to be taken into consideration while undertaking this assessment include (Wilkie & Burns, 2003):

- whether the time allocated for the learning process was enough,
- relevance of the learning triggers used in the different scenarios to guide the students in their research and knowledge acquisition process, as well as the learning coming from them to practice
- availability of resources, such as information sources, articles on the research subject, etc.
- facilitator performance, including support received, suitability to provide support to the learning process, and facilitation skills

These issues may also be added to the general evaluation of the module.

4.1.3. The role of the facilitator in the assessment

Facilitation is a process that provides behaviour modelling and structural support for students. These functions remain the same during the assessment process: providing modelling of the assessment process for students, as well as enabling and encouraging them to carry this out in such a way that it will be useful (Wilkie & Burns, 2003).

The interaction between the facilitator and the students during the assessment process can happen in different ways (Wilkie & Burns):

- *Verbal, face-to-face assessment:* Student reflection on the material produced and its relation to the learning outcomes may be encouraged by the

facilitators by modelling the behaviour themselves, giving and receiving criticism in a positive, constructive and non-threatening manner (Wilkie & Burns, 2003). Other characteristics of the assessment process in which the facilitator can model the desired behaviour are confidentiality, stimulating open participation and discussion (including the non-verbal communication: body language, facial expression, gestures and voice tones, to name but a few), focus on behaviours rather than personality since the latter is much harder to modify than the former.

- *Written questionnaires*: Another option is to carry out assessments with written questionnaires. Different scales may be used to reflect the different ranges of the assessment, from narrow ones (such as “Yes/No”), to other scales with a wider range of values (e.g., “Very appropriate, Appropriate, Not Very Appropriate, Inappropriate”).

4.2. Module Evaluation

According to Wilkie & Burns (2003), module evaluation in PBL has three main purposes:

- to validate, thus justifying the activity and providing a rationale for its continuance,
- to improve by building on acceptable practice and
- to condemn through the highlighting of poor practice and inadequate processes

These processes ensure the quality of the module delivered to the students.

4.2.1. Acting on findings

The evaluation design must take into consideration who is going to receive the evaluation, and what is going to be the intended use of this evaluation.

This also has to take into account that it will not always be possible to record the evaluation, especially when this is undertaken orally, although student, facilitator and/or evaluator's personal notes may be available, and may be used to extract in-

formation and highlight any issues. Nevertheless, the evaluation must remain confidential to the facilitator and the team.

If the evaluation is undertaken using written supports, such as questionnaires, statistical information could be used to develop further awareness by creating reports and identify trends. These questions may be approached using yes/no questions, or with “graded” answers (e.g. “always, sometimes, never”). An opportunity for students / evaluators to express their own points of view outside these options should also be provided, using resources such as “free text”, to capture information not considered by the evaluation team.

A combination of both methods may also be useful to identify problems and difficulties common to all teams, which may be of importance and interest for those in charge of timetabling and resourcing of the different modules, and inform any future decisions considered.

4.2.2. Questions for the evaluation of the module

As it has been already mentioned earlier in this dissertation, the nursing informatics module described in this dissertation was not delivered to real student groups. This was due to the unavailability of student groups to pilot this approach.

As a consequence, a formal evaluation of its contents and delivery is not possible within this dissertation. Nevertheless, a set of questions that are relevant from the author's point of view for the rating of this module by students are provided. These are (based on TCD Quality Office, 2004):

Module content and level

1. The content of the module was of interest
2. The relevance of each aspect of the curriculum was made clear

Student learning and engagement with the subject

1. The module encouraged me to think critically
2. The module has developed my interest in the subject
3. The way the module was delivered encouraged me to participate
4. The module encouraged my own study of the subject

Student assessment and module evaluation

5. I fully participated in discussions in this module
6. This course enabled me to acquire problem-solving skills

Module work and its assessment

1. The feedback on my assessments has helped me to see where I need to concentrate my efforts

Delivery and continuity

1. Advice and support was available when I needed it

Projects

1. The project was intellectually stimulating
2. The project was challenging

The facilitator

1. Was courteous towards students
2. Was enthusiastic about the subject
3. Communicated clearly and effectively
4. Encouraged me to participate
5. Encouraged reflection
6. Encouraged me to learn
7. Could be contacted for advice if needed

Overall rating for modules

1. The module was appropriate for the curriculum

These questions are designed to provide ratings from the students on the module. The use of the word “rating”, rather than “evaluation”, is intentional. According to Clark (2001), “rating” implies a source of data, while “evaluation” implies that we have an answer. The learners provide information which, combined with other sources of information, shape a total evaluation. Learners are not always on target, thus their ratings can provide valuable information, but they cannot always tell evaluators everything needed in order to make a valid assessment of the training.

4.3. Summary

In this chapter, we have seen the process of student assessment, and module evaluation in relation to PBL. These are crucial steps to ensure the quality of student learning and of the module.

In the following chapter we'll see a review of the work done, a summary of the contributions made by this dissertation, and a summary of the future work required.

CHAPTER 5. CONCLUSIONS AND FUTURE WORK

5.1. Review of this dissertation

In this dissertation, a modular programme to deliver nursing informatics education to undergraduate nursing students has been developed. The approach chosen for this has been problem-based, since it is important to ensure a perception of usefulness of this subject to ensure its successful introduction in the curriculum, and Problem-Based Learning is a suitable candidate to achieve this.

This dissertation started by analysing the reasons for the introduction of nursing informatics in the undergraduate nursing curriculum: it is important to involve nurses in the field of informatics to aid their practice, as well as improve the information tools at their disposal. Following this, chapter 2 presented an overview of the state of the art in nursing informatics and Problem-Based Learning. This overview included an introduction to the relevant concepts and historical developments in both fields. A small research conducted during the course of the preparation for this dissertation regarding the current situation of nursing informatics in undergraduate nursing curricula in Ireland for the academic year 2005-2006 was also presented. The results of this research show that nursing training in Ireland does not contemplate any issues related to nursing informatics. There is a small number of schools that do include some form of IT literacy in the first year of their curricula. As it was argued during the course of this dissertation, this preparation is insufficient, as IT literacy for nurses is not equivalent to nursing informatics.

The module prepared was analysed in chapter 3. In this chapter, the context of this programme is introduced, including issues such as module prerequisites, the definition of learning aims and outcomes, the planning of the module delivery, and the preparation of any other teaching strategies. This is followed by the four problems designed for this module, which include the scenario describing the initial situ-

Conclusions and future work

ation, the questions used as prompts for student learning, and the facilitator's guide. Finally, an analysis on each individual problem is performed, describing their relation to the learning outcomes defined earlier.

In chapter 4, issues surrounding student assessment and programme evaluation were explored. Due to the fact that there is a number of important factors that are unknown at present, and that have an impact on the way the student assessment is designed and prepared, it was decided not to produce any specific materials for the assessment. This allows greater freedom for future piloting of this material with real students. Since there weren't any student groups available to pilot this module, it was not possible to test the materials produced in this dissertation. Some suggestions on questions that may be relevant to this end are presented here. Nevertheless, an evaluation following the piloting of this approach with real students is currently future work to be undertaken.

During the preparation of this dissertation, the author has followed a Problem-Based Learning process. This included learning about:

- *issues directly related to the content of the dissertation*, such as education and PBL itself, academic design, academic assessment and evaluation, specific research on the situation of health and nursing informatics education, both at Irish and international levels
- *issues not directly related to the content of the dissertation*, such as nuances of the English language (e.g. research the differences between *will* and *shall*, or sentence structure), technical issues (i.e. word processing with OpenOffice.org Writer, Network File System (NFS), OpenSSH, Version Control Systems), standards on referencing, and how to write a dissertation
- *reflection on the learning process*, such as these particular lines, which relate to the concept of self-evaluation in PBL

This PBL process has been both challenging and rewarding. Furthermore, it helped the author develop new knowledge and understanding in many subjects, both familiar and new.

5.2. Summary of dissertation contributions

The main contributions from this dissertation can be summarised as follows:

- *Module learning materials for a PBL approach to PBL:* including a scenario and a facilitator's guide for each of the four problems
- *Design of the module of nursing informatics for undergraduate students:* this includes the design of the learning objectives for the module, the definition of the prerequisites, the choice of PBL as the instructional strategy to deliver the content, and the planning of the sessions
- *Research on nursing informatics in undergraduate nursing curricula in Ireland, for the course 2005-2006:* this research showed a very low presence of computer related issues in the undergraduate nursing curricula in Ireland. However, a more comprehensive research of this subject remains as future work

5.3. Future work

This dissertation covered a large area of knowledge, including Problem-Based Learning, nursing education, and health and nursing informatics. However, due to time constraints and the unavailability of a student group to test the module, following this dissertation, these tasks remain as future work:

- formal piloting of the nursing informatics module with undergraduate nursing students,
- assessment of a pilot group of undergraduate nursing students after taking this module, and
- formal module evaluation

Future work should also focus on a more comprehensive analysis of undergraduate nursing curricula at Irish and European / international level. Currently, this is a very underdeveloped area within the nursing curricula for undergraduate students in Ireland. A more thorough assessment of the situation may shed some light on how to improve the current situation.

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APPENDIX

These are the websites checked to gather information regarding nursing informatics in undergraduate programmes in Ireland. These sites were viewed on September 7th, 2005.

Name	Webpage
Athlone Institute of Technology (AIT)	http://www.ait.ie/courses/science/bscnursgennurs.shtml
Dublin City University, (DCU)	http://www.dcu.ie/registry/module_contents.php?function=4&programme=BNGN http://www.dcu.ie/registry/module_contents.php?function=2&subcode=NS110
Dundalk Institute of Technology (DKIT)	http://www.dkit.ie/index.asp?id=569
Galway-Mayo Institute of Technology (GMIT)	http://www.gmit.ie/prospective_students/prospectus2005/Nursing/GA810/index.html
Institute of Technology Tralee (IT Tralee)	http://www.ittralee.ie/Courses/SchoolofScienceComputing/NursingandHealthCareStudies/TL110TL111-BScHONSinNursingGeneralNursing/
Letterkenny Institute of Technology (LYIT)	http://www.lyit.ie/courses/nursing/Bsc_Hons_general_nursing.html
National University of Ireland Galway, (NUIG)	http://www.nuigalway.ie/cns/bachgensci.html#3
Royal College of Surgeons in Ireland, (RCSI)	http://www.rcsi.ie/faculty_nursing/prospectus/FONProspectus05.pdf
St Angela's College	http://www.stacs.edu.ie/depts/nurse/index.htm
University College Cork (UCC)	http://www.ucc.ie/academic/nursing/postprog/BSNursingflyer.pdf
University College Dublin (UCD)	http://www.ucd.ie/prospec/2005/medsci.pdf

Name	Webpage
University of Dublin Trinity College (TCD)	http://www.tcd.ie/Nursing_Midwifery/courses/undergrad_bsc_cur.php
University of Limerick (UL)	http://www.ul.ie/admissions/newprospectus/Undergraduate/colleges/science/LM150.shtml
Waterford Institute of Technology (Waterford IT)	http://www.wit.ie/sos/cns.html

Table 6 Sources of information in nursing undergraduate programmes