2012

A Case Based Learning Model in Therapeutics

Ângelo Jesus

Maria João Gomes

Agostinho Cruz

A Case Based Learning Model in Therapeutics

Ângelo Jesus[1,2], Maria João Gomes[2], Agostinho Cruz[1]
[1]Nucleo de Investigação em Farmácia, Centro de Investigação em Saúde e Ambiente, Escola Superior de Tecnologia da Saúde do Instituto Politécnico do Porto (PORTUGAL)
[2]Centro de Investigação em Educação, Instituto de Educação, Universidade do Minho (PORTUGAL)
acj@estsp.ipp.pt

Keywords: Case Based Learning, Therapeutics, Case Studies

Abstract
Nowadays, learning a Pharmaceutical Profession is an increasing challenge. Apart from traditional texts, lectures and self-guided individual learning, pharmaceutical educators are encouraged to find and implement ways to promote higher order thinking, collaborative learning and to increase students' motivation. One way of achieving these objectives is to complement traditional learning methods with the development and implementation of Case Based Learning (CBL), supported in real life situations. Methods regarding real problems stand in contrast to a more traditional approach to learning and instruction. They promote learner-centered, small group, interactive learning experiences, instead of large group, didactic, teacher-centered instruction. Developing such a learning approach can be a challenge. In this sense, it becomes relevant to promote and share experiences already underway and by doing so, disseminate knowledge in this field. It is our goal with this text to share our experience in the design and implementation of a Case Based Approach to Therapeutics.

1   Introduction

Significant changes in national health care systems worldwide are fuelling a critical examination of how health professionals are being educated and trained, what they learn and, more importantly, how they learn it. Many of the factors contributing to these changes are presented in the World Health Organization's (WHO) Ninth General Programme of Work (H. Bryant & F. Harrison, 1996). WHO considers essential that all health professionals (Pharmaceutical Professionals included) are appropriately and adequately prepared to support a global policy framework for health. The changes referred by WHO are a reflection of the constant evolution of professions and professionals. Over the past sixty years, in many parts of the world, the Pharmaceutical Profession has lost three of the four pillars of the structure that has traditionally been the mainstay of its work since the eighth century – that of drug procurement, storage and the compounding of drugs. For many, only the fourth and last function remains – the task of dispensing. A fifth pillar, that of pharmaceutical care, has been added in recent years and will probably define the role of the Pharmaceutical Professionals (Morgall & Almarsdóttir, 1999). Where it was once the case that Pharmaceutical Professionals stayed within the dispensary, compounding and dispensing medications; there has been an increasing trend towards spending more time communicating with patients. Several years ago, WHO has organized three meetings on the potential role of Pharmaceutical Professionals in the health care system: in New Delhi in 1988, in Tokyo in 1993, and in Vancouver in 1997. The first meeting outlined the various activities and responsibilities of Pharmaceutical Professionals, namely regulatory control and drug management, legislation, procurement, storage and distribution of drugs, drug information, quality control, community and hospital pharmacy, industrial pharmacy, and academic activities. The second introduced the new concept of pharmaceutical care as a means of furthering the rational use of drugs and of actively participating in illness prevention and health promotion, and the third one was on developing curriculum for the education of future Pharmaceutical Professionals (WHO, 1988) (WHO, 1993). In the third and last reunion, the consultancy agreed that contemporary and future Pharmaceutical Professionals must possess specific knowledge attitudes, skills and behaviors in support of their roles (WHO, 1997). Although these roles go beyond those previously described in official WHO publications and policies, they should be considered essential expectations of national health care systems worldwide:

- **Care-giver** - The Pharmaceutical Professional should provide caring services. Whether these services are clinical, analytical, technological or regulatory. The

Corresponding author: Ângelo Jesus, Assistant Professor
ERASMUS Contact Person | Pharmacy Degree
School Of Allied Health Sciences.
Polytechnic Institute Of Oporto
Rua Valente Perfeito, nº 322
4400 - 303 Vila Nova de Gaia, Portugal

Pharmaceutical Professional must be comfortable interacting with individuals and populations and should view his or her practice as integrated and continuous with those of the health care system.

- **Decision-maker** - the appropriate, efficacious and cost effective use of resources (e.g., personnel, medicines, chemicals, equipment, procedures, practices) should be at the foundation of the pharmaceutical professional's work. Achieving this goal requires the ability to evaluate, synthesize and decide upon the most appropriate course of action.

- **Communicator** - the pharmaceutical professional is in an ideal position between physician and patient. As such, he or she must be knowledgeable and confident while interacting with other health professionals and the public. Communication involves verbal, non-verbal, listening and writing skills.

- **Leader** - whether the pharmaceutical professional finds him/herself in multidisciplinary (e.g., team) caring situations or in areas where other health care providers are in short supply or non-existent, he/she is obligated to assume a leadership position in the overall welfare of the community. Leadership involves compassion and empathy as well as the ability to make decisions, communicate, and manage effectively.

- **Manager** - the pharmaceutical professional must effectively manage resources (human, physical and fiscal) and information; he or she must also be comfortable being managed by others, whether an employer or the manager/leader of a health care team. More and more, information and its related technology will provide challenges to the pharmaceutical professional as he/she assumes greater responsibility for sharing information about medicines and related products.

- **Life-long-learner** - it is no longer possible to learn all, one must learn in school in order to practice a career as a Pharmaceutical Professional. The concepts, principles and commitment to life-long learning must begin while attending pharmacy school and must be supported throughout the career.

- **Teacher** - the Pharmaceutical Professional has a responsibility to assist with the education and training of future generations. Participating as a teacher not only imparts knowledge to others but it also offers an opportunity for the practitioner to gain new knowledge and to fine-tune existing skills.

Ultimately, these updates on the Pharmaceutical Professions highlight the need to introduce changes in educational strategies in Pharmacy Schools and Colleges, educational strategies that focus on real problems of Pharmaceutical Practice.

2   EDUCATIONAL STRATEGIES

Nowadays, learning a Pharmaceutical Profession is an increasing challenge. The student is required to develop a vast and complex range of intellectual, visual and manual skills, as well as to take into account large amounts of factual information, and practice technical and technological procedures. Apart from traditional texts, lectures and self-guided individual learning, pharmaceutical educators are encouraged to find and implement ways to promote higher order thinking, collaborative learning and to increase students' motivation (Jesus, Cruz, & Gomes, 2011a). One way of achieving these objectives is to complement traditional learning methods with the development and implementation of Case Based Learning (CBL), Problem Based Learning (PBL) or Simulation Based Training (SBT), supported in real life situations. The incorporation of real problems in pharmaceutical education is seen as an effort to prepare future health professionals to meet the challenging demands of the profession, in particular, the provision of quality patient care. The foundations of this method can be traced back to Dewey (Dewey, 1997), an early educational philosopher, who suggested that students should be presented with real life problems and then helped to discover the information required to solve them. Furthermore, Dewey encouraged reflection as a process that should be used when problem solving. The author recognized that we can "reflect" on a whole host of things in the sense of merely "thinking about" them, however, logical or analytical reflection can take place only when there is a real problem to be solved (Cisneros, Salisbury-Glennon, & Anderson-Harper, 2002). McMaster University recognized the importance of Dewey's axiom for medical education, and created a curriculum that applied the PBL approach to teach medical students (Neufeld & Barrows, 1974).

All methods regarding real problems stand in contrast to a more traditional approach to learning and instruction. They promote learner-centered, small group, interactive learning experiences, instead of large group, didactic, teacher-centered instruction. Professors facilitate or tutor, rather than lecture. A curriculum that presents such problem solving activities tends to trigger interdisciplinary learning opportunities as opposed to curriculum contained in discipline-based texts and presentations (Cisneros et al., 2002). As such, students are free to pursue determined learning issues in contrast to students in more traditional curriculum who might focus on identifying what material the professor will include on examination. After McMaster

University, innovative techniques were massively reported, several medical and allied health science programs made changes to their curriculum in order to incorporate one of more aspects of PBL, CBL or similar approaches.

2.1 Case Based Learning

Case Based Learning, is an educational paradigm closely related to the more common PBL. CBL's main traits derived from PBL are that a case, problem, or inquiry is used to stimulate and underpin the acquisition of knowledge, skills, and attitudes. Cases place events in a context that promote authentic learning (Williams, 2005) Cases are generally written as problems that provide the student with a background of a patient or other clinical situation. Supporting information is provided, such as latest research articles, vital signs, clinical signs and symptoms, and laboratory results. CBL allows students to develop a collaborative, team based approach to their education (Jesus, Gomes, & Cruz, 2012), and promotes the consolidation and integration of learning activities (Schmidt, 2000; Williams, 2005). Other benefits may include (Barrows, 1986; Williams, 2005):

- development of intrinsic and extrinsic motivation,
- encouraging of self-evaluation and critical reflection,
- allowing scientific inquiry and the development of support provision for their conclusions,
- integration of knowledge and practice,
- development of learning skills.

The fundamental difference is that PBL requires no prior experience or understanding in the subject matter, whereas CBL requires the students to have a degree of prior knowledge that can then assist in solving the problem. The case-based format requires students to recall previously covered material to solve clinical cases, which are based on clinical practice (Garvey, O'Sullivan, & Blake, 2000). As such, CBL is more supportive of the learner than PBL, since students in PBL are expected to locate their own resources, whereas CBL generally provide resources in the form of background information to students which helps lower the burden.

2.2 Findings of the CBL approach – a Brief Review

The implementation and assessment of CBL is well documented in various levels of biomedical sciences such as Medicine (Srinivasan, Wilkes, Stevenson, Nguyen, & Slavin, 2007), (Jamkar et al., 2008), Geriatrics (Struck & Teasdale, 2008), Nursing (Yoo, Park, & Lee, 2010), Therapeutics and Medicinal Chemistry (Ives, Deloatch, & Ishaq, 1998), Pharmaceutics (Romero, Erikson, & Haworth, 2004), Obstetrics and Gynecology (Massonetto, Marcellini, Assis, &

de Toledo, 2004), Anatomy (Peplow, 1990), Orthodontics (Engel & Hendricson, 1994) and Allied Health (McKay & White, 2003).

In all the latter mentioned examples, the clinical cases presented three essential elements summarized by Merril (2003):

1. They are real or based in real-life situations.
2. They require the learner to carefully research and study to understand the scenario.
3. They encourage the user to develop multiple perspectives based on material from the case.

We found several differences in the studies analyzed, namely regarding, characteristics, and the time of case distribution to the students, and the number of students involved. However, in all situations, the student had previous contact with text materials or even lectures related to the topic in question. Class activities were normally structured around active and collaborative learning principles, and in all cases except one (Ives et al., 1998), the class size was diminished compared to traditional lecture classes. The cases were generally discussed in groups ranging from 6-10 members depending on global class sizes. All case study classes are facilitated by a tutor, normally a faculty member. Each group is then interviewed by the tutor at the end of the case study session. Normally the entire class is present for the interview, but individual questions are directed to one student at a time, with some additional general questions posed for anyone in the group to answer. The interview period lasted, on an average 5 -10 minutes for each group, and normally each student is asked to answer questions on a specific area/topic of the case study. To encourage a wider understanding of the case study, the questioning of each student was sometimes broadened as the student showed the ability to answer more complex questions (Romero et al., 2004). There is also a possibility for other groups to intervene if requested.

Regarding the effectiveness of the CBL as a learning vehicle, most studies are unanimous when affirming it. According to Yoo et al. (2010), significant group differences were observed in clinical decision-making and learning motivation, and post-test scores of clinical decision-making in the CBL group were statistically higher than the control group. Also Jamkar et al. (2008) reports that CBL group students scored better in short answer question and extended matching question assessment, ($p =0.01$) (Romero et al., 2004). Their mixed CBL/PBL experiment also reported a good relationship between student learning and case study performance as measured by grades in writing case study reports and examination scores. Concerning, students' perspectives

about the CBL driven approach, the findings are also agreeable. Massonetto et al. (2004) reports that students gave higher ratings to the CBL approach (p=0.05). Also Struck & Teasdale (2008) and Engel & Hendricson (1994) indicate that students rated the CBL approach positively, mainly due to the interactive nature of sessions and longitudinal nature of the cases. On this matter, the study conducted by Ives et al. (1998) thoroughly addresses students, who indicate that CBL improves understanding and application of clinical concepts. We only identified one study comparing CBL to PBL (Srinivasan et al., 2007). In this study, the authors tried to compare faculty and medical students' perceptions of traditional PBL with CBL after a curricular shift at two institutions. Over periods of three years, the medical schools at the University of California, Los Angeles (UCLA) and the University of California, Davis (UCD) changed first-, second-, and third-year Doctoring courses from PBL to CBL formats. Ten months after the shift (2001 at UCLA and 2004 at UCD), students and faculty who had participated in both curriculum completed a 24-item questionnaire about their PBL and CBL perceptions and the perceived advantages of each format. A total of 286 students (86%-97%) and 31 faculty (92%-100%) completed questionnaires. CBL was preferred by students (255; 89%) and faculty (26; 84%) across schools and learner levels. From logistic regression, students preferred CBL because of fewer unfocused tangents (59%, odds ration [OR] 4.10, P = .01), less busywork (80%, OR 3.97, P = .01), and more opportunities for clinical skills application (52%, OR 25.6, P = .002).

2.3 Bologna Process and the European Higher Education Area

Launched in 1999 by the Ministers of Education and university leaders of 29 countries, the Bologna Process aimed to create a European Higher Education Area by 2010; it has further developed into a major reform encompassing 46 countries. The Bologna Process did not aim to harmonize national educational systems, but rather to provide tools to connect them (European Commission, 1999). The intention was to allow the diversity of national systems and universities to be maintained while the European Higher Education Area improved transparency between higher education systems, as well as implemented tools to facilitate recognition of degrees and academic qualifications, mobility, and exchanges between institutions. All participating countries all agreed on a comparable three cycle degree system for undergraduates (Bachelor degrees) and graduates (Master and PhD degrees). The Bologna Declaration also points to a new educational paradigm, that of a student-centered learning, opening up the potential for interdisciplinary training, with an easier diversification and articulation of basic with the specialized training. However, implementation of this new paradigm was

not made immediately. It was a culture change, and like all cultural adaptations, it took time to happen. For the Bachelor of Science in Pharmacy, the functional content is described in Decree-Law No. 261/93 of 24th July and 564/99 of 21st December, and although lacking an upgrade, the Bachelor of Science in Pharmacy, should be able to develop activities in the medicines circuit, such as analysis and pharmacological tests, interpretation of medical prescription, including those relating to compounding formulations; preparation, identification, distribution and conservation of pharmaceutical formulations, stock managing of drugs and other health products and of course, provide information and advice about the use of drugs. With the introduction of the Bologna Process in Portugal, the School of Allied Health Sciences of Porto saw this opportunity to put in practice Dewey´s axiom, and implement Case Based Learning in several disciplines, one of them being Therapeutics. The purpose of using case studies, is to present the student with a scenario as close to that which he may encounter in their professional life, in order that the student may be able to work through the problem and devise reasonable and workable solutions. A good case study must not provide answers. Rather, it should raise questions and allow the students to work through the decision-making process. As such, a teaching environment generated in CBL is one where the student must actively participate in order to meet the learning objectives. Through this process, much of the responsibility for learning is naturally centered on the student.

3 INSTRUCTIONAL DESIGN APPLIED TO CASE STUDIES

Despite the proliferation of instructional design models, several elements are common to most of them. These common elements are defining leaning objectives, determining sequence and structure of content, determining the instructional strategies and methods for presenting the material, and developing the curriculum (Tripp & Bichelmeyer, 1990). Most models include evaluation and feedback at some stage in the process. The major discrepancy in the numerous models is in the method or approach to design. Although almost every model presented in the literature is linear, some debate has been generated regarding the linearity of the models. The fast-paced, time-intensive process of instructional design doesn't always allow you to follow a step-by-step process. Many of the steps occur concurrently or, in some cases, not at all. This was one of the major concerns with the faculty, considering that the entire curricula had to be adapted. Considering also that the adaptation was progressive, we choose to follow a variant of the Rapid Prototyping Model (Tripp & Bichelmeyer, 1990). Although usually applied in educational technology, it seemed to fit the demands of this challenge (Figure1).

3.1 Analysis of the Therapeutics Curriculum

The entire therapeutics curriculum was subject to analysis. In order to streamline the process, the faculty designed a workflow of action, and several focus groups were assembled consisting of faculty members and colleagues with professional activities outside the school. It was necessary to analyze each point of the curriculum where the case studies were going to be implemented. Ascertain the learner´s features and instructions needs for each curricular year and topic. This was a progressive work and was performed during one curricular year. Some examples of topics and cases being covered are available in Figure 2. For a deeper understanding, some examples of cases and the respective learning objectives are provided in Figure 3.

The tutor's characteristics were also object of analysis. According to Williams (2005), the most common area of enquiry relating to desirable CBL tutor characteristics concerns the issue of whether the tutor should be an expert in the subject matter related to the problem under study. Considering the variety of subjects being taught, it´s not possible to guarantee an expert tutor on each topic being covered. Nevertheless it is necessary to define some basic guidelines for tutor selection. Pedagogical background (for example as a licensed instructor or with previous teaching background) and an active role in professional activities outside the School were the two basic requirements.

3.2 Design

There are two questions that arise to anyone who is interested in using the case based approach – how are we going to write the case, and how are we going to teach it (Herreid, 1994). While designing an effective case study can be time consuming, basing cases on actual events or experiences can help limit the initial investment of time (Center for Teaching and Learning, 1994). As health professionals, we have been confronted with complex issues in our own research or teaching that can often naturally lead to a story others will learn from. Turning experiences into cases can be as simple as outlining the major components of a problem to be solved, or can require gathering materials that are necessary background to the circumstances. Because the case study approach is now being used in several disciplines, relying on published cases can save preparation time. After selecting and adapting the case studies, a set of teaching notes were also written. The notes are intended to help the instructor understand the reason the case study was written, the questions that might arise from it and the professional or theoretical points that might be raised in discussion. The teaching notes can be useful for the author of the case and for any subsequent instructor using the case. According to Herreid, (1994), in the same way that students

should prepare a case, it's important that the instructor knows the directions the discussion might take. Since one of the goals of teaching with a case is to monitor students' ability to apply knowledge and principles to real experiences, it's useful to identify the major concepts, connections and reasoning's that students should reach.

3.3 Implementation

The cases used in the Therapeutics CBL classes are in paper format and are based, or adapted from, real situations from professional practice or from published literature. They are normally ill-defined so that the students can discover the course of action to pursue. Sometimes the cases need to be simplified to allow students to focus on one main therapeutic area. However, as we grow in complexity, and in order to prepare students for practice in settings in which patients often are receiving multiple medications (especially elderly patients) it is important to gradually expose them to cases with multiple issues and drug-related problems. This emphasizes the interrelationship between conditions and how to set priorities while settling multiple drug-related problems (Raman-Wilms, 2005). Including CBL sessions at several points in the curriculum, provides students with an opportunity to work through multiple therapeutic issues and serves as a review of previously learned information, as students are now required to apply the same information in a different context. By assuring the opportunity to gradually work through more difficult topics, students are also able to gain the required knowledge and develop their skills in assessment and management of drug therapy problems (Raman-Wilms, 2005). For each week the students should focus on one or two case studies, related to pharmacology topics being covered at the time.

Student participation is central to the case based approach, and the effectiveness of the method is related to the proficiency with which students participate in case discussion. A week before the CBL class, scientific articles or reports, as well as a class guide, are presented to the students in the Open Source Course Management System, Moodle (Moodle Pty Ltd, Perth, Western Australia). By doing this, we are trying to ensure that the students focus on particular points of the subjects in order to better understand the clinical case that will only be presented in class. Once in class, the students are divided in case-study groups of about 4 students. Normally there are 4 groups in each class. The allocation of students to groups is random and maintained during the semester. Development of group dynamics is an important element of the course, and best achieved if students have to work with colleagues who they don´t necessarily know well (Johnson & Johnson, 1994). The development of groups in collaborative

and cooperative learning is a topic of great interest, but beyond the scope of this paper[1]. The case study per se has the description of the situation and a set of questions/guidelines that the students must address during the class. Students should then work collaboratively with their group members, in order to present solutions to the problem. It is their responsibility to:

a) recognize symptoms and correlate them with the illness,
b) locate critical information to clarify and solve the problem,
c) explain pharmaceutical care problems in the case,
d) identify drug-interactions,
e) identify and select reasonable therapeutic alternatives and goals,
f) educate the patient.

At the end of the case study, each group is debriefed by the tutor. Individual questions are directed to a specific student, with some additional general questions open for anyone in the group to answer. There is also the possibility for other groups to argue if there are different points of view being discussed. The tutors should always have prepared a series of teaching notes for each case, but mainly, they should encourage the students' problem-solving strategies and ability to justify their treatment approaches rather than looking for just "one right answer".

3.3.1   Assessment issues

Traditional ways of evaluation are not entirely compatible with the nature of case-based learning. This approach assumes that the student has a leading role in the classroom, and the teacher should focus not only on the final product but also the process. In this type of learning approach we should value the work of the group, communication skills, reasoning and the ability to solve the case itself. Nevertheless, it is also valid concern of instructors to ensure the commitment of the student to follow the theoretical background. As such, individual and group assessments should be performed. Assessment in case-based learning can seem challenging. It is probably more subjective than some other methods and some teachers may be uncomfortable with that. However, with careful lesson planning and preparation, assessment in case-based learning can be done with efficiency and fairly. Students also can be uncomfortable

with assessment, especially those who are accustomed to multiple choice or other kinds of assessment that always have clear right and wrong answers. Wassermann (1994) asserts that the learning goals and objectives established at the beginning are key. Once those are clear, the next step is to establish standards and let students know exactly what is expected of them (Wassermann, 1994). We use a variety of objective and subjective techniques for evaluating students, both summative for the determination of grades and formative for the purpose of providing corrective feedback (Dick, Carey, & Carey, 2004). For individual assessment, mini-tests are periodically taken at the beginning of the class, relating the contents, the student should explore before coming to the CBL class. For group assessment, a benchmark was developed, including the following items:

a) ability to work in groups,
b) objectivity and consistency,
c) using correct scientific language,
d) referencing "mandatory" topics, depending on the case,
e) communicating ideas and opinions,
f) making and defending ideas.

Although one of the initial objectives was to move away from reliance on multiple choice and short answer testing, this objective has not been fully accomplished. At the end of the semester, a final exam is still performed. The questions relate to the clinical cases explored in the classes, and the questions are drawn in order to promote reflection on the topic at hand. The final examination only accounts for 30% of the final grade.

3.3.2   Lifespan of a Case Study in Case Based Learning

Case studies can easily become obsolete. For example, a case referring to cancer treatments may be out of date as soon as new protocols for oncology emerge and are established in clinical practice. Thus, when constructing case studies, it is worth considering the potential life of the work in relation to the amount of work put into its creation. And most importantly, it is imperative that the teacher be able to keep up with the newest, most reliable evidence and practices in professional activity, in order to provide up-to-date cases.

3.4 Feedback and Maintenance
For a feasible maintenance and evolution of the CBL approach, its necessary to retrieve feedback from all stakeholders. Informal interviews were performed with faculty members and students, and surveys were conducted with the students.

---

[1] Further information about the topic can be found in: Felder, R.M., & Brent, R. (2001). Effective strategies for cooperative learning. *Journal of Cooperation and Collaboration in College Teaching*, 10(2), 69-75. And in Oakley, B., Felder, R.M., Brent, R., & and Elhajj, I. (2004). Turning student groups into effective teams. *Journal of Student Centered Learning, 2*(1), 9–34.

3.4.1   Faculty

Initially, it was difficult to coordinate the structure of the case studies. Another difficulty from a facilitation perspective focused on managing the classroom, making sure that every person was recognized and was engaged in the discussion. Keeping the case within the boundaries of the learning objectives and summarizing, and were also seen as challenges. Faculty members argued that instructors themselves should have extra pedagogical training, to help them in the design and implementation of the CBL classes. This training should be financed by the institution and promoted among all potential instructors. This was actually an idea that later was set in to practice by the School Board. Regarding topics being covered, most of the interviewed agreed that the CBL approach requires more time than traditional methods to cover the same content; however they recognized the benefits of the method to students´ development of critical thinking, self-study and presentation skills.

3.4.2   Students

The students had no previous experience with CBL. It was unclear for them how to prepare properly for a class, and it became quite intimidating because they did not understand what was expected of them in class. This feeling was progressively diminished, with the follow-up. They were also uneasy, when discussing cases with peers, and with the instructor, since this they did not feel confident when speaking in public. However, the opportunity for interaction with peers was perceived as important i.e., making statements in class and defending them and relating to other students' statements. The cases forced the students to think as professionals. The cases stimulated the students to read continually during the semester, not just the last week prior to the final examinations, which helped them to understand more what type of situations could arise during professional practice.

In the 2010/2011 academic year an online survey (n=82 students) was conducted, and it generally shows a positive response to the CBL approach in Therapeutics (Table 1). Students generally agree that the CBL approach helped them understand theoretical concepts, required them to go to class prepared and spend more time learning on their own. Students also reported that the class guide is a useful tool in the preparation of classes. They also generally agreed that the instructors give adequate feedback during classes. Some criticism was expressed regarding class pace and frequency. When this topic was later addressed, students indicated that the number of classes per week, specifically the ones with individual assessments, were very high. After an appraisal of

the first year, the number of individual assessments per week was reduced, anticipating that the students would be less stressed, and more focused on solving the cases. When talking about interaction and discussion among students, most of them agreed or strongly agreed, although some students expressed the opinion that this approach may not allow all students to participate actively. Finally, the CBL sessions were identified as greater promoters of the professional life. In 2012, we delivered the same survey to ex-students (n=32), and 100% agreed that the CBL cases promoted great preparation for professional life.

Since the first archaic try in 2008, we have had the opportunity to perfect this teaching strategy. One of the first issues to address was faculty workload and proper design of case studies. At the beginning there was no way to overcome the increase in faculty workload. Cases had to be prepared - many times by individuals with no prior experience is such learning approach. The workload has progressively been lower, now that a set a case studies is already defined. Every year new instructors are trained and now, the case studies are reviewed by peers. It has been a continuous process of improvement. We are also pursuing new forms of assessment, with the use of interviews and role playing.

4.   LESSONS LEARNED

The implementation of CBL in the Pharmacy Curricula in the School of Allied Health Sciences of Oporto Polytechnic Institute is now a reality in various disciplines, from Therapeutics to Management and even Dermopharmacy. Although conversion of traditional courses to an active-learning approach has been challenging, faculty and students generally view the integration of CBL in the teaching of Therapeutics as positive and rewarding in terms of improving student participation, performance and motivation. Although demanding more learning time to cover the same content, the CBL approach promotes that students work together, retain key concepts and apply them to patient care situations. Students generally respond positively to this approach and realize its importance to future professional life. Continued efforts are still needed to, more thoroughly determine, the effectiveness of this approach in improving student learning and retention.

At the same time the possibility of integrating technology with the CBL approach in Therapeutics is an option currently being developed (Jesus, Cruz, & Gomes, 2011b). In fact, the field of pharmaceutical education and clinical training, educators and clinicians are increasingly recognizing the potential of information and communication technologies for learning, practice and evaluation of knowledge (H. L. D. Silveira, Gomes, Silveira, & Dalla-Bona, 2009). When applying these technologies

to the teaching of Therapeutics the possibilities multiply. The opportunity to create and use learning objects, use video logs of patients, simulators for drug action and metabolism and simulations of diagnostic exams should provide a case discussion, without risk to patients, and brings a new dimension to education. The construction of a student-centered online learning environment and its assessment (Jesus, Cruz, & Gomes, 2011b) is one of the research lines we are now pursuing, in order to implement an online CBL approach to Therapeutics (Jesus et al., 2012).

References

1. Barrows, H. S. (1986). A taxonomy of problem-based learning methods. *Medical Education*, *20*(6), 481–486.

2. Center for Teaching and Learning. (1994). Teaching with Case Studies. *Speaking of Teaching, Standford University Newsletter on Teaching*, *5*(2), 1–4.

3. Cisneros, R. M., Salisbury-Glennon, J. D., & Anderson-Harper, H. M. (2002). Status of Problem-Based Learning Research in Pharmacy Education: A Call for Future Research. *American Journal of Pharmaceutical Education*, *66*(1), 19–26.

4. Dewey, J. (1997). *Democracy And Education*. New York: Free Press.

5. Dick, W., Carey, L., & Carey, J. O. (2004). *Systematic Design of Instruction, The* (6th ed.). Allyn & Bacon.

6. Engel, F. E., & Hendricson, W. D. (1994). A case-based learning model in orthodontics. *Journal of Dental Education*, *58*(10), 762–767.

7. European Commission. (1999). The Bologna Process - Towards the European Higher Education Area. Retrieved from http://ec.europa.eu/education/higher-education/bologna_en.htm

8. Garvey, M. T., O'Sullivan, M., & Blake, M. (2000). Multidisciplinary case-based learning for undergraduate students. *European Journal of Dental Education: Official Journal of the Association for Dental Education in Europe*, *4*(4), 165–168.

9. H. Bryant, J., & F. Harrison, P. (1996). *Global Health in Transition: A Synthesis:Perspectives from International Organizations*. Washington, D.C.: The National Academies Press.

10. Herreid, C. F. (1994). Case Studies in Science--A Novel Method of Science Education. *Journal of College Science Teaching*, *23*(4), 221–29.

11. Ives, T., Deloatch, K. H., & Ishaq, K. S. (1998). Integration of Medicinal Chemistry and Pharmacotherapeutics Courses: A Case-Based, Learner-Centered Approach. *American Journal of Pharmaceutical Education*, *62*(4).

12. Jamkar, A. V., Burdick, W., Morahan, P., Yemul, V. Y., Sarmukadum, & Singh, G. (2008). Proposed model of case based learning for training undergraduate medical student in surgery. *Indian Journal of Surgery*, *69*(5), 176–183. doi:10.1007/s12262-007-0016-2

13. Jesus, A., Cruz, A., & Gomes, M. J. (2011a). Case Based, Learner Centered Approach to Pharmacotherapy. *Proceedings from EDULEARN 2011* (pp. 6074–6080). Presented at the Edulearn 2011, Barcelona: IATED.

14. Jesus, A., Cruz, A., & Gomes, M. J. (2011b). Implementação de Metodologias Blended-Learning no ensino da Farmacoterapia baseado em Simulações. *VII International Conference of ICT in Education- Perspectives on Innovation*. Presented at the Challenges 2011, Braga: Centro de Competência da Universidade do Minho.

15. Jesus, A., Gomes, M. J., & Cruz, A. (2012). A B-learning strategy for Therapeutics at the Bachelor Level. Presented at the FIP World Centennial Congress of Pharmacy and Pharmaceutical Sciences, Amsterdam: International Pharmaceutical Federation.

16. Johnson, R. T., & Johnson, D. W. (1994). An overview on cooperative learning. In J. Thousand, A. Villa, & A. Nevin (Eds.), *Creativity and Collaborative Learning*. Baltimore: Brookes Press. Retrieved from http://clearspecs.com/joomla15/downloads/ClearSpecs69V01_Overview%20of%20Cooperative%20Learning.pdf

17. Massonetto, J. C., Marcellini, C., Assis, P. S. R., & de Toledo, S. F. (2004). Student responses to the introduction of case-based learning and practical activities into a theoretical obstetrics and gynaecology teaching programme. *BMC Medical Education*, *4*(1), 26. doi:10.1186/1472-6920-4-26

18. McKay, J., & White, P. (2003). Case-based Learning Introduced into an Allied Health Programme. *International Journal of Learning*, *10*.

19. Merril, H. S. (2003). Case Study, Problem-Based Learning and Simulation in Online Graduate Courses. Presented at the The Annual Conference on Distance Teaching & Learning, University of Wisconsin. Retrieved from http://www.uwex.edu/disted/conference/Resource_library/proceedings/03_04.pdf

20. Morgall, J. ., & Almarsdóttir, A. . (1999). No struggle, no strength: how pharmacists lost their monopoly. *Social science & medicine (1982)*, *48*(9), 1247–58.

21. Neufeld, V. R., & Barrows, H. S. (1974). The "McMaster Philosophy": an approach to medical education. *Journal of Medical Education*, *49*(11), 1040–1050.

22. Peplow, P. V. (1990). Self-directed learning in anatomy: incorporation of case-based studies into a conventional medical curriculum. *Medical Education*, *24*(5), 426–432.

23. Raman-Wilms, L. (2005). Applying Therapeutic Knowledge and Skills in a Large Group Problem-Based Class. *American Journal of Pharmaceutical Education*, *69*(5).

24. Romero, R., Erikson, S., & Haworth, I. (2004). A Decade of Teaching Pharmaceutics Using Case Studies and ProblemBased Learning. *American Journal of Pharmaceutical Education*, *68*(2).

25. Schmidt, H. G. (2000). Assumptions underlying self-directed learning may be false. *Medical Education*, *34*(4), 243–245.

26. Srinivasan, M., Wilkes, M., Stevenson, F., Nguyen, T., & Slavin, S. (2007). Comparing problem-based learning with case-based learning: effects of a major curricular shift at two institutions. *Academic Medicine: Journal of the Association of American Medical Colleges*, *82*(1), 74–82. doi:10.1097/01.ACM.0000249963.93776.aa

27. Struck, B. D., & Teasdale, T. A. (2008). Development and evaluation of a longitudinal Case Based Learning (CBL) experience for a geriatric medicine rotation. *Gerontology & Geriatrics Education*, *28*(3), 105–114.

28. Tripp, S., & Bichelmeyer, B. (1990). Rapid prototyping: An alternative instructional design strategy. *Educational Technology Research and Development*, *38*(1), 31–44. doi:10.1007/BF02298246

29. Wassermann, S. (1994). *Introduction to Case Method Teaching: A Guide to the Galaxy*. Teachers College Press.

30. WHO. (1988). *The role of the pharmacist in the health care system: Report of a WHO consultative group*. New Delhi. India.

31. WHO. (1993). *Role of the pharmacist in support of the WHO revised drug strategy*. Tokyo.

32. WHO. (1997). *The role of the pharmacist in the health care system. Preparing the future pharmacist: Curricular development. Report of a third WHO Consultative Group on the role of the pharmacist*. Vancouver.

33. illiams, B. (2005). Case Based Learning—a Review of the Literature: Is There Scope for This Educational Paradigm in Prehospital Education? *Emergency Medicine Journal*, *22*(8), 577–581. doi:10.1136/emj.2004.022707

34. Yoo, M.-S., Park, J.-H., & Lee, S.-R. (2010). The effects of case-based learning using video on clinical decision making and learning motivation in undergraduate nursing students. *Journal of Korean Academy of Nursing*, *40*(6), 863–871. doi:10.4040/jkan.2010.40.6.863

Figure 1: Adaptation of "The Rapid Prototyping Model", for Instructional Design of Case Based Learning.
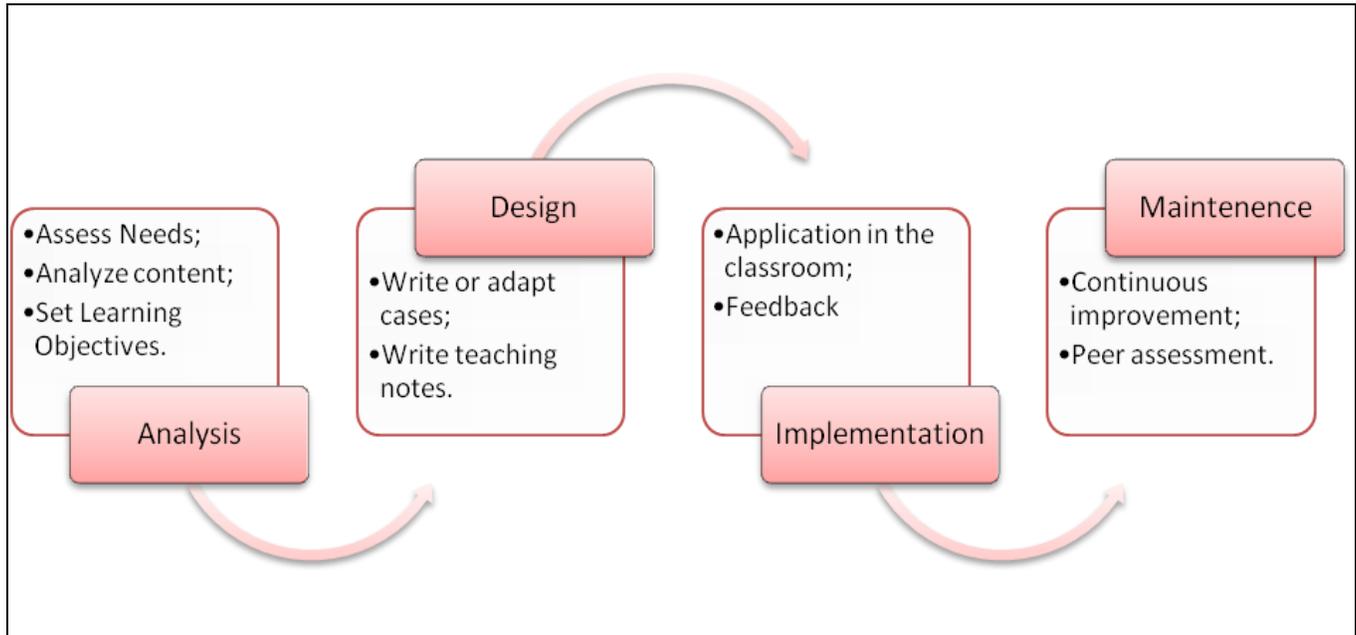

Figure 2: Examples of topics being covered and the respective case studies assigned.
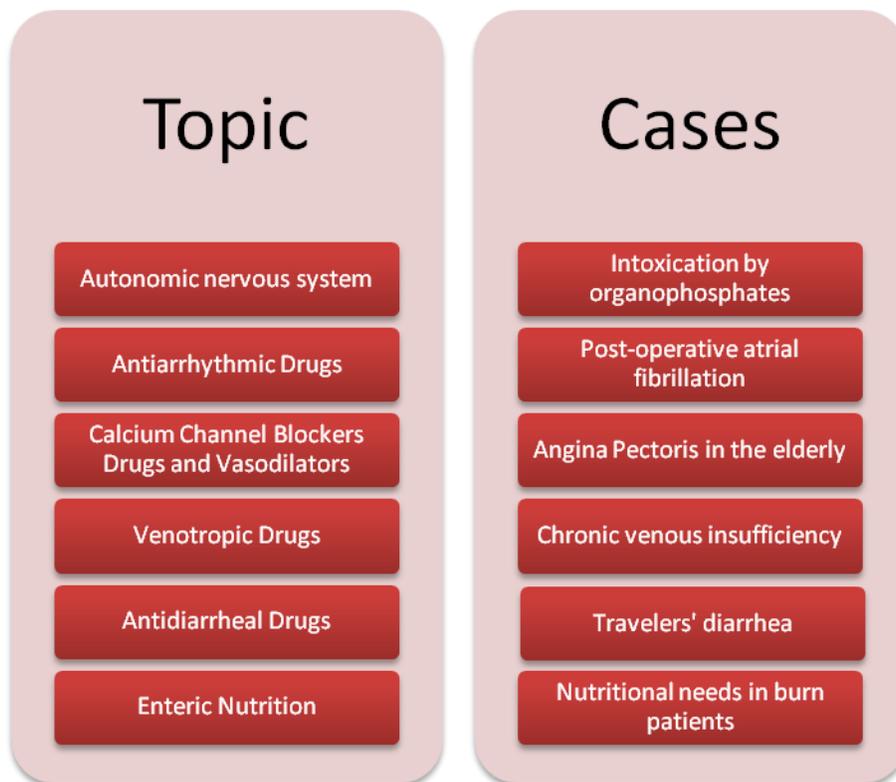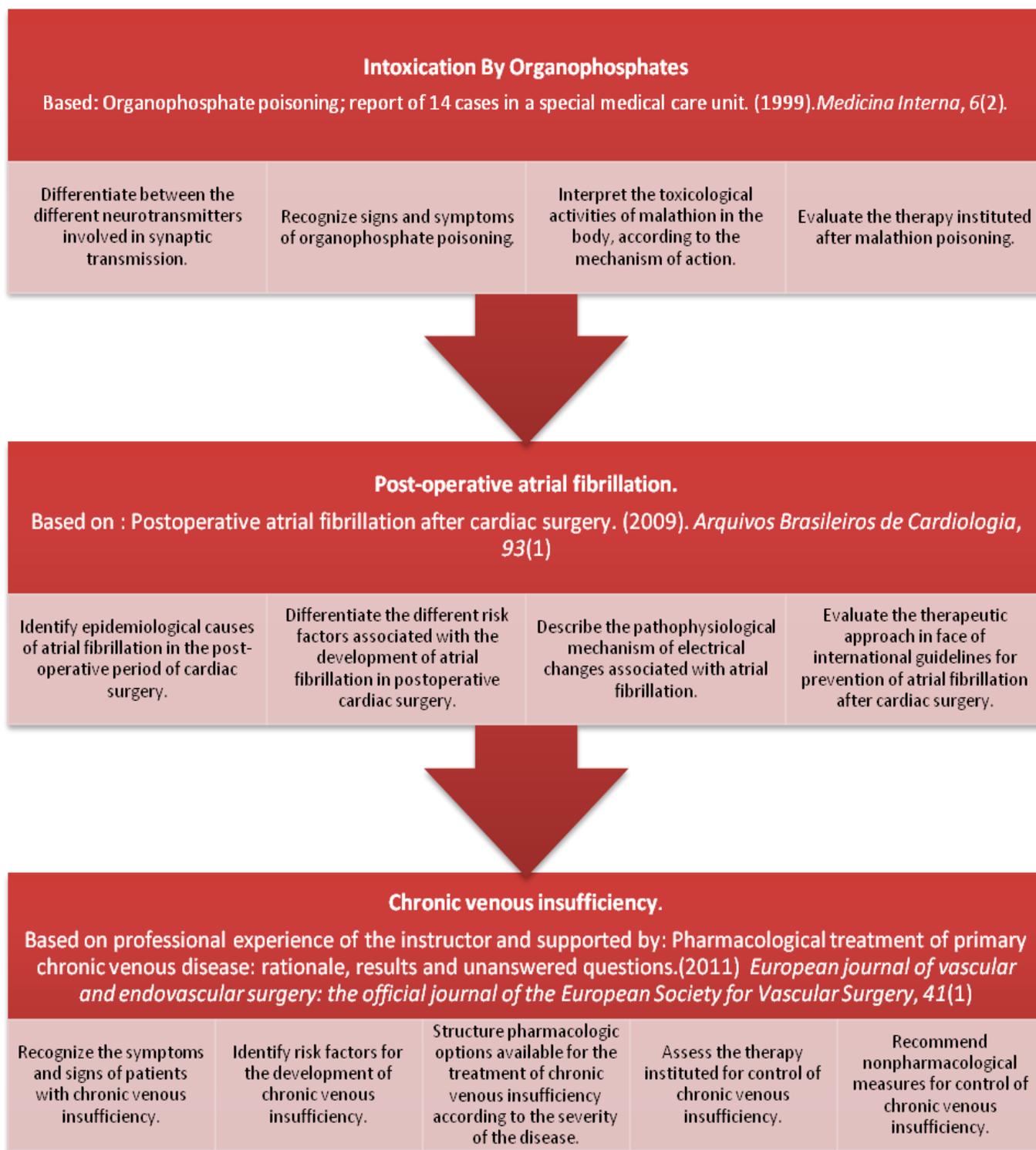
Figure 3: Examples of cases and learning objectives

Intoxication By Organophosphates

Based: Organophosphate poisoning; report of 14 cases in a special medical care unit. (1999).*Medicina Interna, 6*(2).

Differentiate between the different neurotransmitters involved in synaptic transmission.	Recognize signs and symptoms of organophosphate poisoning.	Interpret the toxicological activities of malathion in the body, according to the mechanism of action.	Evaluate the therapy instituted after malathion poisoning.

Post-operative atrial fibrillation.

Based on : Postoperative atrial fibrillation after cardiac surgery. (2009). *Arquivos Brasileiros de Cardiologia, 93*(1)

Identify epidemiological causes of atrial fibrillation in the post-operative period of cardiac surgery.	Differentiate the different risk factors associated with the development of atrial fibrillation in postoperative cardiac surgery.	Describe the pathophysiological mechanism of electrical changes associated with atrial fibrillation.	Evaluate the therapeutic approach in face of international guidelines for prevention of atrial fibrillation after cardiac surgery.

Chronic venous insufficiency.

Based on professional experience of the instructor and supported by: Pharmacological treatment of primary chronic venous disease: rationale, results and unanswered questions.(2011) *European journal of vascular and endovascular surgery: the official journal of the European Society for Vascular Surgery, 41*(1)

Recognize the symptoms and signs of patients with chronic venous insufficiency.	Identify risk factors for the development of chronic venous insufficiency.	Structure pharmacologic options available for the treatment of chronic venous insufficiency according to the severity of the disease.	Assess the therapy instituted for control of chronic venous insufficiency.	Recommend nonpharmacological measures for control of chronic venous insufficiency.

Table 1: Student Feedback to the CBL approach in Therapeutics (n=82)

Question	Strongly Agree	Agree	Disagree	Strongly Disagree
CBL approach helped me understand fundamental concepts.	24%	74%	1%	0%
Theoretical concepts become more understandable with the CBL approach.	41%	59%	0%	0%
Professors provide significant feedback classes.	15%	76%	7%	2%
The pace and frequency of classes allows me to have enough time to prepare.	2%	13%	73%	11%
This approach requires that I prepare in advance for the class.	50%	46%	4%	0%
The CBL approach requires a greater investment of time on my part.	59%	39%	2%	0%
The CBL approach promotes interaction and discussion among students.	50%	49%	1%	0%
The CBL approach allows all students to participate actively.	13%	59%	24%	3%
The class guide provided in the previous week is a good tool to guide my study.	23%	62%	10%	5%
Clinical situations discussed promote a great preparation for professional life.	45%	50%	2%	2%