

CASE BASED, LEARNER CENTERED APPROACH TO PHARMACOTHERAPY

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Abstract

The incorporation of real problems into health 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 foundation of this methodology can be traced back to Dewey. The author suggested that students should be presented with real life problems in order to discover the information required to solve them. With the introduction of the Bologna Process in Portugal, the School of Allied Health Sciences of Oporto, saw this opportunity to put in practice Dewey's axiom. This paper represents a small part in the process of integrating a Case Based, Learner Centered approach to Pharmacotherapy. Since 2008, Pharmacotherapy is no longer taught in a lecture based model. With the implementation of Bologna Process in the Pharmacy Degree, some basic science curricular units maintained their lecture based approach, only to serve as mediators to a more student-centered approach in the applications of knowledge to real life situations. Pharmacology and Pharmacotherapy, are good examples of this dichotomy. Normally the students have to attend lectures on pharmacology topics during one week, then in the next week, they will have to collaborative solve a real problem (relating to the previous week Pharmacology topics) during a pre-established time, in the presence of a tutor. The cases are in paper format, and they are adapted or based in real life situations. They are normally ill-defined so that the students can discover what course of action to pursue. For all cases there are some orientations that are provided by the tutor, that are previously constructed under Bloom's Taxonomy. The tutor himself, must have certain characteristics that permit him/her to be in this situation. Normally for tutor selection we endorse that besides the pedagogical background, he/she has an active role in professional activities outside the School. The class is divided in case-study groups of about 4 students. Normally there are 4 groups in each class. At the end of the case study, each case-study group is interviewed by the tutor. Evaluation and assessment is divided in case study grading, mini-test grading and examination grading. Results show that gradings tend to increase from second year to the third year in the bachelor degree, despite the raised level of complexity, which can demonstrate that a student centered approach is a favorable mean to promote reflexive thinking and develop complex epistemic beliefs.

Keywords: CBL, Pharmacotherapy.

1 INTRODUCTION

Nowadays, learning a biomedical profession is a huge challenge. The student is required to develop a vast range of intellectual, visual and manual skills, as well as to take in account large amounts of factual information. Traditionally, biomedical teaching is based on texts, lectures and bedside teaching, with self-guided individual learning from books being the mainstay. These traditional methods can be complemented with several methodologies, that promote high order thinking, collaborative learning and increase the motivation of the students.

1.1 Education Based On Problems

The incorporation of real problems into health 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 methodology can be traced back to Dewey [1], 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 [2]. 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 [3]. In PBL, students are first presented with the patient’s presenting problem. Next, the learners engaged in such clinical reasoning processes as hypothesis generation, data gathering, data analysis and decision making, while synthesizing basic science and clinical information in an effort to offer some potential diagnoses and courses of treatment for the patient’s problem [2]. In PBL, instead of a lecturer, we have an expert tutor or facilitator to guide the problem-solving process. All methodologies 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. Curricula that present such problem solving activities trigger interdisciplinary learning opportunities as opposed to curricula contained in discipline-based texts and presentations [2]. As such, students are free to pursue determined learning issues in contrast to students in more traditional curricula who might focus on identifying what material the professor will include on an examination [2]. Finally, the assessments in PBL typically include performance-based and self-reflective assessments, while traditional approaches to instruction often emphasize multiple choice, objective tests [4]. After MacMaster University, innovative techniques were massively divulged, several medical and allied health science programs made changes to their curricula in order to incorporate one of more aspects of PBL. However, as pointed out by Barrows [5] the taxonomy of PBL and Case Based Learning (CBL) can be overlapped. Nevertheless the pedagogical objectives are the same.

Pharmacotherapy, can be one of the most defiant disciplines for the pharmacy students. Although in pharmacology the student must consider concepts of pharmacodynamics, pharmacokinetics... in pharmacotherapy, the student must consider all latter points as he makes an evaluation of the patient condition. A typical example can be set with antitussive drugs. While in pharmacology the student must study and understand, absorption, metabolism and excretion of drugs, mechanism of action and side effects, in pharmacotherapy the student is confronted with a patient with diabetes, who’s taking antidepressive drugs and has a dry cough... With the introduction of the Bologna Process in Portugal, the School of Allied Health Sciences of Oporto, saw this opportunity to put in practice Dewey’s axiom, and implement case based learned Centered approach to Pharmacotherapy.

2 FINDINGS OF THE CBL APPROACH

The implementation and assessment of CBL is well documented in various levels of health sciences such as Medicine [6],[7], Geriatrics [8], Nursing [9], Therapeutics and Medicinal Chemistry [10], Pharmaceutics [11], Obstetrics and Gynaecology [12], Anatomy [13] and Orthodontics [14].

In all the latter mentioned examples, the clinical cases presented three essential elements summarized by Merrill [15]:

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.

There is no consistency in all studies, regarding the time the case studies were distributed to the students, however, in all situations the student had previous contact with text materials or even lectures relating to the topic in question. Class activities were structured around active and collaborative learning principles, and in all cases except one [10], the class size was diminished compared to traditional lecture classes. The cases are 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. In some cases there are specific criteria for the selection of the tutor, based on professional activity or faculty time [12]. Each group is interviewed by the tutor at the end of the case study. 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 lasts, on an average 5 -10 minutes for each group, and normally each student is asked to answer questions on a specific area/topics of the case study. To encourage a broader understanding of the case study, the questioning of each student can be broadened as the

student shows the ability to answer more complex questions [11]. 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*, significant group differences were observed in clinical decision-making and learning motivation [9]. The post-test scores of clinical decision-making in the CBL group were statistically higher than the control group. Also, Singh reports that CBL group students scored better in short answer question and extended matching question assessment, (p value 0.01) [7]. Romero *et al* in their mix CBL/PBL experiment also report a good relationship between student learning and case study performance as measures by grades for written case study reports and examination scores[11]. Concerning, students perspectives about CBL driven approach, the findings are also agreeable. Massoneto *et al* reports that students gave higher ratings to the CBL approach (p 0,05) [12]. Also, Struck & Teasdale [8] and Engel & Hendricson [14] 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* thoroughly addresses students, who indicate that CBL improves understanding and application of clinical concepts[10].

We only came across with one study comparing CBL to PBL [6]. 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 curricula 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 busy-work (80%, OR 3.97, $P = .01$), and more opportunities for clinical skills application (52%, OR 25.6, $P = .002$).

3 DEVELOPMENT AND IMPLEMENTATION

3.1 Changes by Bologna

The Bologna Declaration points to a new educational paradigm, that of a student-centered learning, opening up potential for interdisciplinary training, with an easier diversification and articulation of basic training 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. The implementation of a new curricula, in accordance with Bologna, for Bachelor of Science Degree in Pharmacy only occurred in the 2008/09 academic year. This late implementation was mainly due to the lack of consensus on the number of ECTS needed to acquire the skills of each graduate in the Allied Health Professions. Nowadays, all Allied Health Professions in Portugal have a Bachelor Degree of 240 ECTS. In Portuguese Polytechnics, the cycle of studies leading to a degree, values specially training/practice ensuring students a component application of knowledge and learning that correlates to the concrete activities of their professional profile. 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—leading to the Profession of Pharmacy Technician—should be able to develop activities in the medicine 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. Considering all latter points, an approach to pharmacotherapy in a CBL method, seems to be a natural choice to make.

3.2 Course Structure

3.2.1 Clinical Cases and Tutor

The cases used in the CBL classes of pharmacotherapy are given in paper and are based or adapted from real situations from practice. They are normally ill-defined so that the students can discover what 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, specially elderly patients, it is important to gradually expose students to cases with multiple issues and drug-related problems. This emphasizes the interrelationship between conditions and how to set priority in resolution of multiple drug-related problems [16]. Including CBL sessions at several points in the curricula, provides students with an opportunity to work through multiple therapeutic issues and also 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 [16]. Normally the students have to attend lectures on pharmacology topics during the week, then in the next week, they will have to collaborative solve a real problem (relating to last week Pharmacology topics) during a pre-established time, in the presence of a tutor. Students are also given in advance, some information regarding the clinical case as well as some backup reading. The tutor himself must have certain characteristics that permit him/her to be in this situation. Normally for tutor selection we endorse that besides the pedagogical background, he/she has an active role in professional activities outside the School.

3.2.2 Class Dynamics

Normally, a week before the CBL class, articles as well as a class guide, are presented to the students in the collaborative platform Moodle. 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 the 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. Development of an appreciation of group dynamics is an important element of the course, and best achieved if students had to work with colleagues who they don't necessarily know well [10]. 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) Educating the patient.

At the end of the case study, each group is interviewed 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 standardized answer key 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."

3.2.3 Assessment of Students

A variety of objective and subjective techniques for evaluating students are used, both summative for the determination of grades and formative for the purpose of providing corrective feedback [17]. To analyse the extent of the students commitment to the problem solving activities, mini-test are periodically taken at the beginning of the class, relating the contents the student should explore before coming to the CBL class. The performance of students in the clinical case is also assessed, by a grid specially developed for the CBL classes. This grid contemplates the following items:

- a) Capacity to work in group;
- b) Objectivity and consistency;
- c) Using correct scientific language;
- d) Reference to “mandatory” topics

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 trimester, a final exam is still performed. The questions are related to the clinical cases explored in the classes, and the questions are formulated in order to promote reflection on the topic at hand. The final examination only accounts for 30% of the final grade.

3.3 Feedback

Faculty and students agree that the CBL format covers less contents, however students generally report that they feel more confident of their knowledge since the classes are based in real cases. Overall performance in the last two years, as measured by final examinations, has produced grades summarized in Fig. 1. As no baseline data was collected from prior courses, no direct comparison of achievement of specific learning objectives or retention of learning is possible at this time.

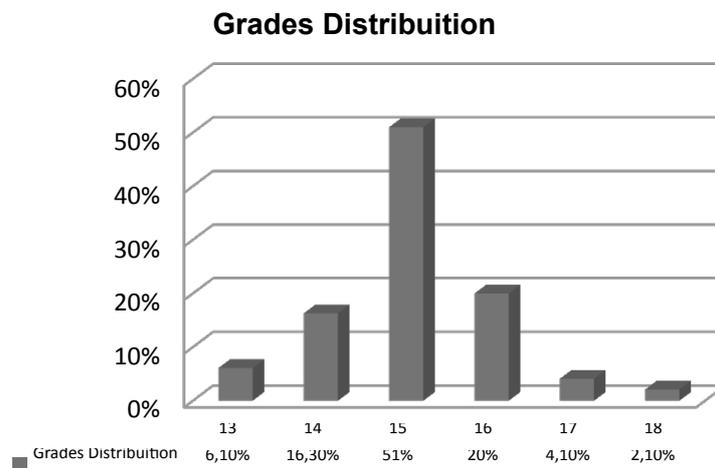


Fig.1: Grades Distribution in the last academic year

In the last academic year an online survey to the students (n=82) was conducted, and it generally shows a positive response to CBL approach in Pharmacotherapy (Table 1). Students generally agree that the CBL approach helped them understand theoretical concepts, requires them to come to class prepared and spend more time learning on their own. Students also report that the class guide is a useful tool in the preparation of classes. They also generally agree that the professors give adequate feedback during classes. This result is quite important if we consider that several professors are involved in these classes. Some criticism was expressed regarding classes pace and frequency. This might let us to consider a re-structuring of the CBL classes schedules during the week. When talking about interaction and discussion among students, most of them agrees or strongly agree, 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 to the professional life.

Table1: Student Feedback to the CBL approach in Pharmacotherapy (n=82)

Question	Strongly agree	Agree	Disagree	Strongly Disagree
CBL approach helped my understanding of 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 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 greater preparation for professional life.	45%	50%	2%	2%

4 CONCLUSIONS AND FUTURE RESEARCH

Although conversion of traditional, independent courses to active-learning approach has been challenging, faculty and students generally view the integration of CBL in the teaching of pharmacotherapy as positive and rewarding in terms of improving student participation, performance and motivation. Although by covering less contents, the CBL approach promotes that students work together, retain key concepts and to apply them to patient care situations. Students generally respond positively to this approach and realize its importance to the future professional life. Continued efforts are still needed to, more thoroughly determine, the effectiveness of this approach in improving student learning and retention. Also the possibility of integrating technology with the CBL approach in Pharmacotherapy is an option currently being developed [18]. In the field of biomedical education and clinical training, educators and clinicians are increasingly recognizing the potential of ICT for learning, practice and evaluation of knowledge[19]. The technology now available allows the use of dynamic models, making learning more efficient. When applying these technologies to the teaching of Pharmacotherapy the possibilities multiply. The opportunity to create and use learning objects, use videologs of patients, simulators for drug action and metabolism and simulations of diagnostic exams should provide, fictitious case discussion, without risk to patients, and bring a new dimension to education. The construction of a student-centered online learning environment and its assessment [20] is one of the research lines we are now pursuing, in order to implement an Online CBL Approach to Pharmacotherapy.

REFERENCES

- [1] J. Dewey, *Democracy And Education*. Free Press, 1997.
- [2] R. M. Cisneros, J. D. Salisbury-Glennon, and H. M. Anderson-Harper, "Status of Problem-Based Learning Research in Pharmacy Education: A Call for Future Research.," *American Journal of Pharmaceutical Education*, vol. 66, no. 1, pp. 19-26, 2002.
- [3] V. R. Neufeld and H. S. Barrows, "The 'McMaster Philosophy': an approach to medical education," *Journal of Medical Education*, vol. 49, no. 11, pp. 1040-1050, Nov. 1974.
- [4] D. H. Evensen, J. D. Salisbury-Glennon, and J. Glenn, "A qualitative study of six medical students in a problem-based curriculum: Toward a situated model of self-regulation.," *Journal of Educational Psychology*, vol. 93, no. 4, pp. 659-676, 2001.
- [5] H. S. Barrows, "A taxonomy of problem-based learning methods," *Medical Education*, vol. 20, no. 6, pp. 481-486, Nov. 1986.
- [6] M. Srinivasan, M. Wilkes, F. Stevenson, T. Nguyen, and S. Slavin, "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*, vol. 82, no. 1, pp. 74-82, 2007.
- [7] G. Singh, with Sarmukadam, "Proposed model of case based learning for training undergraduate medical student in surgery," *Indian Journal of Surgery*, vol. 69, no. 5, pp. 176-183, 2008.

- [8] B. D. Struck and T. A. Teasdale, "Development and evaluation of a longitudinal Case Based Learning (CBL) experience for a geriatric medicine rotation," *Gerontology & Geriatrics Education*, vol. 28, no. 3, pp. 105-114, 2008.
- [9] M.-S. Yoo, J.-H. Park, and S.-R. Lee, "[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*, vol. 40, no. 6, pp. 863-871, Dec. 2010.
- [10] T. Ives, K. H. Deloatch, and K. S. Ishaq, "Integration of Medicinal Chemistry and Pharmacotherapeutics Courses: A Case-Based, Learner-Centered Approach.," *American Journal of Pharmaceutical Education*, vol. 62, no. 4, 1998.
- [11] R. Romero, S. Erikson, and I. Haworth, "A Decade of Teaching Pharmaceutics Using Case Studies and ProblemBased Learning," *American Journal of Pharmaceutical Education*, vol. 68, no. 2, 2004.
- [12] J. C. Massonetto, C. Marcellini, P. S. R. Assis, and S. F. de Toledo, "Student responses to the introduction of case-based learning and practical activities into a theoretical obstetrics and gynaecology teaching programme," *BMC Medical Education*, vol. 4, no. 1, p. 26, Nov. 2004.
- [13] P. V. Peplow, "Self-directed learning in anatomy: incorporation of case-based studies into a conventional medical curriculum," *Medical Education*, vol. 24, no. 5, pp. 426-432, Sep. 1990.
- [14] F. E. Engel and W. D. Hendricson, "A case-based learning model in orthodontics," *Journal of Dental Education*, vol. 58, no. 10, pp. 762-767, Oct. 1994.
- [15] H. S. Merrill, "Case Study, Problem-Based Learning and Simulation in Online Graduate Courses," presented at the The Annual Conference on Distance Teaching & Learning, 2003.
- [16] L. Raman-Wilms, "Applying Therapeutic Knowledge and Skills in a Large Group Problem-Based Class," *American Journal of Pharmaceutical Education*, vol. 69, no. 5, 2005.
- [17] W. Dick, L. Carey, and J. O. Carey, *Systematic Design of Instruction, The*, 6th ed. Allyn & Bacon, 2004.
- [18] A. Jesus, A. Cruz, and M. J. Gomes, "Implementação de Metodologias Blended-Learning no ensino da Farmacoterapia baseado em Simulações.," in *VII International Conference of ICT in Education- Perspectives on Innovation*, Braga, 2011.
- [19] H. L. D. Silveira, M. J. Gomes, H. E. D. Silveira, and R. R. Dalla-Bona, "Evaluation of the radiographic cephalometry learning process by a learning virtual object," *American Journal of Orthodontics and Dentofacial Orthopedics: Official Publication of the American Association of Orthodontists, Its Constituent Societies, and the American Board of Orthodontics*, vol. 136, no. 1, pp. 134-138, Jul. 2009.
- [20] A. Jesus, A. Cruz, and M. J. Gomes, "Online Learning Environment Surveys for Higher Education. Comparative Analysis and Future Research," in *VII International Conference of ICT in Education- Perspectives on Innovation*, Braga, 2011.