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Case Based Learning for Therapeutics

Student's performance in Face to Face vs Blended Learning

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Abstract — The adoption of E-Learning activities by higher education institutions, is considered an important contribution for new learning opportunities, both in terms of initial, as well as lifelong training. In the field of clinical education and training, educators and clinicians are gradually recognizing the potential of ICT for learning purposes, practice and assessment of knowledge. In medicine and nursing, there are extensive examples that illustrate the adaptation of technological components and teaching methods. However, as much as it was possible to ascertain, examples are scarce in Pharmacy and Pharmaceutical Sciences. In this paper we propose to explore a case based learning approach for the teaching of therapeutics, using blended learning. When in comparison with face to face setting, our results show a significant better performance in the blended learning group.

Keywords - Blended-Learning, Case Based Learning, Therapeutics, Collaboration, Online Assessment.

I. INTRODUCTION

Nowadays, becoming a Pharmaceutical Professional is a huge 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 student's high order thinking and collaborative learning and to increase students' motivation [1]. 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 methods can be traced back to Dewey [2], 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 for problem solving. The author recognized that we can "reflect" on a whole host of things in the sense of merely "thinking about" them, however, he argues logical or analytical reflection can take place only when there is a real problem to be solved [3]. Some higher education institutions, as 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 [4]. 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 [3]. 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 the exam. After McMaster University innovative techniques were massively divulged, 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. A substantial number of articles discuss the implementation of PBL methods into the curriculum, alongside with the necessary measures that were taken to carry out this complex method, namely in Basic Medical Sciences [5], Ophthalmology [6], Public Health [7], Respiratory Therapy [8], Nursing [9][10] and Laboratory Medicine [11]. In the Pharmacy related subjects, studies have been conducted in Pharmacology [6]; Therapeutics [12]; Pharmaceutics [13] and Medicinal Chemistry [14]. In all previous studies, the problem is not confined to one session. Normally, the information is presented to the students in vague details (ill-structured problem) and they are responsible for generating hypotheses, analyze data and propose a future inquiry. The PBL sessions can stretch for time periods equal or greater than one week, and post-session work varies according to the group's interests in pursuing additional issues.

II. CASE BASED LEARNING

Case Based Learning is an educational paradigm closely related to the PBL educational approach. CBL's main traits derived from PBL are that a "case" is used to stimulate and support the acquisition of knowledge, skills, and attitudes. The cases, place events in a context that promotes authentic learning [15]. 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.

Cases are generally written as problems that provide the student with a background of a patient or other clinical situation. Supporting information is given, such as latest research articles, vital signs, symptoms, and laboratory results.

CBL allows students to develop a collaborative, team based approach to their education [16], and promotes the consolidation and integration of learning activities [15], [17]. Other benefits may include [15], [18]:

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

The case-based format requires students to recall previously covered material to solve clinical cases, which are based on clinical practice [19]. 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. Information regarding the implementation of Case Based learning in Therapeutics has been a priority in related research [1], [20], [21].

III. BLENDED LEARNING

The proliferation of research on blended learning is verifiable in the number of articles and books published annually. However the definition of a unified concept of blended learning is not always easy, not only because there are multiple perspectives among authors, but also by the linguistic peculiarities of each language. The first references to the term came from the industry (with an emphasis on lifelong learning), but recently, the focus of blended learning has been accentuated at higher education level [22]. In a time where the existing literature on blended learning rested mainly on issues of "how to", oriented to industry and services, authors like Thorne [23] or Bersin [24] presented us definitions of blended learning settings, as classic training programs (instructor-led) supplemented with electronic components (CD-ROM, multimedia technologies, voicemail, email, animations and streaming). We must remind ourselves that at this time, the main audience consisted of managers and entrepreneurs in the industrial and commercial sector, whose objective would be to create more effective, fast and cheaper training programs, for lifelong training of employees. Therefore, minor concern was given to the definition of terms, and more emphasis was given to practical questions of "how can this help your business? How to organize, implement and evaluate a training program of this kind? ". The blended learning was praised as an effective response, and certainly less expensive, to the problems of continuing education in the private sector.

In a more academic perspective, Whitelock & Jelfs [25] suggest three different types of b-learning:

- a) "The combination of traditional learning with web-based online approaches;
- b) The combination of media and tools employed in an e-learning environment;
- c) The combination of a number of pedagogic approaches, irrespective of learning technology use."

In this sequence, Driscoll [26] makes a proposal, with the identification of four concepts:

- a) "Combining or mixing web-based technology to accomplish an educational goal;
- b) Combining pedagogical approaches to produce an optimal learning outcome with or without instructional technology;
- c) Combining any form of instructional technology with face-to-face instructor led training;
- d) Combining instructional technology with actual educational tasks."

In a different perspective, Lencastre [27] deals with b-learning, focusing on the concepts of synchronous and asynchronous. According to the author, synchronous moments occur simultaneously for all stakeholders, that is, all students have virtual access to the same information (whether textual, visual or auditory) at the same time interval, as if they were in a classroom. In contrast, asynchronous moments (forum, email ...), learning happens at different times for each participant, according to the time and availability of each student. Blended

learning will therefore consist in an mixed use of both approaches (synchronous and asynchronous) [27]. Nevertheless, the author safeguards, that synchronous and asynchronous communication should not be distinguished by embedded technologies, but by the goals.

Despite the myriad of definitions, usually blended learning is associated with the integrated, effective and systematic combination of virtual activities (usually supported by a LMS), combined with face to face interaction, in order to take advantage of the benefits provided by synchronous and asynchronous learning situations and contexts[28]–[34]. In this definition, we do not report the "actual time" of virtual activities, but the effective use of pedagogical potential inherent in each of them, emphasizing the need for correct instructional design [21], [22], [33] and safeguarding the potential to support a collaborative learning [35]–[37].

IV. CASE BASED LEARNING FOR THERAPEUTICS

To design the Therapeutics training program we considered educational goals, pedagogical models, student's characteristics, strategies and instructional technologies that best fit the expectations of the teacher, the student and the educational context, enabling greater efficiency of the process as a whole. As for instructional model opted for the MIPO model - integration model by objectives [38]. The term "integration by objectives" reinforces the importance the integration of web technologies in the educational context, supported by the objectives of learning set for the unit and for the course. This approach has the intention to reinforce the importance of learning objectives in the design and implementation of online activities. Blended learning contents were made exclusively with free open access tools and collaboration was motivated by the use of forums and digital portfolios. A detailed explanation of the instruction design, and the strategies for online collaboration and assessment has been discussed previously [16], [21], [39] and an example can be viewed in table 1.

TABLE I. EXAMPLE OF A TOPICS, LEARNING OBJECTIVES AND ASSESSMENTS STRATEGIES FOR THE BLENDED LEARNING APPROACH

Chronic venous insufficiency (Treatment and Prevention)	
Objectives	Assessments Strategies /Technologies used
Recognize the symptoms and signs of patients with chronic venous insufficiency;	Crossword puzzle / Hot Potatoes
Identify risk factors for the development of chronic venous insufficiency	Quiz/Moodle
Structure pharmacologic options available for the treatment of chronic venous insufficiency according to the severity of the disease;	MindMap /MindMeister
Assess the therapy instituted for control of chronic venous insufficiency;	e-portfolio/Wikispaces
Recommend nonpharmacological measures for control of chronic venous insufficiency	e-portfolio/Wikispaces
Build a database of scientific evidence on the effectiveness of venotropic drugs	Zotero Bibliographic Management
Establish a dialogue with the patient in order to transmit all important information	Video/Audio /Windows Movie Maker

V. METHODS

To determine the project's impact on student's performance, we developed a quasi-experimental study[40]–[42], during two academic years. Two different groups of students were part of the experiment. The first group (n=54) was taught face-to-face. The second group was taught in blended learning. Topics, learning objectives and professors were the same in both groups. Both groups had classes over a period of 10 weeks. The blended learning group had 2 face to face sessions. Final scores were used in order to make more objective comparisons. Blended learning contents were made exclusively with free access authoring tools like Xerte[®] (The Xerte Project–Nottingham University), TimeGlider[®] (MnemoGraph LLC), VUVOX[®] (VUVOX Network, inc.), Toondoo[®] (Jambav, Inc.) e Prezi[®] (Prezi Inc.). The selection of these tools was based on their usability, the diversity of media and activities allowed to incorporate and the aesthetic aspect of the final result. The articulation of digital content with the learning objectives, teaching strategies and subsequent assessment techniques, deserved a profound attention, so that as a whole it could provide relevant and meaningful learning experience. The tasks associated with each clinical case were prepared for students to engage with all their knowledge, but these should not be sufficient for an immediate resolution because, that way, there would be no need for interaction between colleagues, nor commitment to search and discover new information (see "zone of proximal development" [43]

VI. DATA ANALYSIS AND RESULTS

Student's characteristics were assessed prior to the implementation of the courses. Both groups had a median age of 19 years old, they had never taken an online course before and none of them had prior experience with the topics being covered. Students were allocated in a face to face group (n=54) and a blended learning group (n=56). To verify that the quantitative variables had a normal distribution, we applied the Kolmogorov-Smirnov test (p = 0.578). We continued statistical analysis using Levene's test for homogeneity of variance analysis (p = 0.832). Comparing the values of the Levene test with One Way ANOVA (Table II), it appears that with p <0.05 (p = 0.000), there is at least one difference between the groups. We proceed with the application of the t-student test for independent samples.

TABLE II. RESULTS RELATING TO NORMAL DISTRIBUTION AND HOMOGENEITY OF VARIANCE.

Final Assessment (Exam Scores)	ANOVA				
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	19,211	1	19,211	24,039	,000
Within Groups	86,308	108	,799		
Total	105,519	109			

Since $P = 0.000$ (Table III), we can confirm that there are statistically significant differences between the Final Exam Scores from both groups, being that the b-learning group achieved higher scores.

TABLE III. RESULTS FOR T-TEST FOR INDEPENDENT SAMPLES.

Independent Samples Test				
Levene's Test		t-test for Equality of Means		
F	Sig.	t	df	Sig. (2-tailed)
.045	.832	-4.903	108	.000

VI. DISCUSSION AND CONCLUSION

The existing literature on blended learning for the teaching of pharmacy professionals is not extensive, but can already lead to a comparative analysis with the study developed here. A similar experiment was presented by Crouch [44] on the learning process of cardiovascular pharmacotherapy in a blended learning approach. As in our case, training was established over several weeks, and the evaluation process carried out with online quizzes (8) and a written evaluation. Forty five sessions were scheduled. Students would have to collaborate in the online sessions and make specific presentations in the face-to-face sessions. Analyzing the marks obtained by students in APPE examinations (Advance Pharmacy Practice Experience), it appears that students who chose the blended learning methodology reached higher values. Still regarding health professional's education, but in Respiratory Care, Strickland [45] proposed to analyze the performance of students through their final grade in classroom training and b-learning. Although the performance of students in b-learning was higher, it was not statistically significant. It should be mentioned that this study referred only to a group of 14 students, and is probably one of its biggest limitations. Still with students of Pharmacy and using a case based learning approach, Lapidus and colleagues [46] sought to test the effectiveness of blended learning approach (compared to face to face) in student performance in terms of capacity for drug literature evaluation. With an N of 909, students were divided in three different groups, having no significant differences were found in terms of the final grade of the course. However, we should safeguard that in this case there was no final examination, assessment consisted of a set of papers/presentations, and there were several teachers involved in the different groups of students, which in itself can cause variability in the results. In a similar context, Suda and colleagues [47] aimed to evaluate student pharmacist experience and academic performance in the first offering of a drug information and literature evaluation course utilizing a blended learning approach. Their strategy allowed for an increase in active learning sessions, higher course grades, and improvement in components of the course evaluations. Regarding the effectiveness of the use of b-learning, for the learning process of topics related to Pharmacy [44]–[48] or other health sciences the conclusions are consistent [53]–[55]. In the cited cases, the training was structured according to a pre-defined pedagogical model, and student performance was measured according to the marks obtained in final or quizzes reviews. In all cases the evidence suggests that the blended

learning scheme is effective in teaching future health professionals.

Despite the compelling data obtained from the literature, the main objective of this paper was not to prove the superiority of blended learning in the teaching of therapeutics. Much more important, is to demonstrate that these initiatives can be achieved effectively, following pre-established teaching methods and above all, does not negatively affect student performance, as demonstrated. Moreover, we should not only focus on results and tests scores, but also provide new learning environments and strategies, and to promote the development of new skills to learn and collaborate online, which may be relevant in a networked knowledge society and in a context of lifelong learning. These aspects are important for their formative character, and in our understanding, in itself already justify this study.

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