**ACTIVE METHODOLOGY AND BLENDED LEARNING: AN EXPERIENCE IN PHARMACEUTICAL CARE**

**ABSTRACT**

The aim of this study was to analyze the implementation of an active methodology in a blended model of education in the teaching-learning process applied to students enrolled in the disciplines Pharmaceutical Care I and II of the Bachelor of Pharmacy at the Federal University of Paraná. The study design was quasi-experimental, prospective, comparative, of the type before and after, in which Pharmaceutical Care classes were the intervention. Identical pre and post intervention tests were designed based on Bloom's Taxonomy revised by Anderson and Krathwohl (2001), and according to the levels of the cognitive domain: remember and understand, apply and analyze, evaluate and create. The study included 133 students. A significant difference was observed in the acquisition of knowledge in both disciplines regarding students' performance in the applied tests in all cognitive levels. This is the first study relating Pharmaceutical Care and Blended Learning.

Keywords: Blended learning; Pharmaceutical Care; Higher education; Bloom’s taxonomy; multiple-choice questions

In this manuscript we show the importance of active methodologies and blended learning in the teaching-learning process. They are a worldwide trend and are increasingly present in teaching methodologies. This manuscript has not been published and is not under consideration for publication elsewhere, and we have no conflicts of interest to disclose.

**1. BACKGROUND AND PURPOSE**

National Guidelines for Undergraduate Education in Pharmacy are based on a generalist, critical, humanist, and reflective education. It is articulated with guidelines of the Unified Health System enabling pharmacists to exercise activities related to their competencies with general and specific skills. Since then, Pharmacy courses in Brazil started discussing a curriculum reform aiming to suit the current legislation through the development of new political-pedagogical projects. 1

Competencies and general skills established by the National Guidelines for Undergraduate Education in Pharmacy agree with competencies established by the World Health Organization and International Pharmaceutical Federation (FIP) for pharmacists’ education in the 21st century. 2

With the generalist curriculum recently implemented in Brazil, Pharmaceutical Care becomes part of the essential content for degree courses in pharmacy. Since the first publication (“*Opportunities and responsibilities in pharmaceutical care*” by 3), Pharmaceutical Care is a world novelty. It is related to the health-disease process of human beings, communities, families and also is interconnected to the professional and epidemiological reality. 1

By analyzing the pharmaceutical functions in the care system to health the World Health Organization - WHO extends the benefit of pharmaceutical care for the whole community recognizing the importance of the pharmacist involvement with the health staff in disease prevention and health promotion. In the view of WHO pharmaceutical care is:

"A concept of professional practice in which the patient is the main beneficiary of the pharmacist's actions. The pharmaceutical care is the compendium of attitudes, behaviors, commitments, concerns, ethical values, functions, knowledge, responsibilities and pharmacists' skills in providing of pharmacotherapy in order to achieve therapeutic results defined in the health and the patient's quality of life”2

For a long time, pharmacists had their role of health professionals overlooked in relation to health care. Historical changes in production processes and the influence of these changes in academic curriculums culminated in a technicist professional, with compartmented knowledge, decontextualized from the multidisciplinary team, while maintaining a closer relationship with drugs rather than patients. In order to be responsible for patients’ welfare and become one of the health care providers in the multidisciplinary care, the clinical work promotes the reunion between pharmacists and patients, requiring new competencies from this professional, clinical pharmacy services (eg. adherence to treatment, specialized dispensing, medication reconciliation). 4

A movement that is gaining ground is the distance education modality. It has been used for many years in many countries - even in Brazil -, and has received a boost with new communications and information technology tools. The use of these technologies allowed the approximation of students and universities.5

Blended learning is a student-centered approach that integrates traditional learning face-to-face with a computer-mediated learning. 6

Hybrid teaching is a mixture of classroom teaching with virtual teaching, making it possible to be done inside and outside the school. It is already consolidated as one of the most reputable trends for the education of the 21st century. Practices of blended learning have become widespread in educational networks around the world, providing students with a more interesting and efficient learning, personalized to their needs. Hybrid teaching and learning based on competence - commonly practiced together-, form the foundation of a student-centered learning system. Students develop a sense of performance and prosperity for their progress and, consequently, the ability to conduct their own learning. This translates into the capability to become an eternal apprentice - a necessary characteristic in the rapidly changing world we live, in which knowledge and skills become obsolete at an accelerated pace.7

Pharmacists have recently been involved in a variety of patient care services, which requires appropriate training to develop competencies required for these practices. Thus, reorientation of pharmacy education has become indispensable. 8

Bloom's Taxonomy 9 is an instrument used to support the didactic pedagogic planning, as well as structuring, organizing, and setting learning objectives linked to cognitive development that includes acquisition of knowledge, skills and actions, promoting the facilitation of planning an effective and enduring teaching-learning process. 10

According to Bloom and colleagues9, learning objectives are distributed in three domains: cognitive, affective and psychomotor. The cognitive domain is related to learning and mastering knowledge. It involves acquisition of new knowledge, skills, and attitudes. In this domain, objectives were grouped into six categories and are presented in a hierarchy of complexity and dependence (categories), from the simplest to the most complex. In order to be lifted up to a new category, it is necessary to acquire an appropriate performance in the previous one, because each category uses skills gained in previous levels. Thus, a cumulative hierarchy is represented - in other words, the domain of each simpler category is prerequisite for more complex ones. The affective domain: related to feelings and attitudes. It involves categories linked to the development of emotional and affective area, including behavior, attitude, responsibility, respect, emotion and values. The psychomotor domain: related to specific physical skills. The categories of this area are: Imitation; Manipulation; Articulation; And Naturalization.

In this sense, the suggested taxonomy is not solely a scheme for classification, but a probability of hierarchical organization of cognitive processes in accordance with levels of complexity and objectives of the desired and delineated cognitive development. Categories of this domain are: knowledge, comprehension, application, analysis, synthesis and evaluation.10 11 In the Anderson and Krathwohl – Bloom’s Taxonomy Revised 12, verbal aspects used in the "knowledge" category were kept, but it was renamed to "remembering"; "comprehension" was renamed to "understanding"; and "application", "analysis", "synthesis" and "evaluation", were renamed respectively to "applying", "analyzing", "evaluating", and "creating" to better express the desired action and be in harmony with expected results. The position of the categories "evaluation" and "synthesis" ("creating" and "evaluating", respectively) have changed (FIGURE 1).

How then can we use this table? Action verbs are inserted into the categories, but to describe how this goal will be achieved, and to choose strategies and educational technologies, it is necessary to think of the verb form gerund. The following are examples to better understand how to use the table: “Understanding the classification of medicines, explaining the differences between generic, reference/brand, and similar drugs; to remember the pathology of asthma, recognizing signs, symptoms, risk factors and comorbidities associated with this pathology; to assess problems of pharmacotherapy, checking the presence of drug interactions”. It is observed that, in each built learning objective, the verb form gerund allows the clarification of the "what" and "how" to evaluate, and if the goal was achieved or not.

We can cite two of many advantages of using Bloom's Taxonomy 9 in the educational context: I) provide the basis for the development of assessment tools and use of strategies to facilitate and assess students at different levels of knowledge acquisition, and II) instigate teachers to help their students to acquire competencies from the perception of the need to master simpler skills to more complex ones.10

This research is justified the need to seek new methodologies in teaching-learning process that meets the demands of an education with an integrative view according to the National Guidelines for Undergraduate Education in Pharmacy.

So, we conducted an analysis of the implementation of an active methodology in a blended model of education in the teaching-learning process applied to students enrolled in the disciplines Pharmaceutical Care of the Bachelor of Pharmacy at the Federal University of Paraná by taking and comparing the results of the diagnostic and summative assessments based on Bloom's Taxonomy, in multiple-choice questions.

**2. EDUCATIONAL ACTIVITY AND SETTING**

The study design was quasi-experimental, prospective, comparative, of the type before and after, in which Pharmaceutical Care classes were the intervention. Participants of this study were students enrolled in disciplines Pharmaceutical Care I and II of the Bachelor of Pharmacy at the Federal University of Paraná.

The active methodology was applied to students in the disciplines of Pharmaceutical Care Pharmaceutical Care I and II of the Bachelor of Pharmacy course at the Federal University of Paraná through a model of blended learning. Disciplines were structured combining face to face learning activities with activities carried out by distance, considering the context of these disciplines, students, the virtual learning environment "Moodle UFPR" (*Modular Object-Oriented Dynamic Learning Environment* of Federal University of Parana, learning objectives and educational adequacy.

The hybrid teaching model used was the enriched virtual model (FIGURE 2). It consists of subjects in which students have mandatory classroom lessons with their professors, and, afterwards, they are free to complete the remaining tasks by distance. Online education is the backbone of learning when students are in remote locations. The same teacher conducted classroom lessons and distance activities. The chosen model differs from a fully online course, because classroom lessons are mandatory.7

Proposition of the work plan's schedule was initiated from the disciplines' themes, seeking its current context and problematization, giving meaning to learning. Learning assessment occurred throughout the process, and the interface of the Virtual Environment for Teaching and Learning could be directed to assessments situations.

For evaluating the impact of the disciplines Pharmaceutical Care I and II in blended learning format on the acquisition of knowledge, a pre-test (diagnostic evaluation) was applied on the first day of classes to assess the students' knowledge level on the subjects that would be addressed throughout the disciplines; and at the end of the semester a post-test (summative assessment) was applied to assess how much students had learned about the content.

According to Vygotsky 13 14, the diagnostic dimension of evaluation designates real knowledge - what is already known about a particular object of knowledge.

The term "summative evaluation" refers to the assessment that aims to give an overview of student's performance at the end of a period.15

Evaluations, both identical, were developed from learning objectives that have been developed for all clinical cases studied over the disciplines, based on Bloom's Taxonomy revised by Anderson and Krathwohl 12, and according to the levels of the cognitive domain: remember and understand, apply and analyze, evaluate and create.

The researcher developed a database of multiple choice questions using appropriate guidelines to ensure the validity of the content.16 From this question bank, 30 questions were selected, being 10 of each level.

This study took place during the year of 2014.

2.4 Ethical principles

The study was approved on 06/26/2013 by the Research Ethics Committee (CEP) of the Federal University of Paraná, under the number 317.676/2013.

All students agreeing to participate in the study were previously informed about the research goals and signed a Terms of Free and Informed Consent, according to the Resolution 196/96.

It was assured that they would not be jeopardized in the disciplines assessments with their refusal to participate. Information collected was used exclusively in research with academic purpose and confidentiality was guaranteed.

2.5 Data analysis

The statistical treatment used in the variables was descriptive and inferential.

The data related to students' performance on tests are presented using mean, standard deviation (SD), differences (delta) between pre and post-tests, and paired student's T-test to assess the significance of the results.

The database organization and statistical analysis were performed using Microsoft Excel® 2013 and SPSS® 20.0 for Windows, respectively. It was considered statistically significant when p<0.05.

**3. FINDINGS**

This study included 133 students, being 82 of Pharmaceutical Care I and 51 students of Pharmaceutical Care II.

Regarding students' performance in acquiring knowledge after using blended learning throughout the disciplines, we obtained the following results: for Pharmaceutical Care I, as shown in TABLE 1, changes were observed in pre-test and general post-test scores - an increase in the mean between the tests (from 4.8 to 6.3), with a variation of 30.2%, characterizing a statistically significant difference (p<0.05).

As previously described in the methodology section, the test consisted of 30 questions, being 10 of each level of Bloom's Taxonomy - remember and understand; apply and analyze and evaluate and create. By analyzing scores obtained in the diagnostic (pre) and summative (post) tests in Pharmaceutical Care I considering the three levels of Bloom's Taxonomy, it was observed an increase in percentage change - at the level I (29.8%), level II (21.2%), and at the level III (37.2%), with p <0.05, also characterizing a statistically significant difference in each taxonomic level (TABLE 1).

For Pharmaceutical Care II, as shown in TABLE 2, changes were observed in pre-test and general post-test scores - an increase in the mean between the tests (from 4.1 to 5.5), with a variation of 34.1%, also characterizing a statistically significant difference (p<0.05).

By analyzing the scores obtained in the diagnostic (pre) and summative (post) tests in Pharmaceutical Care II, considering the three levels of Bloom's Taxonomy, it was observed an increase in percentage change - at the level I (16.7%), level II (39.5%), and at the level III (37.8%), with p <0.05, also characterizing a statistically significant difference in each taxonomic level (TABLE 2).

**4. DISCUSSION**

It was observed an increase in percentage change in both disciplines (Pharmaceutical Care I and Pharmaceutical Care II) when comparing the tests generally and also at the levels I, II and III of Bloom's Taxonomy. This characterizes a great use of active methodology which was implemented to students through blended learning.

Given the increase in the scores after intervention (Pharmaceutical Care classes) from the beginning to the end of the academic semesters, the study states that the central concepts of the disciplines of Pharmaceutical Care I and II were learned and retained at all levels of the cognitive domain.

Blended Learning uses face to face and online classes. This type of education has been well received by students, and has shown a good performance. 17181920

Besides the on-line education, blended learning is growing in popularity. Educators consider it an essential component of education, promoting effective learning.21

Kirschner, Swelle and Clark 22 support the impact of the learning goals. Guided instruction results in a better academic achievement of "what to do". “What to do” and “how to do it” should be explicitly shown to students.

Learning evaluation involves collecting data on the principles, facts and techniques that have been achieved by the students. This step includes pre and post-tests in order to measure the gains of learning experiences.23

Pre/post-course tests, and summative assessments are important to measure student learning in pharmaceutical education.2425

By using Bloom's Taxonomy to prepare questions, Fernandes, Borges and Rodabaugh 26 also showed a statistically significant difference in the performance of pre and post-tests applied to medical students in the discipline of Bioethics (increase of 12.9%).

During the 50 years since its publication, Bloom's Taxonomy has become widely cited and influential in education12 as a useful tool to identify levels of cognitive processing of goals and assessments, independently of the type of evaluation. Bloom's Taxonomy is an accessible tool scientist can use easily. 27

The cognitive domain of Bloom's Taxonomy has been well explained and cited in articles. 2829

Learning goals were developed for all studied clinical cases and related to questions that have also been developed based on Bloom's Taxonomy, revised by Anderson and Krathwohl.12 In practice, the design of a good discipline needs to align the discipline goals, assessments and learning activities.3031

Honey and Mumford 32 agree with Bloom 9 to use different teaching methods ensuring higher levels of the cognitive domain. Any teacher who works in higher education and is aware of Bloom's Taxonomy when formulating his or her teaching strategy will be successful.33

A well-formulated multiple choice question is superior compared to an open question when testing higher cognitive skills of undergraduate students in medicine in a problem-based learning configuration.34

Evaluations of open questions and well-structured multiple choice questions appear similar in their ability to assess cognitive functions.35

Multiple choice questions are commonly used for evaluation because they can provide a large number of examination items covering several content areas, they can be applied in a short period of time, and they can be classified by the computer. They are increasingly being used because of their greater reliability. These factors make the use of this type of evaluation simple and standardized.16

Multiple choice questions are the most frequently used type of test, being implemented alone or in combination with other types of assessment test tools. Furthermore, multiple choice questions are appropriate to measure the knowledge and understanding, and they can be designed to measure application and analysis.36

The theory of cognitive-constructivist learning predicts that well-formulated multiple-choice questions activate a sequence of cognitive processes that are identical to those required in clinical practice, thus explaining the high validity of this format.35

The use of Bloom's Taxonomy in multiple-choice tests is effective for evaluation tests of critical thinking skills in students.37

Several publications have documented that multiple choice questions can be used successfully to test higher cognitive levels, besides being able to play a role in the assessment of students' performance.3839

**5. SUMMARY**

Some limitations in methodology can affect the extrapolation of data. Because of the absence of a control group, we cannot definitively conclude that correlations found in this study could be extrapolated to other disciplines.

Questions were prepared exclusively by the researcher, and, for future studies, a peer review technique can be implemented in order to analyze the cognitive level of Bloom's Taxonomy for questions of the tests, aiming reliability and agreement between evaluators through the use of the *kappa* statistic test.

By comparing the results of the diagnostic and summative assessments based on Bloom's Taxonomy at all levels of the cognitive domain, positive results were observed regarding the students' performance in acquiring knowledge during the disciplines Pharmaceutical Care I and II.

Well-structured multiple-choice questions that incorporate different learning domains of Bloom's Taxonomy is an excellent method to evaluate students' knowledge.

The results of this study can guide the faculty at the Federal University of Paraná in the process of elaboration learning goals for their disciplines, linking professors to a more elaborate assessment.

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