

Contributions of Problem-Based Learning to the achievement of meaningful learning in medical training.

Aportes del Aprendizaje Basado en Problemas al logro de aprendizajes significativos en la formación en Medicina.

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Abstract: In recent decades, medical programs have been recognizing and implementing teaching strategies aimed at promoting critical, meaningful, and open learning. Among them, Problem-Based Learning (PBL) is presented as an innovative strategy with a critical and self-training sense. Therefore, this study seeks to understand the contributions of PBL to the achievement of meaningful learning in students of the medical program at the University of Pamplona (Colombia). A qualitative research design was chosen that follows the hermeneutic process to understand and interpret the experiences of the audiences around the use of PBL, which were addressed through semi-structured interviews with members of the Curriculum Committee, surveys of teachers using an electronic form, and focus groups with students. The data were analyzed, compared, and interpreted in light of the bibliographical references and the results of the documentary analysis of the educational project of the program (PEP). It is evident that there is a difference between the orientation of the PEP and the training proposal that teachers bring to the classroom, especially in relation to the use of didactic strategies, with traditional ones such as the master class predominating. A lower use of active strategies is identified, among which PBL and the clinical case stand out, which are sometimes confused due to their problematizing nature. PBL is mainly used by teachers who have specialized training in pedagogy, but the procedure still needs to be further structuring. Motivation is configured as the main contribution of PBL to achieving significant learning.

Keywords: teaching strategies; problem-based learning; meaningful learning

Resumen: En las últimas décadas, los programas de medicina han venido reconociendo e implementando estrategias didácticas orientadas a favorecer un aprendizaje crítico, significativo y abierto. Dentro de ellas, el Aprendizaje Basado en Problemas (ABP) se presenta como una estrategia innovadora con sentido crítico y de autoformación. Por tanto, este estudio busca comprender los aportes del ABP al logro del aprendizaje significativo en estudiantes del programa de medicina de la Universidad de Pamplona (Colombia). Se opta por un diseño de investigación cualitativo que sigue el proceso hermenéutico para comprender e interpretar las experiencias de las audiencias en torno al uso del ABP, las cuales se abordaron a través de entrevistas semiestructuradas a miembros del Comité de Currículo, encuestas a los profesores mediante un formulario electrónico y grupos focales con estudiantes. Los datos se analizaron, compararon e interpretaron a la luz de los referentes bibliográficos y los resultados del análisis documental del proyecto educativo del programa (PEP). Se evidencia que hay diferencia entre la orientación del PEP y la propuesta formativa que los profesores llevan al aula, especialmente en lo relacionado con el uso de estrategias didácticas, predominando las tradicionales como la clase magistral. Se identifica un menor uso de estrategias activas, dentro de las que destacan el ABP y el caso clínico, que en ocasiones se confunden debido a su carácter problematizador. El ABP es usado principalmente por profesores que cuentan con formación especializada en pedagogía, pero aún

falta mayor estructuración del procedimiento. La motivación se configura como el principal aporte del ABP al logro de aprendizajes significativos.

Palabras clave: estrategias didácticas; aprendizaje basado en problemas; aprendizaje significativo

1. Introduction

Universities have modified their curricular proposals on a recurring basis in recent decades, moving from a behaviorist paradigm, which considered learning as acquired behavior and with an emphasis on the needs of the training area, to critical and humanistic curricular approaches, where the teaching and learning process is centered on the student's processes (1-2). In the United States, several universities have demonstrated the benefits of this transition towards critical curricula that favor self-learning and the development of competencies in knowledge, knowing how to be and knowing how to do (3). In 2004, the Spanish Society of Medical Education demonstrated the need for a curricular renewal in medical schools oriented towards competency-based training and based on strategies that favor significant learning, in a way that allows the active participation of all subjects in the education process (4). In Colombia, in 2017, the Education and Health portfolios created a commission made up of academic experts and health professionals in order to adopt policies for the transformation of medical education. Among their recommendations, they propose a training where health professionals are capable of generating knowledge and have critical reasoning for making assertive decisions. They also urge medical schools to seek a renewed curriculum, based on the development of skills that encourage learning through critical, analytical and reflective reasoning (5).

In the specific field of health education, these curricular changes have led universities to undertake a review and reorientation of didactics in the teaching-learning processes, because traditional strategies, such as the master class, limit the production of critical, open and participatory knowledge. On the contrary, active and innovative didactic strategies, in accordance with a critical curricular orientation, favor significant learning through critical thinking and reflective analysis by the student regarding topics related to the disease process, such as clinical cases, the use of fictitious testimonies of patients with specific pathologies and animated and inanimate biological simulators that improve the learning of medical-surgical skills (6-7). Thus, many universities in the world already have a critical curricular and didactic orientation, based on active didactic strategies that place the student at the center of the training process and that seek to promote significant learning.

Problem-Based Learning (PBL) is one of the most commonly used and recommended teaching strategies in the implementation and execution of critically oriented medical curricula, and its implementation in Colombian universities has become popular in recent years (8). This strategy achieves its coherence with the implementation of critical curricula by making the student the center of the teaching process and by generating a critical and reflective attitude in him/her, since it promotes the use of cognitive functions and mental operations for problem solving, such as observation, comparison, information analysis, hypothetical thinking and logical reasoning, favoring significant learning (9).

Experimental and observational studies have demonstrated the superiority of PBL when compared to traditional methods in developing critical thinking skills in medical students, as it is a strategy framed in constructivist pedagogical models, promoting meaningful learning through a comprehensive view of the object of study and placing the

student in the context of his or her own reality, allowing the development of analytical, argumentative, propositional, social and interpersonal skills based on the planned search for information to solve problems (10-11). In addition, PBL allows the development of other additional skills of a communicative, self-learning, teamwork and interdisciplinarity type in the approach to clinical cases (12). There is evidence of a trend towards critical curricular renewal, where the student is the center of the teaching-learning process and the teacher is a facilitator and companion of this process that, through didactic strategies in accordance with this intention, seeks to promote learning constructed by the student himself, as evidenced in the Educational Project of the medicine program at the University of Pamplona, Colombia. Within these strategies, PBL appears as an innovative methodology, with the capacity to develop critical thinking in the student, in addition to other additional skills essential for their comprehensive training. However, many times this intention is only reflected in the curricular proposals without truly being carried out in the classroom, where traditional didactic strategies with a transmissionist approach continue to be used.

The question therefore arises: how does PBL contribute to achieving meaningful learning in our University's medical program? To this end, the proposed general objective is to understand the contributions of the PBL teaching strategy to achieving meaningful learning proposed by the educational project of the medical program at the University of Pamplona.

2. Methods

2.1. Research design.

A qualitative research design was chosen, with a methodological approach guided by hermeneutics and specifically by the hermeneutic process as part of the hermeneutic experience proposed by Professor Elvia González (13). This hermeneutic process is developed through what the author has called PRACCIS, which starts from the researcher's prejudices to, through reflection, analysis and comparison, reach understanding, interpretation and synthesis about the subject of study in a sequential and structured process.

2.2. Study population.

In this study, the audiences were defined which, according to the objective and the problem, constituted the pertinent sources of information to identify the meaning of the problem through their contribution to the research. A sample of administrative staff was selected, made up of three members of the curriculum committee, a professorial sample made up of 24 professors and a student sample made up of 62 students, all with active participation in the medicine program of the University of Pamplona (Cúcuta, Colombia) at the time of the study.

2.3. Ethical considerations

The development of this research is carried out within the framework of international references in bioethics: the Helsinki Declaration, the Universal Declaration on Bioethics and Human Rights of UNESCO and the Belmont Report. The study was approved by the Bioethics Committee of the University of Antioquia, Colombia. Prior to the application of the questionnaires, informed consent was obtained from the participants.

2.4. Tools and instruments for collecting information

The documentary analysis of the Educational Project of the Program (PEP) was used to identify three key issues: 1) the curricular and didactic approach; 2) the PBL approach as a didactic strategy and 3) meaningful learning as a goal of the student training process. The

information obtained from the documentary analysis was recorded in an Excel format, which served as an instrument for collecting information, which was later converted to Word format. A semi-structured interview was applied to the three members of the Curriculum Committee, who were contacted personally at the Faculty of Health of the University of Pamplona. The interview sought to identify, understand and interpret aspects that were not evident in the documentary analysis and that are related to the experiences and meanings of the members of the Committee regarding the didactic concepts that guide the teaching process of the PEP. The teachers were interviewed through a survey that used an electronic form from the Google platform as an instrument, sent by institutional email of the program to all active teachers, which only 24 teachers responded to. The questionnaire inquired about aspects related to the teacher's professional and pedagogical training, as well as the area of participation in the program, thereby characterizing the profile of the participants according to their disciplinary and pedagogical training. In addition, it allowed the teachers to be questioned about the key concepts of the research: the curricular and didactic approach of the program, the concept and application of PBL as a teaching strategy, and their perception of the concept and the achievement of significant learning.

Through classroom observations, we sought to describe how the PBL strategy is implemented, the interaction between the teacher and the student, and the experiences of the latter during the process. What was observed was described in an observation form, which became the instrument constructed to identify in the classes the evidence of what the audiences experienced about PBL, to later determine the concordance with what was indicated by the teachers in the previously applied form. Two classroom observations were made.

Students were interviewed through focus groups, using a previously developed script containing questions related to students' experiences, opinions and feelings about the development of the PBL strategy. Each focus group was made up of students from the same semester, who participated in single, independent sessions. In general, the number of participants in each group ranged between 5 and 8, for a total of ten focus groups, including a group of representatives of boarding students; only the ninth semester was left without representation.

2.5. *The hermeneutic process: PRACCIS.*

After applying the different instruments to each of the audiences, all the information collected through audio and video recordings in class observations and audio in the semi-structured interview with the Curriculum Committee and student focus groups, was transcribed verbatim and, together with the electronic forms, became the texts on which the PRACCIS of the hermeneutic process was applied. Namely:

Prejudices: For this research experience, the prejudices arise from the researcher's interest in issues such as PBL and meaningful learning, which were the product of his experience as a teacher at the Faculty of Health of the University of Pamplona and as an observer of the teaching-care process.

Reflection: After applying the instruments to the audiences, reflections around PBL emerged, which began with the questions and were strengthened as the audiences expressed their opinions on the use of PBL in the program.

Analysis: In the research, units and categories of analysis were created from the information obtained with each audience, giving meaning to their expressions, always relating each part to the whole (Table 1).

Comparison: During data processing, comparisons were made between what each audience expressed in the analysis units, so the comparison was made within each of the audiences and in turn between the audiences themselves. Comparisons were also made between what was found in the texts derived from the instruments and the classroom observations, that is, what was said and what had been observed.

Understanding: We achieved an understanding of PBL, its conceptual change over time, the aspects that make it up and the multiple ways in which each audience understands and experiences it, in order to be able to apply it to the classroom. In addition, we understood how significant learning is achieved through the development of the strategy.

Interpretation : The interpretation was achieved by correlating what was found in the classroom observations with what was reflected in the texts obtained from each of the audiences, giving meaning to the purpose of the research.

Summary : This made sense of practice and theory, understanding how audiences conceive PBL and meaningful learning, reaching a proposal that allows administrators to propose a strategy in accordance with theoretical references, teachers to carry it out appropriately in the classroom, and students to experience it as a formative experience that favors the achievement of meaningful learning.

2.6. Information analysis.

Once the units of analysis were established, their respective units of meaning were compared with the bibliographical references and with the didactic proposal set out in the PEP, in order to understand, through the units of meaning, the type of teaching and learning that the curriculum committee intends and its correlation with what is set out in the PEP. Likewise, classroom observations allowed us to corroborate the information regarding the intention and what really happens in the classroom.

The audiences were then the source of information, which was later converted into text to be subjected to the hermeneutic process and to reach an understanding of these experiences regarding the use of PBL in the medical program of the University of Pamplona, achieving an answer to the specific objectives of the research. However, in order to give a definitive answer to the general objective of the study, it was necessary that all the information obtained from each audience converse, through triangulation, with the bibliographical references and with what was observed in the classroom, which allowed to identify occurrences and concurrences, in order to give meaning to the experiences of the actors, to reach a fusion of horizons which allowed a deeper understanding of the PBL strategy and its contributions to student learning and finally create a proposal to improve its development in the Medical Program of the University of Pamplona.

Table 1. Units of analysis and units of significance.

Population	Information gathering technique	Units of analysis	Units of meaning
Curriculum Committee	Semi-structured interview	Training intention	Orientation of teaching Teaching strategies
		ABP	Concept Structure
		Meaningful learning	Concept Conditions for meaningful learning
Teachers	Survey	Institutional didactics	Orientation of teaching Teaching strategies
		ABP	Concept Structure
		Meaningful learning	Concept Conditions for meaningful learning
Students	Focus Groups	Institutional didactics	Orientation of teaching Teaching strategies
		ABP	Recognition of the strategy Experience with the strategy
		Meaningful learning	Recognition of the concept Conditions for meaningful learning

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3. Results

The sample of administrative staff of the program was represented by 3 members of the curriculum committee. The questionnaire of the survey made to the professors was answered by a total of 24 professors of the 90 active at the time of the intervention, including the participation of both basic and clinical areas. Of the total of professors who participated in the survey, 16.7% do not have postgraduate studies, 8.3% have a master's degree in basic sciences and 66% have specialization in medical-surgical areas. Regarding training in pedagogy, 75% of the professors surveyed stated that they had complementary studies, the majority of them (66%) corresponding to a diploma in teaching and the rest

corresponding to specialization in teaching. The sample of students consisted of a total of 62 students from all semesters except the ninth. 50% belonged to basic areas and 50% to clinical areas, including the internship year.

3.1. PBL from the Curricular and Didactic Foundations of the PEP: documentary analysis.

The PEP bases its curricular approach on constructivism, which is defined in its postulates as "a generic approach, which refers to a fundamental concept of knowledge construction, learning and transformation of consciousness by all actors in the educational process" (14). In essence, constructivism states that knowledge is not only the result of information transmitted about a pre-existing reality, but requires the participation of the student in a dynamic process that allows him to reinterpret external information and, with this, little by little, build more complex cognitive models that provide resources to explain the reality he faces, creating his own knowledge from experience (15). On the other hand, the medicine program of this university recognizes the importance of promoting changes in the orientation of teaching so that it is consistent with the curricular proposal, which is why it has been incorporating three key concepts: problem-based learning, meaningful learning and metacognitive learning. For its implementation, the Program considers modifying pedagogical aspects from the curricular point of view through active and problematizing teaching strategies aimed at developing competencies in an integral way in being, in knowing and in knowing how to do (14). In this sense, PBL is identified as one of the strategies aimed at achieving critical thinking and significant learning. However, the PEP lacks a detailed description of the teaching strategies, including PBL, as well as instructions to teachers for their implementation in the classroom and a teacher training plan around the understanding and implementation of these strategies.

3.2. The Curriculum Committee and the Curricular and Didactic Orientation.

Although the interviewees were unable to place the curriculum proposal within a classic or critical model, they did identify some characteristics that are specific to the latter, such as comprehensiveness and the leading role of the student. For the Committee, the curricular approach is completely biopsychosocial, made up of the four training components: basic, professional, in-depth and socio-humanist. They did not highlight other characteristics of the curricula with a critical approach proposed in the PEP, such as constructivism and the role of the teacher as a guide. On the other hand, the Committee recognized the importance of creating a teaching proposal based on the development and execution of active and problematizing teaching strategies that facilitate the active participation of the student in the educational process and in the formation of his or her own knowledge, in addition to the implementation of formative assessment proposals, being consistent with the type of learning and the competencies that are intended to be developed in the students. With regard to PBL, it is noteworthy that the Committee members immediately identify it as a problematizing teaching strategy in which problems are the focus of organization and stimulus for learning and also become, based on the search for solutions, an important input for the development of skills. They recognize its role in promoting the acquisition of significant learning and the achievement of the training competencies that are intended in students, in addition to the development of other transversal skills that transcend clinical scenarios, such as collaborative work and self-directed learning. Unlike what was found in the documentary analysis of the PEP, the Committee members have an established procedure for the execution of PBL that, although it does not correlate with that proposed in the bibliographical references, it does collect elements that could direct the execution of the strategy.

3.3. Interpretation and Execution of PBL by Teachers

The written curriculum proposal does not contain any plan to promote the teaching proposal so that it is recognized by the personnel participating in the training process. This is consistent with the findings from the application of the form, which indicate that 70.8% of the teachers are able to identify some of the characteristics of the curriculum, recognizing it as socio-humanist in 44.4%, critical in 16.7% and constructivist in 5.6%. It is striking that a significant percentage of 22.2% still recognize it as a classic curriculum and, in fact, 11.1% of the teachers are unable to identify it (figure 1).

In terms of teaching, it was found that, within the strategies proposed in the PEP, those used by the programme's teachers correspond mainly to traditional strategies, with lectures being by far the most used, followed by the use of clinical cases. As for PBL, only 45.8% of the teachers who participated in the study stated that they had applied it at some point in their teaching in the classroom (figure 2).

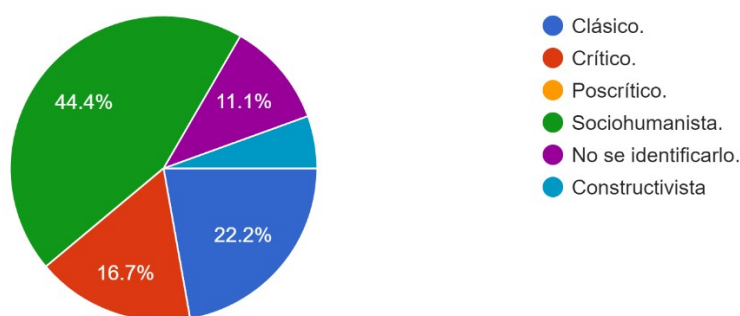


Figure 1. Units of analysis and units of significance.

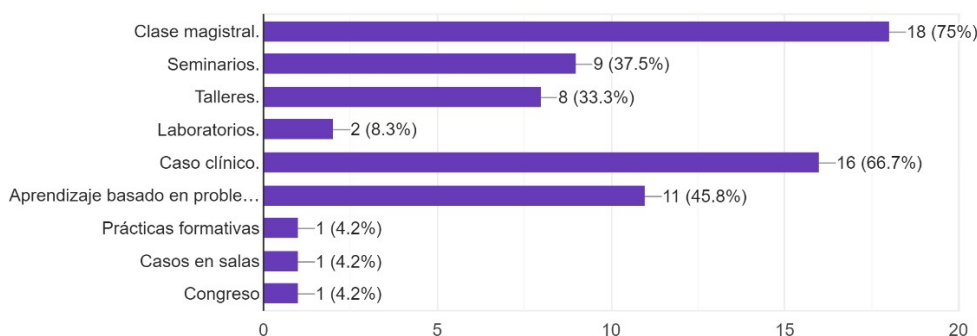


Figure 2. Units of analysis and units of significance.

When investigating the concept that teachers have about PBL, it is evident that, although they do not give a complete definition, they manage to recognize characteristics of the strategy. Some agree in identifying it as a problematizing strategy, where problem solving is used as an inducer of knowledge: "Posing a problem to students and supporting them while they try to solve it themselves and learn during the process" (teacher 1). Other teachers recognize the importance of PBL as a strategy that facilitates the construction of knowledge by the student in a self-taught process, in accordance with the constructivist approach of the program: "It promotes self-learning and critical reflection in the student

by constructing their learning by solving an open, complex problem related to their daily life in work groups" (teacher 6).

A reading of the definitions above reveals that, in general, teachers only identify a few isolated elements characteristic of PBL; only one of the participating teachers managed to bring together several of these elements in a single definition, precisely one of those with postgraduate training in university teaching: "It is a strategy that focuses on problem solving and not just on a final result. Research and teamwork are promoted to apply knowledge to real health situations, strengthening the skills of analysis, critical thinking and decision making" (teacher 3).

Another important aspect identified in the forms applied to teachers is that they fail to clearly identify the procedure for implementing PBL in the classroom. 33.3% of teachers do not know or do not have a specific routine for developing this strategy, 33.3% do it in a sequential and structured manner in a single meeting, 22% in two meetings, and only 5.6% use a sequence such as the one identified in the bibliographical references of this research, which proposes three meetings for the optimal development of the strategy.

3.4. Impact of PBL on student learning.

The students participating in the focus groups feel that, when giving a class, the intention of some teachers is to transmit knowledge in a vertical manner, promoting mechanical learning, since it forces the student to receive the information passively and memorize it, as in traditional curricula, which is manifested in expressions such as: "I think that most teachers want us to learn things the way they tell them to us; it's like they only want us to learn what they say, and that's it" (student 1A). However, in some focus groups, especially in advanced semesters, they identify another training intention more oriented to the generation of critical thinking: "There are some who do want us to think for ourselves. For example, the first respondent's teacher, he makes the classes different and he kind of makes you think" (student 3E).

To identify teaching proposals, students were asked about the use of teaching strategies in the classroom during their time in the program, mentioning those proposed by the PEP. The different focus groups recognized the lecture as the strategy predominantly used by teachers in the classroom; thus, to the question about the most used strategy, "the lecture" was the unanimous answer. Other strategies occasionally recognized are clinical cases and workshops.

As for the specific PBL strategy, no responses were identified in the focus groups that would guide its recognition. Assuming that the students had used PBL without recognizing it, they were given the definition of this strategy and, through an example, were explained how it would be implemented in the classroom. Even so, they were not able to identify or recognize it in any of the semesters. They always expressed similarities with other problem-solving strategies, but they did not recognize it as an independent strategy.

3.5. PBL in the classroom: from words to actions.

Despite repeatedly and insistently requesting permission to carry out *in situ* observations from the 11 teachers who indicated that they applied the strategy in the classroom on the forms, only two teachers responded to the researchers' request. The first observation was carried out with tenth-semester students in the Pediatrics area. In this case, the teacher in charge of developing the strategy has postgraduate training in pedagogy, being a

Master's student in Education. The second observation was carried out in the fifth semester, in the Semiology micro-curriculum that marks the transition between the basic and clinical areas. Within the fulfillment of the parameters for the execution of PBL, we find in the first observation a prior planning of the methodology, a clear statement of the problem to the students, identification of prior knowledge, fulfillment of the role of the actors, independent work, an acceptable number of two sessions and an evaluation with a formative component.

In the second case, on the contrary, features were identified that characterize the strategy used as active and problematizing, but with characteristics more of a clinical case than of a true PBL. Adequate planning is evident and the actors assume their respective roles. However, there is no clear statement of the learning objectives and, rather than a problem, a limited clinical case is presented, no bibliographical references are given, students are not questioned about their prior knowledge, it is carried out in a single session, without allowing independent work by the student, and non-formative evaluation is carried out.

Regarding the type of problem used by the two teachers who participated in the classroom observations, we found in observation #1 an unstructured problem, which demands greater effort from the student in the bibliographic search and therefore enables a greater discovery of knowledge. In observation #2 the problem is more structured, dealing with a clinical case that limits the possibilities of expanding the search and, therefore, also the possible solutions to the case. In both observations the teacher assumes a guiding role, orienting the students to achieve the objectives of the strategy. The students, for their part, were motivated in the two classroom observations and had an active and critical participation, assuming their leading role in the strategy. The number of participants in the two strategies evaluated was in line with what was recommended.

3.6. The reality of meaningful learning in the medical program at the University of Pamplona.

There are three necessary conditions for generating significant learning: the logical significance of the material, the psychological significance of the material, and motivation (16). The logical significance of the material refers to how the content is presented and organized based on a logical and ordered sequence. In this sense, PBL allows offering content in accordance with the objective of each session, through the problem and the bibliographic material, which are organized through brainstorming, bibliographic review and analysis, and discussion. Class observations show the use of structured, complete, and ordered content, both in observation #1 and #2, regardless of whether it is PBL or another active strategy. The psychological significance of the material, another condition for achieving significant learning, refers to how the student connects prior knowledge with new information. That is, there is or is not a solid and strong cognitive structure that allows the student to assimilate and store knowledge in the cognitive structure and, subsequently, develop short- and long-term memory. Classroom observations show that in the first observation in which the strategy coincides with PBL, the students' prior cognitive structure is verified, so in this aspect there is a contribution of the strategy to the achievement of significant learning, which does not occur with the second observation. Finally, one of the most determining factors for the achievement of significant learning is motivation. This is recognized by 50% of the teachers who responded to the form. Likewise, students identify motivation as the main characteristic that a strategy must have so that they can learn better. In fact, when asked to explain why in some courses where active strategies other than PBL are used they feel they learn better, all say that it is due to the motivation generated by these strategies. In the two classroom observations carried

out, a constant attitude of motivation was identified in the students who, in addition to being receptive, were active and participative.

4. Discussion.

4.1. Curriculum and Teaching in the Medicine Program at the University of Pamplona

The University of Pamplona's medical program adopts a critical constructivist approach, in which knowledge is achieved through a process of internal elaboration, built from experience, taking it beyond mere information towards the purpose of learning to learn and solve problems, through an inductive method (17-18). Constructivism plays an important role in health education, where reflective practice favors critical thinking and the acquisition of structured, contextualized and comprehensible learning, since there is a continuous change that occurs both in diseases and their treatment, as well as in the complexity posed by human interrelations and the management of multifactorial situations typical of medical care, where rote learning is limited (19). As a critical curricular orientation, constructivism places the student at the center of the learning processes, since it is he who takes the initiative and responsibility for his own training, actively building knowledge based on prior knowledge and from his own personal learning network (20). In this constructivist paradigm, teachers in the areas of health sciences, and in order to promote a reflective approach, must become guides for the students in their own self-training so that their learning is consistent (21).

In the documentary analysis of the PEP and the testimonies of some members of the Curriculum Committee, it was evident that, starting with the curricular renewal carried out in 2020, the University of Pamplona's medicine program conceives the student as the protagonist of the educational process and the teacher as its guide. In this sense of critical curricular orientation, constructivism becomes an ideal approach in line with the training intention of the program. For Díaz and Hernández (22), teaching not only implies providing information, but also helping the student to learn and develop as people, a matter that commits the teacher to the use of methodologies that involve the student in their learning process and that help them develop critical thinking skills. A study carried out in Peru investigated the impact of the use of active teaching strategies on the development of critical thinking in students (23). Using a predetermined scale, the development of skills associated with the development of critical thinking before and after the use of active teaching strategies was evaluated. The study demonstrated the importance of incorporating educational methodologies into learning processes that involve the active participation of the student in the construction of his or her own learning, and that this translates into the development of competencies, capacities, skills and attitudes, such as analysis and inference, problem solving and argumentation. Another quasi-experimental study, with basic science students from the medical school of the César Vallejo University in Peru, aimed to demonstrate the influence of the PBL method on the development of critical thinking. The skills necessary for its development were evaluated through scores, including: inference, identification, deduction, interpretation and evaluation. At the end of the study, they found that the application of PBL significantly influenced the development of critical thinking in students with an increase in the score in all the variables studied (24).

The development of critical thinking is a goal identified in the documentary analysis of the PEP and in the interviews with the members of the curriculum committee of the medicine program at the University of Pamplona; however, in the interventions made to teachers and students, a predominance of traditional teaching strategies is evident, which

shows a lack of correspondence between the curricular and didactic approach, which aims for a critical focus, with the predominance of strategies such as the master class, with the protagonism of the teacher and relegating the student to a passive and receptive role, without the possibility of developing critical thinking, of self-constructing their knowledge and of acquiring a truly significant learning. Galindo et al. (11) consider that the implementation of active strategies such as PBL, favors the planned search for information, the development of scientific competences such as the analysis and integration of information, the capacity for understanding and, from this, the development of critical thinking, a potential capacity that PBL has and that is recognized by the students.

4.2. PBL in the Medicine Program of the University of Pamplona.

PBL is a teaching strategy that is part of active pedagogies and, particularly, of learning by discovery and construction, completely opposite to expository strategies, such as the master class (25). This teaching strategy is considered to be the one that best applies the principles of constructivism and is the best constructivist learning environment, so it should be the protagonist in any program that claims critical didactics (18), as is the case of the Medicine Program of the University of Pamplona. In medical training, the implementation of PBL seeks to solve a clinical problem posed by the professor, which is addressed by simulating a clinical situation that the student will potentially face in his professional practice. The development of PBL, in addition to immersion in a teamwork environment and the development of communication skills, commits the student to the search for information to solve the problem and theoretical and clinical elements essential for his training are strengthened (18). By guiding discovery learning, PBL agrees with the constructivist approach that guides the PEP of the medicine program at the University of Pamplona, by promoting that the student is the protagonist of the educational process, favoring that he/she is the creator of his/her own knowledge, which is not offered to him/her in a vertical manner from the professor as in a traditional master class, but rather the student himself/herself elaborates it, as a product of this learning experience and subsequently comes to process it and assimilate it in his/her cognitive structure (16).

The PEP recognizes PBL as one of the teaching strategies that allow students to achieve significant learning, but there is no clear definition of this strategy or a description of the procedure for its implementation in the classroom. For this research, the procedure proposed in the medicine program of the University of Antioquia, a leader in the implementation of PBL in Colombia, was taken as a reference, in which the strategy is developed in three sessions with their respective objectives (Table 2) (26). In one of the classroom observations, PBL was executed in two sessions; however, the related bibliographical references recognize flexibility in the PBL procedure, not only for the types of problems that can be used, but also with the number of sessions and/or the number of phases in which it is developed (27). For example, some referenced approaches consider the possibility of developing the strategy in two or more sessions, but what is clear is that a single session does not allow the development of all the skills that are intended to be achieved, since independent work, the search and judicious analysis of information and collaborative work are not favored (28).

Table 2. PBL procedure proposed by the University of Antioquia

Moment	Goals
Planning	The objectives are reviewed and the problem is raised. Sources of information and evaluation methods are proposed.
First session	The problem and the proposed objectives are presented Students' prior knowledge is identified The most relevant aspects of the problem are identified and a work plan is drawn up.
Second session	An analysis of the information and a statement of the results is made. Feedback is provided.
Third session	The steps of the second meeting are resumed and some conclusions are reached. Non-formative feedback and evaluation is provided.

There are some essential steps for the successful development of PBL, which include: planning, execution, monitoring and feedback, which should always be present regardless of the number of sessions (26). In the experience investigated, in the execution of the strategy in two sessions, the phases of planning, execution, monitoring and evaluation/feedback were developed, allowing the presentation and analysis of the problem, the search for information and the resolution of the problem, thus constituting a true PBL. This experience shows the importance of recognizing in the curricular and didactic proposal a specific procedure that guides the teacher in the execution of PBL in the classroom.

The second classroom observation corresponded more to a clinical case than to a PBL, another active methodology whose problematizing nature makes it have some similarity with PBL, which may explain what was observed in this research, where some teachers and students tend to relate PBL with the clinical case. In this sense, some texts describe that it is common to observe that PBL is combined or based on other teaching strategies such as the clinical helmet, but to be considered a true PBL, it is necessary that it allows the sequential development of the strategy in at least two sessions, which give the possibility of carrying out a significant bibliographic search, analyzing the information collected through this search and being able to propose, through critical thinking, solutions to the problem presented (27).

PBL places the student in an active role within the process and thus emphasizes the development of attitudes and skills that seek the active acquisition of new knowledge and not just the memorization of information provided by the teacher. While in traditional strategies the teacher is the protagonist of the educational process, in problem-solving strategies the student is the one who takes ownership of the process, searches for information, selects it, and organizes it to respond to the problems faced (25). This leading role of the student is recognized by all the audiences involved in this research. However, students have mixed feelings about it, as they continue to consider that transmissionist methodologies predominate in the classroom, while active methodologies appear in specific courses and times, being used by few teachers. The teacher must then not only interpret and execute the strategy, but recognize his role within it. By identifying itself as a critical program, the PEP recognizes that the teacher "is a guide, companion, and director of the teaching-learning process" (14). This feeling is shared by the Curriculum Committee and by the teachers who participated in this research. However, once again, there is no correspondence in finding a predominance of the use of the master class. One of the main changes required of teachers in current medical education is to stop being a source of information and start having a role as facilitators of knowledge, which is why they must

change the way they relate to the student in the classroom, designing new teaching situations (29). This makes evident the need for teacher training, not only focused on the specific clinical area in which they develop, but also on issues of pedagogy, which could reduce the gap that is evident in this research between curriculum, didactics and teaching practice. UNESCO already recognized in 1966 the importance of the professionalization of teaching, "It should be recognized that the progress of education depends largely on the training and competence of teachers, as well as on the human, pedagogical and professional qualities of each educator" (30). This professionalization of the teacher, regardless of his or her original training, makes teaching a specialized professional activity, an issue that favors the interpretation and execution of curricular and didactic issues related to the teaching and learning process (30). Analyzing the information obtained in this research, we can say that, although most teachers have specialization in medical-surgical areas, very few have postgraduate training in areas of teaching and pedagogy, which results in difficulties in understanding and interpreting curricular and didactic proposals and implementing them in the classroom.

4.3. Contributions of PBL to the achievement of significant learning in the medical program at the University of Pamplona

The achievement of significant learning requires that the student has a cognitive structure formed by his/her prior knowledge (16). For constructivism, which guides the curricular and didactic approach of the program, knowledge is achieved through a process of internal, constant and dynamic elaboration, and from the student's previous cognitive structure, built from his/her experiences and which, based on the understanding of new knowledge mediated by the teacher, transforms his/her schemes towards more elaborate states of knowledge, which acquire meaning in their own construction (18). In this sense, a medical program that aims to achieve significant learning as an objective of student training, as proposed in its PEP by this university, benefits from a constructivist approach that directs its curricular and didactic proposal. A study conducted at a private university in Peru, which used surveys based on the Likert scale to evaluate the impact of active strategies on achieving meaningful learning in medical students, found that 86.1% of the students surveyed stated that the use of active methodological strategies is efficient in achieving meaningful learning, concluding that there is an important relationship between active methodological strategies and meaningful learning (32). The active strategies evaluated in this study included seminars, case studies, simulation and PBL, which emerged as the strategy with the highest association score with achieving meaningful learning, being recognized by 90.7% of the students as efficient, regular by 5.6% and deficient by 3.7% (32). In this sense, in accordance with the curricular and didactic orientation of the Medicine Program at the University of Pamplona, PBL is not only a constructivist strategy, but also the one that could best guide the achievement of meaningful learning.

According to Ausubel's theory, there are three necessary conditions to achieve significant learning: the logical significance of the material, the psychological significance of the material and motivation (16). The logical significance of the material refers to how the contents are presented and organized, based on a logical and ordered sequence, that is, the didactic elements. In the study by Neyra Díaz (32), 82.4% stated that the application of active didactic strategies has a good level, 16.7% considered it regular and only 0.9% rated its use as bad (32). PBL achieves the logical significance of the material by structuring the problem in an orderly manner within the procedure, facilitating the analysis of the problem and the formulation of possible solutions and by providing pertinent bibliographical sources, which provide the student, through independent and collaborative work, with resources to solve the problem (33). In the classroom observations it was evident that the procedure in the first observation, considered as true PBL, although

not developed as referenced in the theoretical framework, allows to achieve the logical significance of the material.

The psychological significance of the material refers to how the student connects prior knowledge with new information, that is, whether or not there is a strong and solid cognitive structure that allows the student, first, to assimilate and store knowledge in the cognitive structure and, subsequently, to develop short- and long-term memory (16). In PBL, the identification of the student's prior knowledge about the topic being discussed is essential before addressing the problem. In the first classroom observation, corresponding to a true PBL, it was evident that, before addressing the problem in the first session, the teacher identified the students' prior knowledge related to the topic to be discussed during the development of the strategy, which did not occur in the second observation.

Finally, student motivation, the third requirement for meaningful learning, is considered the subjective disposition for learning that influences performance, improving skills when processing information (16). In Neyra's study, motivation in active strategies was recognized by 92.6% of students at a good level, 6.5% indicated it as regular and 0.9% as bad (32). When implementing PBL, the teacher must know the student well and motivate and structure their knowledge (25). In the focus groups, the participating students did not recognize PBL, but they did identify motivation as the main requirement to achieve better learning and identified active strategies as motivating while, on the contrary, they considered expository strategies as monotonous and boring.

Throughout the article, the terms significance and meaningfulness are used. The first term is used according to the RAE to denote importance, relevance or transcendence. The second term, meaningfulness, is used textually as found in the bibliography in the definition of the requirements established by the author Ausubel for the achievement of significant learning: Logical significance of the material and psychological significance of the material.

5. Conclusions

- The documentary analysis of the PEP of the Medicine Program of the University of Pamplona reveals an intention of critical training, based on a constructivist and biopsychosocial approach, which places the student at the center of the educational process and the teacher in the role of guide.
- The members of the Curriculum Committee recognize only some of the curricular characteristics of the training approach of this medical program, including comprehensiveness, the biopsychosocial approach and the leading role of the student.
- In accordance with the critical approach of the curricular proposal, the PEP proposes some active problematizing teaching strategies to guide the execution of the teaching proposal, such as clinical cases, workshops, simulation practices and PBL. However, beyond recognizing these strategies as ideal for achieving the training objectives of students, the PEP lacks a specification or in-depth study of methodologies or procedures that can guide the teacher when implementing each of these strategies in the classroom.
- The traditional lecture continues to be the predominant strategy in the educational process of the University of Pamplona's medical program, as evidenced by the survey applied to professors and students in the different focus groups.
- Professors of the medical program at the University of Pamplona have been introducing some active strategies, mainly the clinical case and PBL, as they recognize

them as facilitators of significant learning through the logical presentation of content, the interaction that it allows between previous and new knowledge, and student motivation.

- PBL is used by just over half of the teachers surveyed, most of them with postgraduate training in pedagogy. However, there is no uniformity in the procedures for implementing this strategy in the classroom, as there is no uniformity in the number of sessions for its effective implementation and, in some cases, planning, execution, monitoring and feedback, components of a well-designed and implemented PBL, are not included.
- The students interviewed recognized how a well-structured implementation of PBL motivates them and enables them to achieve the logical and psychological significance of the material, necessary conditions for generating meaningful learning.

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