

Problem-based learning program for the development of competencies of physiology students of the Faculty of Medicine of the Catholic University of Cuenca, Azogues, 2023

Programa de aprendizaje basado en problemas para el desarrollo de competencias de los estudiantes de Fisiología de la Facultad de Medicina de la Universidad Católica de Cuenca sede Azogues, 2023

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Abstract

Introduction: Higher education has revolutionized over time, currently there are new teaching methodologies. **Objective:** To apply a problem-based learning program for the development of competencies of physiology students of Medicine at the Catholic University of Cuenca, Azogues branch. **Methodology:** action-participatory study with qualitative approach, in second cycle students; a test was used to obtain the data obtained, which were later analyzed. **Results:** evidence-based learning (ABP) has shown to have good results in strengthening and acquiring competencies to new health professionals from problems posed in the classroom. **Conclusions:** It was evidenced that after the application of PBL, the technical, methodological, participatory and personal competencies were strengthened in more than 80% of the students who participated, proving to be a superior method compared to other methods such as the traditional one.

Keywords: higher education; competence; students; learning; evidence

Resumen

Introducción: La educación superior ha revolucionado con el tiempo, actualmente existen nuevas metodologías de enseñanza. **Objetivo:** Aplicar un programa de aprendizaje basado en problemas del desarrollo de competencias de los estudiantes de fisiología de Medicina de la Universidad Católica de Cuenca sede Azogues. **Metodología:** estudio de acción-participativa con enfoque cualitativo, en alumnos de segundo ciclo; se utilizó un test para la obtención de los datos obtenidos, los mismos que fueron analizados posteriormente. **Resultados:** el aprendizaje basado en evidencia (ABP) ha demostrado tener buenos resultados al momento de fortalecer y adquirir competencias a los nuevos profesionales de la salud a partir de problemas planteados en las aulas de educación. **Conclusiones:** Se evidenció que, luego de la aplicación del ABP, las competencias técnicas, metodológicas, participativas y personales se fortalecieron en más del 80% de los estudiantes que participaron, resultando ser un método superior frente a otros métodos como el tradicional.

Palabras clave: educación superior; competencia; estudiantes; aprendizaje; evidencia

1. Introduction

In response to globalization and the social problems that affect societies, it is essential to train professionals capable of ensuring an adequate quality of life for the general population. Therefore, many institutions have been part of programs such as Erasmus, Tempus, Jean Monnet, of the European Union, XII Five-Year Plan of China; in Latin America, organizations such as CELAC, among others, help the development of societies, allowing the creation of professionals who have the skills and abilities capable of proposing solutions, in addition to developing critical thinking (1).

Therefore, it is of vital importance to plan strategies for the development of higher education, the teaching-learning method has been evolving and has undergone paradoxical changes, from passive methodologies such as the traditional method to current times with active methodologies such as Problem-Based Learning (PBL), which propose the training of professionals with human and ethical quality and are capable of solving the problems of society. Problem-based learning (in its acronym in Spanish: PBL), is a teaching-learning method already applied since the 70s, beginning in the United States and then accepted worldwide (2).

There are several authors who recommend PBL over other teaching methods, such as Trullas et al. 2022 in their systematic review; Effectiveness of problem-based learning methodology in undergraduate medical education: a scoping review, carried out in 2022, after reviewing 124 studies, concluded: Problem-based learning was superior to traditional learning, since there is greater retention of information except for 3 studies where it was indicated that it was greater in simulation learning and conference learning studies, another skill that was found to be superior was communication between students and their self-confidence when posing problems, since they felt more secure in collaborative work and interpersonal relationships (3).

Important aspect was the positivism that the students presented to the method; however, there was some resistance to it, unclear objectives, poor management and inadequate flowcharts, it is striking where the tutor does not give the method as favorable and feels dissatisfied, in relation to methods such as the traditional one, by lectures (3).

Yanamadala et al. (2018) in the United States studied the topic “A Problem-Based Learning Curriculum in Geriatrics for Medical Students” determined: better development in a degree of interdisciplinary work, optimized resources appropriately, multidisciplinary work was exemplary (4).

Therefore, the problem-based learning method helps to develop 4 competencies or skills to be known according to Gil -Gálvan (2021) and they are: Technical competencies (know/know), Methodological competencies (know how to do), participatory competencies (know how to be) and personal competencies (know how to be) (5).

In Ecuador, many institutions and teachers continue to use traditional methods, where teachers transmit information mechanically, thus eliminating student participation in face-to-face classes. Therefore, it is important to understand and implement new methodologies such as PBL to help students participate in class and develop critical thinking.

2. Materials and methods

This participatory action research work is based on a qualitative approach, because it is responsible for collecting and analyzing information on the object of study. It was carried out at the Catholic University of Cuenca, located in the Azogues canton, Cañar province, in the Republic of Ecuador, it is a private institution, to second cycle parallel students “A”, “B”, “C”, “D”, “E” of the medicine career, through the application of the problem-based learning strategy solved with collaborative work, it is made up of 115 students taking the subject of General, Hematopoietic,

Renal and Reproductive Physiology, however, 104 completed the study. It consisted of several phases such as exploration, observation, method application phase, information collection phase using a validated test that allows data collection according to the skills developed such as technical, personal, participatory and methodological according to a scale of 1. A lot, 2. Enough, 3. Little, 4. Nothing, which are answered by each of the students, subsequently analyzed in Excel and a DS and averages were obtained.

Bioethical aspects have been taken into consideration to ensure this research is conducted responsibly and respectfully. The authors' intellectual property rights are protected by appropriate citation and referencing. The procedures and methodologies developed in this work are the intellectual property of the authors, with respect to their contextualization and application. The autonomy of respondents is preserved through informed consent, which will be obtained prior to the survey, taking into account the confidentiality, voluntariness, and privacy of participants.

3. Results

According to the demographic characteristics and profile of the students at the beginning of the study, there were 115, however, 104 participated, the average age of those involved was 19 years with a range between 18 and 20 years, women represented 65.3% of the total sample, compared to men with 34.6%, with a ratio of 1.9 to 1.

Regarding the technical skills that students acquired through the application of the Problem-Based Learning methodology in teaching Physiology, we observe in Table 1, after the evaluation on scales from 1 (a lot) to 4 (nothing), the following statistical data.

Table 1. Technical skills acquired through PBL by 101 students of the Physiology course of the medical degree, Azogues 2023

VARIABLES	A lot		Enough		Bit		Nothing	
	No.	%	No.	%	No.	%	No.	%
I see my field of study from a broader perspective	34	32.7	62	59.6	8	7.7	0	0
I develop the capacity for analysis, synthesis and evaluation	29	27.9	58	55.8	16	15.4	1	1
Develop the ability to learn on your own	35	33.7	51	49	17	16.3	1	1
Need to learn	60	57.7	36	34.6	8	7.7	0	0
Facilitates organizing ideas	32	30.8	50	48.1	22	21.2	0	0
Development of creative and intellectual capacity	40	38.5	52	50	12	11.5	0	0

Source: Authors , (2023).

Regarding student opinions after the implementation of PBL, the average score for the six assessed competencies was 1.77 overall. Similarly, there was a high component of the need to learn, with 57.7% of students acquiring competencies after the implementation of PBL. 32.7% of participants viewed the field of physiology from a common perspective, with an average score of 1.75 and a SD of 0.58. However, 88.5% of students felt that they developed a creative and intellectual capacity when studying the subject by applying this method, which was between a lot and enough.

Furthermore, in general terms, we could indicate that more than 90% of the participants, after applying the methodology, achieved a level

of proficiency and knowledge regarding the skills acquired in the ability to analyze, synthesize, evaluate, self-learn, and organize study ideas. Of the skills analyzed, it was determined that all students were familiar with and had adopted, to some degree, acquired techniques related to the proposed methodology. The method influenced all participants except for 1%, who lacked the ability to learn independently, in addition to having difficulty analyzing, synthesizing, and evaluating the material.

When analyzing the impact on the acquisition of methodological skills that the application of PBL has generated in Physiology students in the 104 students, greater acquisition of the five skills was observed, evaluated with a value 1 = a lot and followed by 2 = enough (scale between 1 and 4), in addition all students considered that the method helps to develop the skills to some degree, since no one indicates the opposite (1. nothing) except for 1.9% who did not develop the ability to solve problems, as shown in table 2.

Table 2. Methodological skills acquired through PBL in 104 students of the General Physiology Chair of the second cycle of the Medicine degree, Azogues 2023

VARIABLES	A lot		Enough		Bit		Nothing	
	No.	%	No.	%	No.	%	No.	%
It helps us discover knowledge for ourselves that does not occur in traditional or expository methodology.	37	35.6	49	47.1	18	17.3	0	0
This methodology motivates you to learn more than traditional methodologies.	35	33.7	55	52.9	14	13.5	0	0
Problem-solving skills	28	26.9	60	57.7	14	13.5	0	0

Motivation for learning	35	33.7	56	53.8	13	12.5	0	0
Facilitates collaborative work	30	28.8	55	52.9	19	18.3	0	0
It facilitates playing an active role in a learning process compared to other traditional-expository methodologies.	32	30.8	57	54.8	15	14.4	0	0

Source: Authors , (2023).

The average of the 6 methodological competencies acquired was 1.83 with a SD of 0.6. These acquired competencies in order of frequency from highest to lowest were the discovery of knowledge by ourselves is sufficient or greater in 80% of respondents in relation to the traditional or expository method, followed by others such as motivation for learning (87.5%), problem solving (84.6%), facilitation of collaborative work (81.7%), and facilitating the performance of an active role in 85.6% of cases compared to other methodologies such as the traditional one.

However, another aspect observed is that 10% to 20% of individuals are unaware or have little knowledge of the methodological skills acquired through PBL.

After the analysis of the learning of participatory skills acquired with PBL, as we see in table 3, it can be observed that students have a predisposition to develop these skills greater than 80% in each of the items presented with an average of 1.8 and a SD: 0.64, from highest to lowest it was observed that feedback in students is necessary in the rectification of deficiencies that they felt existed in 90% of cases, it improved the acquisition of values to real problems and interpersonal communication in 89.5 % and 88.5% respectively, therefore, these participatory skills acquired through the application of PBL in general can be characterized by the high degree of impact on learning.

Table 3. Qualification on the participatory skills acquired through PBL in 101 students of the General Physiology chair of the second cycle of the Medicine degree, Azogues 2023

VARIABLES	A lot		Enough		Bit		Nothing	
	No.	%	No.	%	No.	%	No.	%
Ability to work in an interdisciplinary team	31	29.8	60	57.7	12	11.5	1	1
Dialogue within the team is encouraged	36	34.6	53	51	14	13.5	1	1
Feedback is generated to rectify deficiencies and take advantage of identifying strengths.	41	39.4	55	52.9	8	7	0	0
I acquire values based on real problems	42	40.4	50	48.1	11	11.5	0	0
Interpersonal communication is encouraged	34	32.7	55	52.9	14	13.5	1	1

Source: Authors , (2023).

It is striking that 1% of the students did not acquire a form of interdisciplinary work and therefore know nothing about this skill. Undoubtedly, another controversial factor is the presence of students who did not develop different competencies, such as teamwork, as 18.3% knew little or nothing about these competencies. This was followed by team dialogue, which accounted for 18.3%. It is concluded that teamwork is difficult and did not help strengthen the harmony of these competencies.

Regarding the last competencies presented, called personal, Table 4 tells us about the students' opinion regarding the value they give to their learning, placing it at a value of 2 as sufficient in most cases.

Table 4. Qualification on personal skills acquired through PBL in 101 students of the Chair of General Physiology of the Second cycle of the Medicine Degree, Azogues 2023

VARIABLES	A lot		Enough		Bit		Nothing	
	No.	%	No.	%	No.	%	No.	%
Skills for personal interaction, both intellectual and emotional	32	30.8	59	56.7	12	11.5	1	1
Interpersonal relationship skills	32	30.8	57	54.8	14	13.5	1	1
Tolerance to deal with ambiguous situations	33	31.7	60	57.7	9	8.7	2	1.9
Reflective thinking skills	39	37.5	55	52.9	9	8.7	1	1
Critical thinking skills	37	35.6	57	54.8	10	9.6	0	0

Source: Authors , (2023).

Similarly, the students' opinions regarding the acquisition of skills indicated that 19.6% tolerated facing ambiguous situations, followed by 15.4% regarding interpersonal skills. Meanwhile, the skills acquired after PBL for personal interaction, both intellectual and emotional, and those of reflective thinking and critical thinking were found between 12% and 14.4% who did not develop personal skills in this group of students.

There is a 2.4 to 1 ratio of students' opinions of sufficient over much regarding the ability to tolerate dealing with ambiguous situations, and the same trend was similar to the previous one with a ratio greater than 1.5 (sufficient/much).

4. Discussion

We can start by stating that problem-based learning has had a great impact on the students participating in the study, since the vast majority of them have acquired and know the technical, personal, participatory and personal skills after incorporating this methodology as a learning system, since most of them indicate that they know this process enough or a lot and it has allowed a development in the field of problem solving compared to the traditional method of education (6, 7, 8).

The students who participated in the study were mostly female with a ratio of 1.9 to 1 towards men, correlated with the study conducted by Won et al. 2022 (8) in the nursing department, who determined in their study that 78% of the participants were women in what refers to men and with an average age of 21.45 years (SD 0.86), while in the present study the average age was 18 years, in the same way the participating students were from the second cycle of physiology of the medical career, in contrast to the study carried out by Ibrahim et al. 2018 (9) in medical students of the same academic cycle and third.

The skills acquired with the process of Problem Based Learning especially in the field of medicine and that has been accepted worldwide, allows perceived advantages such as seeing the method as something broader in the acquisition of knowledge, organizing ideas, developing creative and intellectual capacity allows the student to know much or enough about the process, improving knowledge retention, integration of scientific skills in the basic clinical field, development of communication, the creation and improvement of critical thinking as indicated and being able to create their own knowledge and lifelong learners (7).

It has been determined that problem-based learning allows the acquisition of skills in the development of technical, methodological, participatory and personal competencies as evidenced in this work, which is corroborated by Gil- Galvan (10) who in his study on the use of

problem-based learning in university teaching determined that there is a positivism and acceptance of this methodology in relation to the acquisition of knowledge, based on real problems ($p = 0.08$), the need to learn, organize ideas ($p = <0.05$).

Problem-Based Learning is an instrument that facilitates problem solving and becomes an active methodology, as it allows for the improvement of personal skills such as self-direction in the learning process and critical reflection as indicated (11). Then we can indicate that this methodology allows for sound, deep learning that positively influences the performance of each individual, so much so that in the study presented, these positive skills have allowed it to be a facilitating vehicle and thus subsequently be applied in the professional field.

Motivation, the acquisition of knowledge and resolutions of events in specific situations are technical skills that are acquired during the process of the methodology studied and have allowed the good judgment of the students to be able to find solutions to meet the objectives and become judicious, since the strengthening of these skills in medicine improves the results (8).

A study conducted by Al Ansari et al. (2021) on the acquisition of confidence and knowledge in medical students established that, in 279 final-year medical students, 13% of the students were confident in performing the procedures, 15% had the ability to recognize alarming signs, 20% adequately assessed blood tests, thus the students indicated that the teaching method under consideration allowed an adequate development of skills (6).

Aldayel et al. (2019) in their review of medical student perception of the problem-based learning method in 259 students, had a positive perception, as their knowledge in basic sciences increased ($P = 0.03$), however, they indicate that the method must be carried out properly, as they felt that the teacher was not prepared to do so and there were limitations in its applicability, only 26.3% considered that there was

adequate applicability, thus the present study identified that 82.7% of the students indicated that they knew between enough and a lot, to discover the different competencies (12).

PBL allows the development of “beneficial skills such as improved communication, teamwork, presentation skills and critical evaluation, independent learning and improved clinical skills” (15) as it is beneficial for students as demonstrated by the present study, where students indicate that they know enough about collaborative work skills and communication skills and much more than 80% of the cases surveyed after the application of this methodology.

In a systematic review carried out by Ghani et al. (2021) they evaluated affective learning behavior and within them are confidence, intrinsic empowerment and functional skills, in relation to critical empowerment students have several roles such as being a leader, writer, editor or any role that helps improve the performance of collaborative work, in addition they have to be diligent and self-critical with the sole purpose of determining if the objectives set are being met and being able to find solutions when posing problems (14).

The work carried out by Gomez - Millan et al. (2019) (15) identifies that the students improved in the results related to the skills of collaborative work, information synthesis, ability to organize, teamwork has allowed the student to have the ability to create and argue the entire development of the work process.

Ates et al. (2011) (16) described the evolution of engineering students on PBL, as they showed that there was an increase in confidence in the process itself, it improved essential skills in problem solving, it promoted the culture of self-learning over the years, as it taught them to think, understand and deal collaboratively, and above all they developed critical thinking in problem solving.

Feedback to rectify deficiencies is seen as a process known by students, since they indicate their relationship to interpret them as

sufficient or much (90%), in the systemic review carried out by Ghani et al. (14) they determined that it is an important parameter in the strengths of knowledge, since carrying out an analysis of the results obtained also helps to strengthen the learning process.

Improving knowledge based on the problems posed has allowed for productive discussions and in this way provides the acquisition of knowledge, strengthens dialogue, thinks and thus improves cognitive skills, the present study observes and communicates that they benefited from the method, since more than 90% of the participants mark the process as sufficient and much, data that are corroborated by Shimizu et al. (2019) (17) in their study of 96 participants in the development of PBL concluded that group discussions were significant and acquired knowledge with higher scores and self-directed learning.

Personal skills are presented as a less favorable result, showing that there is a significant group, since they value it as something less than little, in this way it is understood that it is not favorable, despite this circumstance there is a crucial group of students who know enough or a lot about the acquired skills and is subject to the studies carried out by other authors such as Tadesse et al., Gil-Galván and Contreras et al. (7, 10, 18).

Critical thinking, as a quality of human beings, is influenced by learning pedagogy, the individual is able to solve the problems that arise daily, making coherence in each resolved process and not having problems in decision making (19).

5. Conclusions

It was found that after implementing PBL, more than 80% of the participating students' technical, methodological, participatory, and personal skills were strengthened, making it a superior method compared to other methods, such as traditional methods. It contributes to knowledge

generation, problem-solving, decision-making, fosters critical thinking, and helps solve challenges. In order to create professionals with skills and competencies capable of proposing solutions that guarantee an adequate quality of life for the general population, it is therefore important to plan new strategies for the development of higher education that convey information accurately and with the participation of learners.

6. Contribution of the authors

MVUR: Data collection and analysis of results.

KMPL: Final review of the article.

RMCP: Discussion development.

JRRA: Discussion development.

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