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THEORETICAL-CONCEPTUAL LEARNING IN EMBRYOLOGY AND GENETICS CLINICS

APRENDIZAJE TEÓRICO-CONCEPTUAL EN CLÍNICAS DE EMBRIOLOGÍA Y GENÉTICA

APRENDIZAGEM TEÓRICO-CONCEITUAL EM CLÍNICAS DE EMBRIOLOGIA E GENÉTICA

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ABSTRACT:
This article highlights the urgency of reformulating health education in Bolivia, emphasizing the importance of science, teaching in higher education and the involvement of undergraduate students in the integrative relationship between theory-practice-transformative action, critical thinking and ethical commitment. The first two authors of this article are part of the movement that values the use of active methodologies, such as Problem-Based Learning (PBL) and Team-Based Learning (TBL), in medical education, as evidenced by a study at the Universidad Mayor de San Andrés. The results indicate that these approaches promote learning and enhance student participation and dialogue in classes, which is essential to face ethical, training and practical challenges in Bolivian medicine, helping students to expand their understanding of the content.

KEYWORDS: Team-Based Learning; Problem-Based Learning; Active Methodologies; Embryology-Genetics; Medicine.

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Introduction

The need to reformulate health training has intensified in recent decades due to the limitations of the conventional educational model to satisfy social demands. This challenge is particularly crucial in the context of medical education in Bolivia, where the transition makes innovative learning approaches imperative, as opposed to the traditional teacher-centered method. The increasing complexity of health problems and the easy dissemination of information through the Internet emphasize the urgency of these changes.

Active methodologies represent an educational approach that places the student at the center of the learning process, encouraging their active participation, encouraging collaboration and encouraging the development of critical thinking. Unlike traditional teaching methods, where students play a more passive role in receiving information from the teacher, active methodologies promote meaningful interaction between students and content. These approaches are not just about absorbing knowledge, but also about developing skills, problem-solving skills, and preparing students to face real-world challenges. Therefore, they are gaining prominence in educational institutions as alternatives to the traditional model, providing a more attractive and participatory learning environment (Moya, 2017a; Ruiz, 2011; Toledo, Moreira and Nunes, 2018).

Problem Based Learning (PBL) is a teaching strategy that promotes active learning, using real-world problems as a starting point to stimulate critical thinking and problem solving. Originating in medical education and then applied to various areas of health, PBL places students at the center of the learning process, encouraging active participation and autonomy. Teachers play a guiding role, guiding students through questions and discussions to develop knowledge. PBL stands out for its focus on the practical application of learning, fostering students' curiosity and preparing them to face real-world challenges (Araújo and Sastre, 2009; Berbel, 1998; Liu et al., 2019).

Team Based Learning (TBL) is a student-centered pedagogical strategy designed for implementation in classes in which students are divided into small teams. TBL emphasizes the learning that occurs both within each team and in collaboration between teams, developing teamwork skills, information synthesis, and communication between colleagues. It is notable for its "readiness assurance" phase, which includes individual and team assessments, followed by immediate feedback, and is noted for its effectiveness in environments with a high ratio of students to available instructors (Burgess and Matar, 2020; Haidet et al., 2012; Parmelee et al., 2012).

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Active teaching methodologies, such as Problem-Based Learning (PBL) and Team-Based Learning (TBL), emerge as possible solutions, allowing students to collaborate in groups to analyze and solve the challenges presented. Although genetics may initially seem remote from medical practice, it is an essential area that must be introduced from the early stages of learning, and the use of specific cases can facilitate understanding.

Realistic and relevant case studies are essential in medical education, especially in the areas of Embryology and Genetics, as they provide a practical context for understanding theoretical concepts, promote critical thinking, prepare students for real-world clinical situations, They encourage interdisciplinarity and address ethical issues. and keep students motivated. They play a crucial role in training future healthcare professionals, enabling them to develop the skills necessary to address complex clinical and ethical challenges in medical practice and research.

The development of clinical skills is essential in the training of health professionals, preparing them to care for real patients. Active methodologies, such as Problem-Based Learning (PBL) and Team-Based Learning (TBL), play a critical role in improving these skills, especially when applied through clinical case studies. PBL places students at the center of the learning process, challenging them to solve complex cases, developing their clinical reasoning and diagnostic skills. Meanwhile, TBL emphasizes collaboration among students, preparing them for teamwork in the clinical setting. Case studies provide a realistic context for applying theoretical knowledge to practical situations, preparing students to face real-world challenges. This approach improves clinical skills, decision making and the ability to deal with the complexity of patient care, considering that students, in medical training, need to learn scientific knowledge and develop professional skills to be prepared to provide high-quality care. quality.

Incorporating active methodologies, such as case study and group problems, can improve the relationship between students and the subject matter, which, in turn, assists in the teaching of fundamental genetics. In this context, a study was conducted to evaluate the effectiveness of case studies, with the hypothesis that it stimulates students more than the traditional team learning class format, with the assumption that it promotes more efficient learning in comparison with the individual study. and learning through problematization, which encourages the simulation of real cases seeking to solve these problems. These changes contribute to more solid training in the health sector, better preparing future professionals.

Materials and methods

The research presented in this study adopts a quantitative approach with the purpose of carrying out a rigorous evaluation of the active methodologies applied in the teaching of Embryology and Genetics. The type of research is characterized as descriptive and exploratory, since it is not only intended to describe the application of these methodologies, but also to explore their effects and effectiveness on student learning (Bernal, 2010).

Initially, hypotheses are proposed about the impact of active methodologies in the subject of Embryology and Genetics, and then data are collected to test these hypotheses. This implies a deductive approach for the formulation of hypotheses and a hypothetico-deductive approach for the empirical verification of said hypotheses (Bernal, 2010).

The research was carried out during the second semester of 2023 at the Faculty of Medicine of the Universidad Mayor de San Andrés within the framework of the subject "Embryology and Genetics," which is part of the study plan of the first year of the degree. Medicine. At this stage of the study, a total of 10 students were invited to participate. They were provided with detailed information about the principles and objectives of the research, they were consulted about their interest in being part of the study, and they were provided with a consent form for their participation, ensuring transparency and respect for their willingness to get involved in the study. investigation.

The data collection techniques used are participant observation and survey. Participant observation allows the collection of data through direct observation of classes in which active methodologies are applied. A structured observation guide has been used as an instrument to guarantee the systematic collection of data related to the implementation of these methodologies. But, also, a survey has been administered to the students with the purpose of obtaining detailed information about their perception and experience in relation to the active methodologies in the subject. The instrument used for the survey is a questionnaire with multiple choice questions, specifically designed to measure key aspects, such as the effectiveness of these methodologies in learning, student participation and preference for certain pedagogical techniques (Delgado and Cervantes, 2010).

Questionnaire data collection was carried out using widely accessible applications, Google Forms, which facilitate the efficient and secure collection of student responses. The main data analysis tool used is IBM SPSS version 25 software. This software allows performing statistical analyses, such as significance tests, correlation analysis and descriptive statistics, in order to evaluate the relationship between variables and examine

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the results. quantitatively, as well as validating the questionnaire applied through the calculation of Cronbach's Alpha.

Results

Medical education is constantly evolving, and a fundamental part of this evolution is the development of clinical skills in medical students. In this context, research was carried out at the Faculty of Medicine of the Universidad Mayor de San Andrés (UMSA) with the objective of exploring the potential of active learning methodologies, such as Problem Based Learning (PBL), Team Based Learning (TBL) and case studies, in the subject of Embryology and Genetics. The research involved 10 students, 5 male and 5 female, and focused on a case study distributed in 6 questions, after 4 theoretical classes and 4 practical classes, followed by group discussions and, finally, a discussion with the whole class to analyze and interpret the cases. The results of this research are presented below.

1. Enhancing Active Learning: Active learning methods, such as PBL, TBL and case studies, have proven to be effective in promoting student engagement in the learning process. During group discussions, students actively engaged in problem solving and idea generation, which enhanced their understanding of Embryology and Genetics concepts.

2. Development of Clinical Skills: The application of clinical cases in the context of Embryology and Genetics allowed students to relate theoretical concepts with real medical situations. This encouraged the development of clinical skills, such as diagnostic reasoning, decision making, and effective communication with patients.

3. Collaboration and Communication: The TBL and group discussions promoted collaboration among students. Working as a team allowed them to share knowledge, perspectives and experiences, which enriched the learning process. Additionally, whole-class discussion provided the opportunity to communicate and defend points of view, which is essential in the medical field.

4. Deep Understanding: The focus on case studies allowed students to delve deeper into the subject and apply their knowledge in a meaningful way. Solving clinical problems increased their understanding and helped them relate the concepts of Embryology and Genetics to practical situations.

5. Comprehensive Assessment: Research demonstrated that active learning methodologies are effective for the comprehensive assessment of students. Through group discussion and case presentation, skills such as critical thinking, decision making,

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application of knowledge, and communication were assessed, rather than simply measuring data memorization.

6. Student Satisfaction: Participants expressed a high level of satisfaction with these teaching methodologies. They reported that they felt more motivated, engaged, and prepared to face clinical challenges in their future medical practice.

The assessment of clinical skills is a critical component in the training of health professionals. In this context, an investigation was carried out that focused on the analysis of the changes observed in the clinical skills of the participants through a questionnaire applied by Google Forms. To ensure the reliability and validity of the data collected, IBM SPSS version 25 was used for statistical analysis, and Cronbach's Alpha was calculated with an impressive value of 0.956 to check the feasibility of the research.

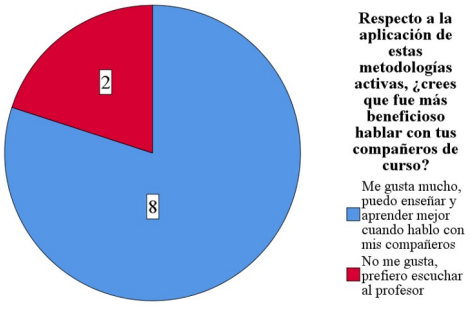
To collect quantitative data, a questionnaire designed in Google Forms was implemented, which consisted of specific questions aimed at evaluating the clinical skills of the participants before and after the implementation of the active methodologies. This questionnaire was distributed to participants, and anonymous responses were collected to ensure confidentiality and honesty in responses.

To understand the evolution of clinical skills, detailed statistical analyzes were performed using IBM SPSS version 25. This software allowed for a precise focus on data collection, organization, and analysis.

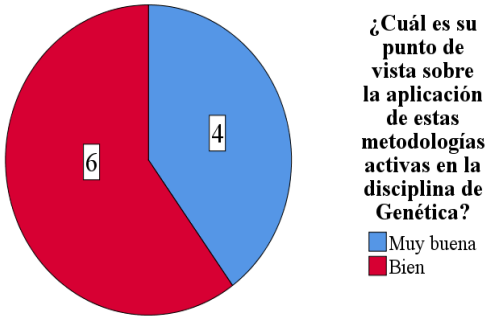
A critical aspect in research is the reliability of the data. To evaluate the coherence and consistency of the questionnaire responses, Cronbach's Alpha coefficient was calculated, which returned an impressive value of 0.956. This value suggests high consistency in responses, supporting the robustness of the research.

Below are the 9 structured questions of the questionnaire with the corresponding graphs that will illustrate the participants' responses:

Figure 1 - Question 1



Source: Prepared by the authors.



Source: Prepared by the authors.

Figure 2 - Question 2

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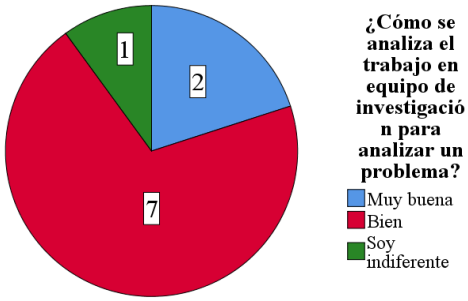
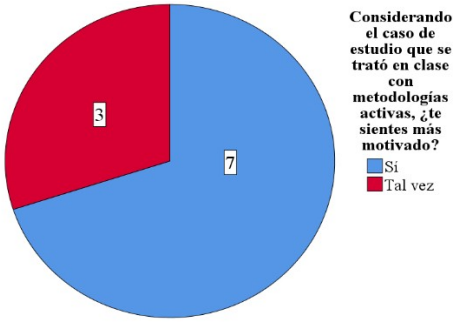
Figure 3 - Question 3



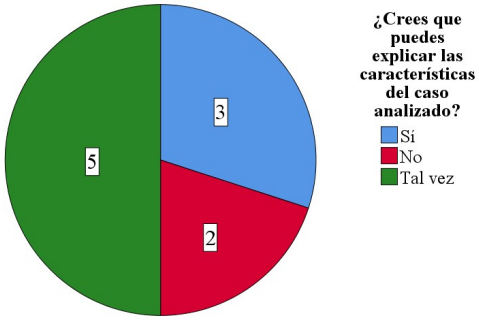
Source: Prepared by the authors.

Figure 4 - Question 4



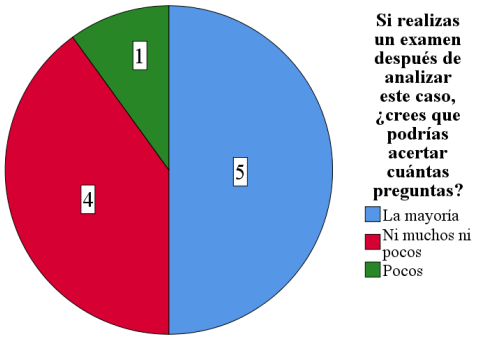
Source: Prepared by the authors.

Figure 5 - Question 5



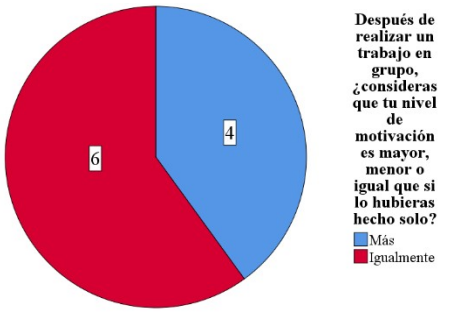
Source: Prepared by the authors.

Figure 6 - Question 6



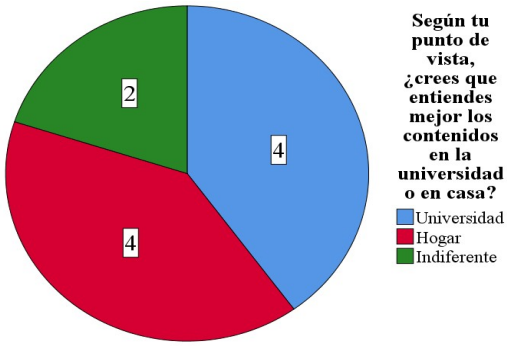
Source: Prepared by the authors.

Figure 7 - Question 7



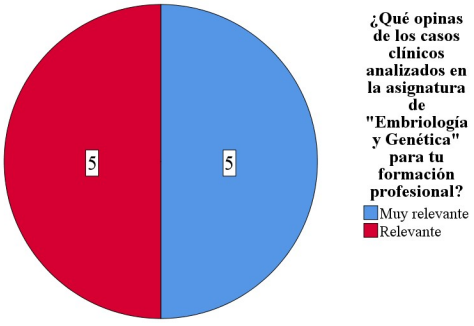
Source: Prepared by the authors.

Figure 8 - Question 8



Source: Prepared by the authors.

Figure 9 - Question 9



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Discussion

In the constantly evolving field of medical education, developing clinical skills in medical students is a crucial component. In this context, a study was carried out at the Faculty of Medicine of the Universidad Mayor de San Andrés (UMSA) with the purpose of exploring the possibilities offered by active learning methodologies, such as Problem Based Learning (PBL), Team Based Learning (TBL) and case studies, specifically in the teaching of Embryology and Genetics. In this way, the research was developed to explore and measure the effectiveness of active teaching methodologies in improving clinical skills, as well as to evaluate the impact of these methods on students' perception.

In the first part of the study, carried out at the Faculty of Medicine of the Universidad Mayor de San Andrés (UMSA), an active learning approach was used through Problem Based Learning (PBL), Team Based Learning (TBL) and the case study. The results indicated several significant findings:

Active methodologies have proven to be effective in involving students in the learning process, encouraging problem solving and idea generation. This significantly helped the understanding of the concepts of Embryology and Genetics. A fact that can also be observed in the research of Godinho et al. (2017) and Souza, Iglesias, Pazin-Filho (2014a), in which both carried out research on PBL in the same discipline. Souza, Iglesias, Pazin-Filho (2014a) highlight the need for more dynamic pedagogical approaches in the training of health professionals, highlighting the importance of active participation of students in the learning process, a fact that was possible to highlight in the development of the activity. While Godinho et al. (2017) state that through PBL it was possible to enhance the development of clinical skills and promote a deeper understanding of the concepts of Embryology and Genetics, in which it was possible to verify and corroborate the results of both authors. Thus, it is possible to affirm that the application of clinical cases allowed students to relate theory and practice, strengthening clinical skills such as diagnostic reasoning and decision making.

Burgess et al. (2017) compare TBL with PBL, highlighting TBL as an effective approach to promoting collaborative learning and communication among students. When we analyze the study carried out by Santana, Oliveira, Ramos (2019) on TBL activities for medical students, the positive perception of students regarding collaboration and improvement of communication through TBL stands out, corroborating our results already It is demonstrated that the use of these methodologies can promote a deeper understanding of the concepts of Embryology and Genetics, as students actively apply their knowledge to real problems.

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The article by Souza, Iglesias, Pazin-Filho (2014a) suggests that innovative teaching strategies can lead to a deeper understanding of content, encouraging students to relate theory and practice. Through a more general view, the study by Chen et al. (2018) on TBL in medical education in China highlights the effectiveness of TBL in promoting the assessment of critical and applicative skills rather than mere memorization of data.

The transition from a teaching-centered educational approach to a learning-centered one represents a significant cultural shift for the university. Moya (2017b) explores students' perceptions of training in active methodologies, teachers' consideration of their use, and whether student opinion is taken into account in teaching planning. These actions are considered essential to improve educational quality, although teachers do not yet fully integrate students' opinions into course planning, which could be enriched through methodological renewal towards more active practices.

Through this research it can be seen that there is a convergence in the importance of collaboration between students, the promotion of deep understanding of the contents and the emphasis on the evaluation of critical and application skills instead of simple memorization of data as such. Fundamental elements for effective medical education. All authors highlight different approaches, such as PBL and TBL, as means to achieve these objectives and improve the teaching-learning process in the area of health, especially when case studies are applied.

The second part of the research focused on the quantitative evaluation of the clinical skills of the participants using a Google Forms questionnaire. IBM SPSS version 25 software was used for statistical analysis, and a strong value of 0.956 was obtained for Cronbach's Alpha, supporting the feasibility of the research. Analysis of the quantitative data revealed significant changes in the participants' clinical skills. The graphs illustrate the answers to the structured questions of the questionnaire, providing a clear view of the evolution in your clinical skills.

Research supports the effectiveness of active methodologies in improving the clinical skills of medical students. The focus on active learning and quantitative assessment demonstrates the importance of implementing dynamic teaching methods in medical education. These approaches not only strengthen clinical skills, but also increase student motivation and satisfaction, better preparing them for the challenges of their future career in healthcare.

Research conducted at the UMSA School of Medicine demonstrated that the use of TBL, PBL, and case study in teaching Embryology and Genetics is highly effective for the development of clinical skills in medical students. These methodologies promote active

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learning, collaboration, communication and deep understanding of the subject. In addition, they offer a comprehensive evaluation and student satisfaction. This innovative approach has the potential to transform medical education, preparing future physicians to successfully meet clinical challenges.

Edgar Morin (2001, 2002, 2004) argues that thinking complexly involves simultaneously considering elements, relationships, and movements, recognizing the inseparability of the parts from the whole. He emphasizes that the amount of memorized content is not the basis of knowledge, but rather how it is integrated into our thinking. This paradigm seeks to overcome simplification, promoting an emerging understanding that complements previous paradigms and renews the disciplinary structure, especially in fields such as genetics and embryology, through the implementation of active methodologies to foster new forms of scientific learning.

Currently, the complexity of university curricula requires new approaches in education, especially in the training of health professionals. So Souza, Iglesias, Pazin-Filho (2014b) addressed in their article the challenges faced in this process, such as the need to break with traditional teaching methods, and explores innovative strategies to implement teaching-learning methodologies, considering the perspective institutional, teaching and student.

The use of active methodologies such as Problem Based Learning (PBL) and Team Based Learning (TBL) in teaching Embryology and Genetics provides significant benefits, including the encouragement of critical thinking, the practical application of concepts, the promotion of collaboration and teamwork, encouragement of self-directed learning, student motivation and immediate feedback. These methodologies allow students to address real problems and clinical situations, which is essential in fields such as medicine, specifically for this study of embryology and genetics, and effectively prepares them to apply their knowledge in the real world, in this way. way, differentiating itself from purely traditional teaching.

Final considerations

The implementation of active methodologies, such as Problem-Based Learning (PBL) and Team-Based Learning (TBL), through case studies in embryology and genetics, with first-year medical students, has proven to be highly effective and promising

First, through the use of case studies, students are encouraged to actively and practically engage with real genetic issues. This not only increases their interest in

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genetics topics, but also motivates them to seek solutions to real-world problems, which is essential for meaningful learning.

Additionally, these approaches encourage the development of critical and problem-solving skills, essential skills in any scientific discipline, including genetics. Students learn to analyze data, identify fundamental questions, and apply their theoretical knowledge to solve practical problems, preparing them for real-world challenges.

Together, PBL and TBL promote effective communication and collaboration among students, allowing them to share their knowledge, discuss ideas, and make group decisions. This reflects the real dynamics of genetic research, which often involves collaboration between scientists. Participants expressed a high level of satisfaction, highlighting their greater motivation and preparation to face clinical challenges in their future medical practice.

Another notable benefit is the emphasis on self-reflection and metacognition as students evaluate their own progress, identify gaps in their knowledge, and adapt their learning strategies. This contributes significantly to the development of self-learning skills, which are invaluable throughout your academic and professional journey. These active approaches provide meaningful learning, preparing students for clinical challenges in their future medical practice, which contrasts with the traditional model, which is usually more passive and based on memorization of information.

It is up to teachers to plan teaching so that students can learn scientific knowledge and professional practices, developing the ability to relate theory and practice combined with critical thinking and professional, ethical and human commitment to the patient, considering the context, injustices social and economic inequalities. In this sense, teachers are fundamental in the planning and development of classes with the mediation of student learning. Research shows that active methodologies, problem-based learning (PBL) and team-based learning (TBL) can play a role and contribute to medical training by providing the opportunity for participation, dialogue, case study and reconnection of the knowledge and teaching of students mediation that allows levels of depth of the contents studied in the discipline. It is necessary to complement and go beyond expository classes, it is a historic moment to promote paradigmatic breaks and teach dialogue classes with scientific and conceptual discussions articulated with professional practice and thus think complexly and reconnect knowledge and practices.

In higher education, it is important to go beyond the lecture class to promote contextualized and current theoretical-practical learning. For this, it is essential that

students commit to science, as a field of study, as well as to their own training having studied. discipline and, in class, participate in the exchange of knowledge through dialogue, which is why the article proposes active methodologies as a possible path.

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RESUMEN:
Este artículo destaca la urgencia de reformular la educación en salud en Bolivia, enfatizando la importancia de la ciencia, la enseñanza en la educación superior y el involucramiento de los estudiantes de pregrado en la relación integradora entre teoría-práctica-acción transformadora, pensamiento crítico y compromiso ético. Los dos primeros autores de este artículo forman parte del movimiento que valora el uso de metodologías activas, como el Aprendizaje Basado en Problemas (ABP) y el Aprendizaje Basado en Equipos (TBL), en la educación médica, como lo evidencia un estudio de la Universidad Mayor de San Andrés. Los resultados indican que estos enfoques promueven el aprendizaje y potencian la participación y el diálogo de los estudiantes en las clases, lo cual es fundamental para afrontar los desafíos éticos, formativos y prácticos de la medicina boliviana, ayudando a los estudiantes a ampliar su comprensión de los contenidos.

PALABRAS CLAVE: Aprendizaje Basado en Equipo; Aprendizaje Basado en Problemas; Metodologías Activas; Embriología-Genética; Medicina.

RESUMO:
Este artigo destaca a urgência de reformular a educação em saúde na Bolívia, enfatizando a importância da ciência, do ensino na educação superior e do envolvimento dos estudantes de graduação na relação integradora entre teoria-prática-ação transformadora, do pensamento crítico e do compromisso ético. Os dois primeiros autores desse artigo compõem o movimento que valoriza a utilização de metodologias ativas, como a Aprendizagem Baseada em Problemas (PBL) e a Aprendizagem Baseada em Equipes (TBL), no ensino médico, conforme evidenciado por um estudo na Universidade Mayor de San Andrés. Os resultados indicam que essas abordagens promovem aprendizagem e potencializa a participação estudantil e o diálogo em aulas, o que é essencial para enfrentar desafios éticos, formativos e práticos na médica boliviana, auxiliando o estudante na ampliação da compreensão do conteúdo.

PALAVRAS-CHAVE: Aprendizagem Baseada em Equipes; Aprendizagem Baseada em Problemas; Metodologias Ativas; Embriologia-Genética; Medicina.