

The Influence of Formative Feedback on the Development of Self-regulated Learning in Medical Education

A Influência do Feedback Formativo no Desenvolvimento da Autorregulação da Aprendizagem na Formação Médica

La Influencia de la Retroalimentación Formativa en el Desarrollo de la Autorregulación del Aprendizaje en la Formación Médica

RESUMO

Esse artigo buscou investigar como o feedback formativo pode promover a autorregulação da aprendizagem na educação médica. Esta pesquisa adota uma abordagem qualitativa e descritiva, sendo conduzida como uma revisão integrativa de literatura. Os dados foram levantados nas bases PubMed, SciELO e ERIC, considerando estudos publicados entre 2019 e 2024. Após a aplicação dos critérios de inclusão e exclusão, 19 estudos foram analisados. Os resultados indicam que o feedback formativo estruturado e contínuo favorece a autorregulação da aprendizagem, auxiliando estudantes de medicina na monitorização do desempenho acadêmico e aprimoramento de estratégias de estudo. Abordagens como feedback multimodal, reflexivo e combinado entre pares e docentes demonstram impacto positivo na aprendizagem autorregulada. No entanto, desafios como sobrecarga docente e resistência a modelos avaliativos inovadores dificultam a implementação dessas práticas. Conclui-se que investir em metodologias avaliativas baseadas no feedback formativo é essencial para fortalecer a autonomia e a competência profissional dos futuros médicos.

DESCRITORES: Feedback formativo; Autorregulação da aprendizagem; Educação médica.

ABSTRACT

This study aimed to investigate how formative feedback can promote self-regulated learning in medical education. An integrative literature review was conducted, searching for articles in the PubMed, SciELO, and ERIC databases, considering publications between 2019 and 2024. After applying the inclusion and exclusion criteria, 19 studies were selected and analyzed. The results showed that structured and continuous formative feedback plays a crucial role in developing self-regulated learning, helping medical students monitor their academic performance and refine their study strategies. The literature indicates that approaches such as multimodal feedback, reflective feedback, and a combination of peer and faculty feedback enhance self-regulated learning and positively impact students' performance. However, challenges such as faculty workload and resistance to adopting innovative assessment models still hinder the effective implementation of these practices. It is concluded that investing in formative feedback-based assessment methodologies is essential to strengthening the autonomy and professional competence of future physicians.

DESCRIPTORS: Formative feedback; Self-regulated learning; Medical education.

RESUMEN

Este estudio tuvo como objetivo investigar cómo la retroalimentación formativa puede promover el aprendizaje autorregulado en la educación médica. Se realizó una revisión integradora de la literatura mediante la búsqueda de artículos en las bases de datos PubMed, SciELO y ERIC, considerando publicaciones entre 2019 y 2024. Tras aplicar los criterios de inclusión y exclusión, se seleccionaron y analizaron 19 estudios. Los resultados evidenciaron que la retroalimentación formativa estructurada y continua desempeña un papel fundamental en el desarrollo del aprendizaje autorregulado, ayudando a los estudiantes de medicina a monitorear su desempeño académico y mejorar sus estrategias de estudio. La literatura indica que enfoques como la retroalimentación multimodal, la retroalimentación reflexiva y la combinación de retroalimentación entre pares y docentes potencian el aprendizaje autorregulado e impactan positivamente en

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el rendimiento de los estudiantes. Sin embargo, desafíos como la sobrecarga docente y la resistencia a la adopción de modelos de evaluación innovadores aún dificultan la implementación efectiva de estas prácticas. Se concluye que la inversión en metodologías de evaluación basadas en la retroalimentación formativa es fundamental para fortalecer la autonomía y la competencia profesional de los futuros médicos.

DESCRIPTORES: Retroalimentación formativa; Aprendizaje autorregulado; Educación médica.

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INTRODUCTION

Formative feedback has become an essential tool in higher education, especially for its role in developing self-regulated learning. This approach not only informs students about their performance, but also guides them towards their learning objectives, encouraging critical reflection and strategic adjustments in their academic trajectory.¹

In the context of medical education, where the acquisition of clinical skills requires continuous and applied learning, formative feedback plays a crucial role in the consolidation of knowledge and practical skills, and is particularly relevant for stimulating

self-regulation of learning. Evidence suggests that the implementation of structured feedback favors student autonomy and improves their study strategies.²

The concept of self-regulation of learning refers to the student's ability to plan, monitor and adjust their learning strategies autonomously, promoting greater control over their own educational process.³ In medical education, this skill is fundamental for continuous professional development, as it allows students to take an active stance in the face of the complexity of clinical practice and the need for constant updating of knowledge.² Formative feedback plays an essential role in this process, provid-

ing information that helps students identify gaps in their learning and improve their study strategies.¹

The need to reformulate assessment strategies in medical education has been widely discussed, especially given the complexity of professional practice and the demands of contemporary higher education.⁴ Traditional assessment models, centered on grades and one-off exams, often do not provide students with sufficient opportunities to reflect on their learning and improve their performance.⁴ On the other hand, continuous and structured feedback has been recognized as an essential resource to strengthen students' autonomy and facilitate the development of criti-

cal skills for clinical practice.² Given this, structured feedback not only improves learning, but also contributes to the development of students' professional security.⁵

Recent studies indicate that integrating feedback with structured reflection can significantly enhance learning and clinical skill development. Studies have shown that those who received feedback integrated with reflection had significantly greater increases in performance on higher-order assessments compared to those who simply reflected on their practice without structured feedback.⁶ These findings reinforce the importance of aligning formative assessment with structured reflective processes, ensuring that feedback is used effectively to enhance clinical learning and decision-making.^{4,5}

Furthermore, teacher feedback plays a crucial role in promoting self-regulated learning.³ The interaction between teachers and students, mediated by feedback, strengthens the feeling of academic belonging and enhances students' ability to self-regulate their learning.⁷ This process directly impacts academic engagement and motivation to learn, making feedback not only a correction tool, but also a means of emotional and academic support for medical students.^{6,7}

Despite the clear benefits of formative feedback, its implementation still faces challenges. Institutional barriers, such as teacher overload and lack of specific training in the application of feedback, can compromise the effectiveness of this assessment process.¹ Furthermore, resistance to the adoption of more dynamic assessment methodologies can hinder the transition from traditional models to approaches focused on continuous and dialogic feedback.⁴

Acceptance of innovative feedback practices requires institutional changes and a culture that values

formative assessment.⁷ Despite these challenges, research indicates that investment in assessment practices that incorporate structured and formative feedback has a significant impact on the quality of teaching and the learning experience of students.²

Given this scenario, this integrative review aims to investigate how formative feedback can promote self-regulation of learning in medical education, analyzing its characteristics, strategies and impact on student training. By systematizing knowledge about this practice, we seek to contribute to the improvement of assessment methodologies and the training of more prepared and autonomous professionals.

METHOD

This integrative literature review was conducted to investigate how formative feedback can promote self-regulation of learning in the context of medical education. The search for articles was conducted in the PubMed, SciELO and ERIC databases, selected for their relevance and scope in the areas of health and education. The time frame included studies published between 2019 and 2024, ensuring the current scientific evidence. The descriptors used in the searches were: feedback, formative assessment, formative feedback, medical education, formative feedback, formative education, formative assessment, self-regulation of learning and self-regulation. These terms were combined with the Boolean operators AND and OR to optimize the results, ensuring the inclusion of studies aligned with the objective of the review.

The articles were selected based on the following criteria: studies published between 2019 and 2024, articles available in full in the selected databases, publications in Portuguese or English, studies that addressed

formative feedback, self-regulation of learning and educational practices in medical education, with emphasis on interventions or methodological approaches in the application of feedback. In addition, studies applied to undergraduate medical education or other relevant levels in the medical field, original articles, systematic reviews and qualitative or quantitative studies were included.

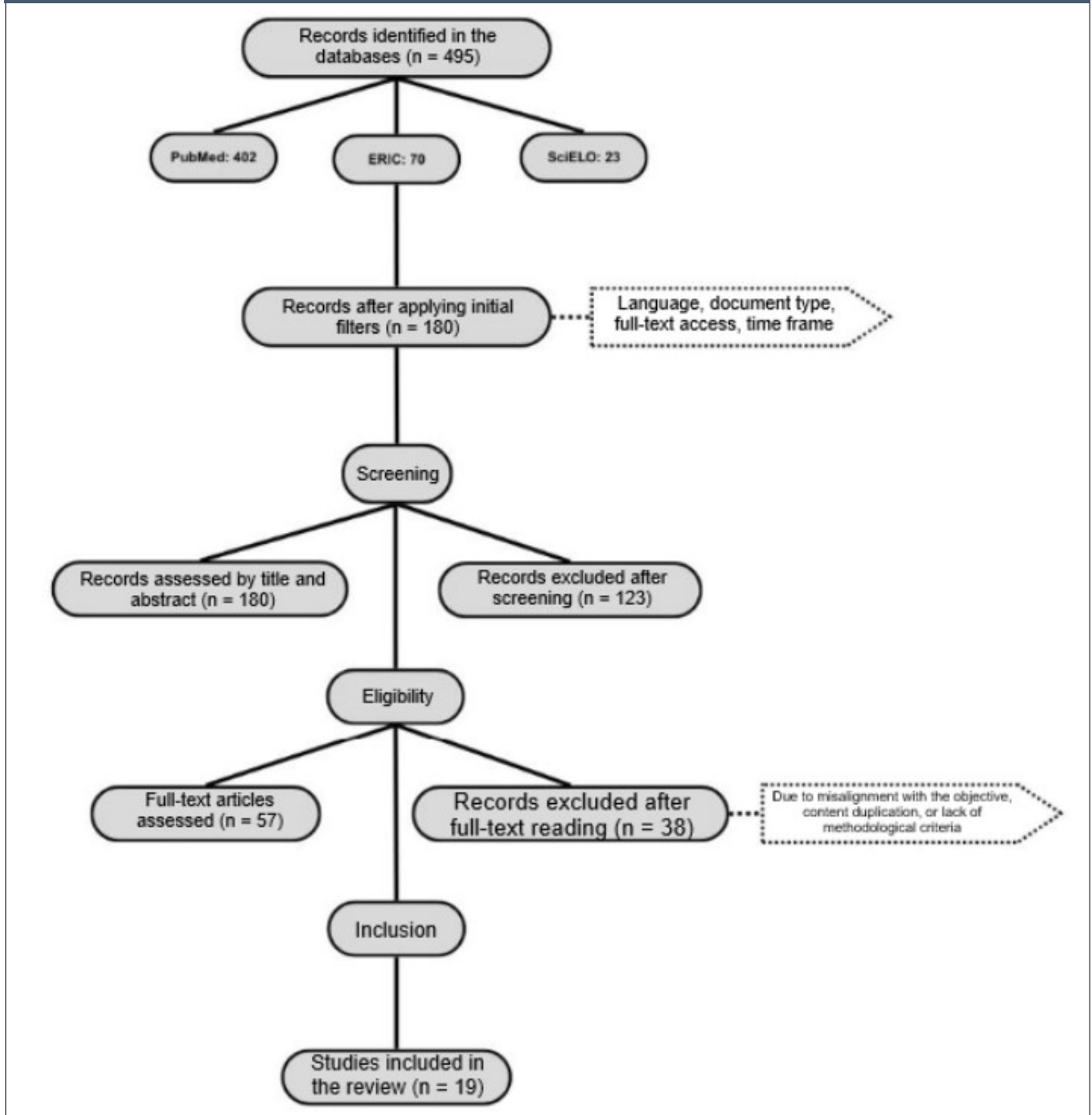
Studies that were outside the time frame, were not available in full or in Portuguese/English, exclusively addressed theoretical aspects or contexts distinct from medical education, or were abstracts of conferences, editorials, letters to the editor or unpublished theses were excluded. The study selection process followed the methodological principles of integrative review, starting with screening by titles and abstracts, followed by analysis of the full text of potentially eligible articles. Artificial intelligence tools were used to assist in screening and verify the alignment of studies with the inclusion criteria.

Initially, 495 articles were identified in the databases: 402 in PubMed, 70 in ERIC and 23 in SciELO. After applying eligibility filters, such as language, time frame, type of document and access to the full text, 180 articles were considered for reading the title and abstract. At this stage, 57 articles were selected because they were aligned with the inclusion criteria of the research, and were then subjected to full reading. At the end of the screening, 19 articles met all established criteria and comprised the final review sample (FIGURE 1).

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Figure 1 – Flowchart of the methodological path in the PubMed, ERIC and SciELO databases



RESULTS

The integrative review included 19 studies that investigated the impact of formative feedback on self-regulated learning in medical education,

whose characteristics are presented in Table 1. The articles analyzed presented methodological diversity, with 40% being qualitative, 33.3% quantitative and 26.7% mixed methods. Most of the publications orig-

inated in North America, Asia and Europe, with a significant increase in scientific production from 2023 onwards, which highlights the growing interest of the academic community in the topic (Table 1).

TABLE 1 – Characterization of selected studies

Nº	Authors (year)	Title of the article	Objective	Main findings
1	Braund et al. (2024)	Making assessment a team sport: a qualitative study of facilitated group feedback in internal medicine residency	To explore how the Feedback Fridays initiative contributed to the formative assessment of Internal Medicine residents within the current competency-based training model.	The introduction of team-facilitated assessments provided rich narrative feedback, focusing on competencies of CanMEDS roles. Key themes identified were: communication, intra- and interpersonal awareness, leadership and teamwork, and learning opportunities. The model created a safe space for constructive feedback, promoting a formative approach complementary to workplace-based assessment (WBA).
2	Staal et al. (2023)	Deliberate practice of diagnostic clinical reasoning reveals low performance and improvement of diagnostic justification in pre-clerkship students	To observe how preclinical medical students use clinical information during the diagnostic process.	Students performed poorly in diagnostic justification, especially in the use of physical examination data and information that decreases the likelihood of incorrect diagnoses. Deliberate practice accompanied by formative feedback resulted in a 40% improvement in this skill over 10 to 11 simulated cases, demonstrating that diagnostic justification can be developed progressively from the beginning of medical training.
3	Nguyen-Tri et al. (2024)	Feedback in an Entrustment-Based Objective Structured Clinical Examination: Analysis of Content and Scoring Methods	To assess the quality and coherence of verbal feedback provided by examiners during a structured clinical examination based on entrustable professional activities (EPAs)	Examiners provided high-quality feedback (Qual mean 4.3/5) with strong alignment to competency milestones (61%) and task-specific skills (46%). There was no significant difference in the quality or alignment of feedback between the two scoring methods, indicating that both are effective in trust-based OSCE contexts.
4	Surapaneni (2024)	ABCs of providing constructive feedback to students during small group learning activities	To present the ABCs model of constructive feedback and demonstrate how its application can improve the teaching-learning process in small group activities in medical education, promoting a positive, collaborative learning environment that is geared towards student development.	The ABCs model — Appreciate, Balance, and Clarify — favors constructive feedback that recognizes student effort, balances participation in the process, and proposes clear solutions for improvement. Adopting this model strengthens students' confidence, engagement, and self-regulation, especially in small group dynamics, but it can also be adapted to teaching in larger groups, contributing to better educational outcomes.
5	Sanchayan et al. (2024)	Feedback practices in undergraduate clinical teaching in Sri Lanka - a qualitative study	To assess feedback practices in clinical teaching for medical students in Sri Lanka.	The study revealed that feedback in clinical teaching is predominantly unidirectional, focused on error correction, and is often given in public and in groups. Despite the format, students found the feedback useful, although they wished for more positive reinforcement and opportunities for reflection. Factors such as cultural hierarchy, lack of formal feedback in the curriculum, and lack of teacher training negatively influenced the effectiveness of feedback. The authors recommend strategies that promote dialogue, reflection, and a more balanced feedback culture.
6	Hosseinpour et al. (2024)	Comparison of the effects of apprenticeship training by sandwich feedback and traditional methods on final-semester operating room technology students' perioperative competence and performance: a randomized, controlled trial	To compare the effects of sandwich-based feedback training and traditional methods on the competence and perioperative performance of surgical technology students in the last semester.	Students who underwent the sandwich-based feedback model (FBL) presented higher scores on the perioperative competence (PPCS-R) and performance (DOPS) scales compared to those who received traditional training. The FBL intervention also generated positive attitudes on the part of the students and was well evaluated by the instructors, being considered effective, feasible and capable of being incorporated into the clinical teaching routine.

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7	Bhattarai et al. (2020)	Tutor-demonstrated feedback in the mini-clinical evaluation exercise	To explore the feasibility and educational impact of tutor-demonstrated feedback (TDF) in clinical assessment encounters using mini-CEX.	The study demonstrated that tutor-demonstrated feedback (TDF) in the context of mini-CEX is feasible and has a positive educational impact. After implementation of TDF, there was an increase in peer satisfaction, a significant decrease in observation time, and a change in peer assessments, which became more critical, indicating knowledge acquisition and perception change. The data suggest that expert observation of performance followed by practice promotes effective learning, reinforcing the value of TDF as a clinical teaching strategy.
8	Brian et al. (2024)	Comparing Peer and Faculty Feedback for Asynchronous Laparoscopic Skill Acquisition	To evaluate the effect of peer feedback on laparoscopic performance and determine how residents perceive the experience of giving and receiving this type of feedback.	The study showed that peer feedback resulted in similar performance as faculty-provided feedback on basic laparoscopic skills. Residents highlighted benefits of peer feedback, such as shared mental models, a less pressured learning environment, and opportunities for brainstorming. These factors contributed to a positive learning experience, suggesting that peer feedback is a viable alternative to faculty feedback in asynchronous practice settings.
9	Van Wijk et al. (2024)	Does 'summative' count? The influence of the awarding of study credits on feedback use and test-taking motivation in medical progress testing	To investigate the effect of a progress test with a summative component (PT summative) and a purely formative progress test (PT formative) on (1) test preparation, (2) factors influencing motivation to take the test and use of feedback, and (3) self-reported and actual use of feedback after the test among medical students	The study revealed that students used less feedback after the formative PT compared with the summative PT. Motivation to take the test and consult feedback was strongly related to how students perceived the value of the assessment. Students with a performance orientation prioritized the summative PT because of the assignment of academic credits, whereas students with a learning orientation valued feedback regardless of the type of assessment. Overall, active use of feedback was low in both groups, and the impact of formative assessments on promoting learning was limited when there are no direct consequences for academic progress.
10	Fuentes-Cimma et al. (2024)	Designing feedback processes in the workplace-based learning of undergraduate health professions education: a scoping review	To map the literature on how feedback processes are organized in workplace-based learning environments in undergraduate health professions education.	The review mapped 61 studies and identified two major themes: (1) organization of feedback processes in clinical settings and (2) sociocultural factors that influence this organization. The findings highlight that creating clear learning goals, using diverse feedback strategies, and strengthening trusting relationships between students and tutors are essential for feedback effectiveness. The study also highlights the need to structure feedback encounters with opportunities for follow-up, as part of a complete learning cycle.
11	Nayak et al. (2020)	Impact of readiness assurance process and faculty feedback on individual application exercises: a model for continuous assessment in physiology	To explore the extent to which the readiness assurance process (RAP) and immediate feedback from faculty contribute to the acquisition of conceptual knowledge by medical students through individual application exercises in classes with a large number of students.	The study demonstrated that students who participated in the complete process — iRAT, gRAT, and discussion with the faculty member — performed better in individual application exercises (iAE) than those exposed only to the iRAT. Most students considered that the feedback received from faculty members during classroom discussions was useful for correcting errors and deepening knowledge. The implementation of this model demonstrated a positive impact on the development of clinical reasoning and active learning, even in large classes.

12	Edwardson (2021)	The active feedback program: bringing medical students out of the shadows	To present the “active feedback program” as an effective educational framework for integrating medical students into clinical activities during hospital rotations, promoting active learning through immediate and structured feedback.	The article describes an educational intervention that emphasizes immediate and structured feedback during clinical rotations in Neurology. The program guides preceptors to establish clear expectations, provide brief and formal daily feedback twice a week, and focus on both correction and positive reinforcement. Experience has shown that students learn more quickly, become more engaged, and that residents also benefit from taking on more advanced roles. Although the model has yet to be formally tested, its preliminary results indicate efficacy and feasibility without compromising other faculty responsibilities.
13	Johnson et al. (2022)	Medical Students’ Intention to Change After Receiving Formative Feedback: Employing Social Cognitive Theories of Behavior	To understand the factors that influence medical students’ intention to change their behavior based on feedback received during their obstetrics and gynecology internship, using the theories of planned action (TPB) and interpersonal behavior (TIB).	The study analyzed 1,443 feedback entries from 122 students. Most of the comments revealed that students intended to apply feedback based on self-efficacy. Other less frequent factors included beliefs about expected outcomes, social norms, and emotional responses. Self-confidence was identified as the main motivator for change, although the authors suggest that faculty training focused on attitudes, beliefs, and social norms can improve the effectiveness of feedback. The use of the TPB and TIB theories contributed to understanding how feedback can foster significant behavioral change in medical education.
14	Abraham et al. (2024)	Self and peer feedback engagement and receptivity among medical students with varied academic performance in the clinical skills laboratory.	To investigate the engagement and receptivity to self-reflective and peer feedback among medical students with different levels of academic performance, exploring its impact on self-assessment and peer criticism, in order to develop a model to optimize feedback processes in the preclinical phase of undergraduate medical education.	The study revealed that students with higher academic performance demonstrated greater comfort and engagement with self-reflective and peer feedback practices, valuing the process as a tool for professional development. Students with lower performance, on the other hand, presented difficulties in accepting and implementing feedback, citing lack of confidence, friendship bias and emotional distress as barriers. Both groups recognized the importance of a trusting environment, clarity in learning objectives and guidance from tutors as facilitating factors for engagement in the process. The study proposes a three-stage training model to strengthen the effective practice of self-reflective and peer feedback, based on educational theories such as Kolb’s Experiential Learning and Zimmerman’s Self-Regulation Theory.
15	Ma et al. (2023)	Reflection on the teaching of student-centred formative assessment in medical curricula: an investigation from the perspective of medical students	To explore and understand ways to improve student-centered formative assessment and provide a practical framework for the future construction of a formative assessment index system in medical curricula.	The results indicated that most students recognize the teacher as the main assessment agent, but there is a low understanding of formative assessment and its applicability. Although levels of satisfaction with the methods and feedback were relatively high, the authors warn that student satisfaction should not be the only criterion for measuring the effectiveness of formative assessment. The data highlight the importance of strengthening student participation, shared power in the assessment process, and the need for a more comprehensive index system for student-centered formative assessment.

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16	Pangastuti et al. (2022)	Piloting a constructive feedback model for problem-based learning in medical education	To examine the perceptions of students and tutors about a constructive feedback model that was tested in Problem-Based Learning (PBL) tutorials.	The constructive feedback model promoted had a positive impact on both cognitive and behavioral aspects of tutors and students, facilitating the understanding of the feedback process and promoting greater student participation and self-efficacy. However, challenges such as technological limitations, model adaptation, and variability in the characteristics of tutors and students were identified as barriers to its effective implementation.
17	Atwa et al. (2024)	Implementing Formative Assessment in Human Anatomy Practical Sessions: Medical Students' Perception and Effect on Final Exam Performance	To explore medical students' perceptions of formative assessment and feedback sessions conducted after practical anatomy sessions and to compare their performance in the summative assessment of educational units that had formative assessment with their performance in units that did not.	Students demonstrated positive perceptions of formative assessment and feedback, recognizing its role in preparing for exams, understanding the content and reducing anxiety. The study revealed a statistically significant difference in the mean grades of the units with formative assessment, suggesting that this approach contributed to improved practical performance. In addition, the sessions were seen as valuable opportunities for practice and reflection, reinforcing the understanding of anatomy concepts and knowledge retention.
18	Lockyer et al. (2022)	Multisource feedback: an overview of its use and application as a formative assessment	To provide an overview of the utility, evidence base, and cautions related to the use of formative performance assessment through multisource feedback (MSF) in medical education.	The article highlights MSF as an effective formative assessment tool across the medical education continuum, especially in the areas of communication, collaboration, and professionalism. Despite its utility, successful use of MSF depends on rigorous implementation of its four steps (data collection, aggregation, delivery, and discussion), with attention to validity, reliability, and necessary infrastructure. It also points out that MSF has a positive impact when accompanied by facilitated discussion and action plans, and is widely used in continuing professional development programs, although it is still underused in undergraduate medical education.
19	Orsini et al. (2022)	Common models and approaches for the clinical educator to plan effective feedback encounters	To explore six of the most common and accepted feedback models in clinical settings and assess their transferability to different clinical feedback encounters, so that clinical educators can make informed decisions about how and when to use them.	The study presents six widely recognized clinical feedback models—Sandwich Feedback, Pendleton Rules, One-Minute Preceptor, SET-GO model, R2C2, and ALOBA—highlighting their structures, strengths, limitations, skill levels required of educators and learners, and the most appropriate clinical situations for application. The analysis indicates that, although each model has specific characteristics, all can be adapted according to the educator's style and the feedback context. The article highlights the importance of planning feedback encounters, considering factors such as a safe environment, a basis in direct observation, clarity of objectives, and establishment of shared action plans.

Source: Hartuique et al., 2025.

Region	N	%
North America	6	31,6
Europe	3	15,8
Asia	5	26,3
Latin America	3	15,8
Oceania/Others	2	10,5
Total	19	100

Source: Hartuique et al., 2025.

The studies analyzed explored different approaches to the application of formative feedback, with an emphasis on pedagogical strategies aimed at medical education. Among the main findings, it is worth highlighting that the implementation of structured feedback contributes to the improvement of self-regulation of learning, promoting greater student engagement in the evaluation

process. In addition, evidence indicates that feedback models associated with critical reflection and goal setting demonstrate a positive impact on knowledge retention and the development of clinical skills.

The analysis of the articles allowed the organization of the results into three major thematic categories (Table 2):

1. Characteristics of effective formative feedback, highlighting aspects such as clarity, specificity,

frequency and alignment with learning objectives;

2. Impact of feedback on self-regulation of learning, showing that continuous and structured feedback favors the development of metacognitive strategies and academic autonomy;

3. Pedagogical strategies in medical education, which include the use of active methodologies, such as simulations, PBL tutorials and multimodal feedback applied in different learning contexts.

Furthermore, the ABCs model of constructive feedback, which emphasizes balanced and specific communication, has been shown to increase the acceptance and effectiveness of feedback in group learning environments.^{10,17} Additionally, the use of sandwich feedback has been shown to be more effective than traditional methods in improving the perioperative competencies of surgical training students.^{15,18}

The use of structured instruments, such as the Mini-CEX, has proven to be an effective tool in promoting autonomy and developing clinical skills. Studies indicate that the application of the Mini-CEX in formative assessments contributes to the improvement of students' clinical skills, allowing them to critically reflect on their performance and adjust their conduct autonomously.¹⁹ In addition, research conducted in different academic contexts reinforces this perspective, demonstrating that the use of the Mini-CEX enables immediate and targeted feedback, promoting a continuous learning cycle.²⁰ Evidence also suggests that the implementation of structured assessment and feedback instruments in pediatric education favors active learning and the professional development of residents.²¹ Thus, structuring feedback through methodologies such as the Mini-CEX not only assists in the technical development of students, but also stimulates their capacity for self-regulation and continuous improvement.

Another fundamental aspect discussed in the literature is the influence of cultural factors on feedback practices. In hierarchical contexts, such as Sri Lanka, feedback tends to be unidirectional and public, which can limit its effectiveness.²² However, studies indicate that students express the need for a balance between error correction and positive reinforcement, suggesting that structural changes, such as greater dialogue between teachers and students, can improve the educational experience.²³ In this sense, students' psychological safety also emerges as an essential factor for the effectiveness of feedback, especially in multicultural con-

Table 2 – Categorization of the studies analyzed according to main theme

Category	N
Characteristics of effective formative feedback	12
Impact of feedback on self-regulation	11
Pedagogical strategies in medical education	10

Note: Some articles were classified in more than one category, according to content analysis.

Source: Hartuique et al., 2025.

Despite the benefits identified, studies also highlighted recurring challenges in implementing formative feedback. Among the most frequent obstacles are teacher overload, lack of specific training to con-

duct structured feedback, resistance to innovative methodologies, and difficulties in integrating these practices into the formal curriculum (Table 3). These data reinforce the need for investments in teacher training, as well as in institutional policies that promote a culture of continuous and collaborative feedback in medical education.

Tabela 1 – Distribuição geográfica dos estudos analisados

Challenge identified	N	%
Teacher overload	7	36,8
Lack of training for structured feedback	6	31,6
Resistance to innovative methodologies	4	21,1
Difficulty in curricular integration	2	10,5
Total	19	100

Source: Hartuique et al., 2025.

DISCUSSION

Characteristics of Effective Formative Feedback

Formative feedback is widely recognized as an essential tool for developing the academic and professional skills of medical students.^{8,9,10,11} In this sense, effective feedback should go beyond simply correcting errors, encompassing cognitive and metacognitive elements that help students monitor their performance and

critically reflect on their actions.^{8,9} This approach allows identifying gaps in learning and fostering a culture of continuous reflection, promoting student autonomy.^{12,13}

The studies analyzed in the review confirm that structured and well-targeted feedback has a positive impact on students' learning and professional development.^{11,14,15} The deliberate model of feedback in clinical simulations, for example, demonstrated significant improvement in the diagnostic ability of preclinical stu-

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texts. Building long-term relationships between tutors and students, combined with teachers' cultural awareness, has been highlighted as a fundamental strategy to increase receptiveness to feedback and make it more productive.²³ Furthermore, excessively hierarchical or public feedback practices can compromise this psychological safety, reinforcing the need for adaptations in the assessment process to ensure a more inclusive and participatory learning environment.^{22,23,34}

The findings of this review also show that combining technological and traditional approaches can improve the quality of feedback. In medical education, multisource feedback, combined with structured assessment methods, has been shown to be effective in strengthening not only technical skills, but also communication and professionalism skills.^{24,25} In addition, studies suggest that the use of digital feedback tools, such as automated scoring systems, can complement these approaches, improving the objectivity of assessment and reducing the burden on teachers.^{26,27} Thus, integrating innovative strategies with traditional feedback contributes to a more accurate assessment process, aligned with the needs of students and the reality of clinical practice.

These findings indicate that the effectiveness of formative feedback depends on a combination of appropriate structuring, consistent frequency, and the quality of the human interactions that support it. When implemented well, feedback not only assesses but also acts as a catalyst for the personal and professional growth of medical students.

Impact of Feedback on Self-Regulation of Learning

Feedback plays a crucial role in promoting self-regulated learning, providing students with valuable information so they can adjust and improve their study strategies. The value of formative feedback depends on students' perception of its usefulness and impact on their academic performance.^{11,12,28} Studies show that formative assessments, when not associa-

ted with academic credits, tend to be less valued by students, reducing their engagement with the feedback received.^{11,13}

Structuring feedback in continuous cycles has proven to be an effective strategy for enhancing its impact on self-regulation. The feed-up, feedback, and feed-forward model establishes a continuous process that helps students set clear goals, assess their current performance, and plan future actions for improvement.¹⁴ This approach is particularly relevant in clinical settings, where learning is dynamic and based on practical experience.^{14,19}

Another important aspect is the impact of immediate feedback on learning and the development of critical skills. Studies indicate that feedback provided immediately after formative assessments significantly improves students' performance in subsequent summative assessments, allowing for faster adjustment of study strategies and consolidating the link between theory and practice.^{11,14,29} Similarly, the integration of feedback into processes such as the Readiness Assurance Process (RAP) has been associated with improved knowledge acquisition, in addition to favoring the development of fundamental skills, such as clinical reasoning and teamwork.^{13,30,31}

The literature also highlights the importance of structured feedback for self-directed learning. Studies indicate that the use of formative feedback improves students' perception of their own performance and strengthens self-regulation of learning, allowing continuous adjustments throughout the educational process.^{12,13} Similarly, applying structured feedback in specific modules helps students identify areas for improvement and enhance their academic autonomy, favoring continuous learning.³² This evidence converges with previous findings that highlight the role of constructive feedback in PBL tutorials in promoting critical reflection and collaborative learning.³³ The complementarity of these findings reinforces the need to structure feedback processes that encourage the development of students' academic autonomy.

Furthermore, combining peer and teacher feedback can provide a more comprehensive perspective on student performance. Studies indicate that peer feedback tends to be more detailed and specific, while teacher feedback covers a broader spectrum of competencies, providing a more balanced assessment of learning.^{15,17} This complementarity strengthens self-regulation capacity, as it allows students to receive multiple perspectives on their performance and adjust their study strategies more effectively.²¹

Finally, the use of technological tools has enhanced students' self-regulation by providing continuous, real-time feedback. Studies indicate that the implementation of educational technology increases students' autonomy in managing tasks and adapting to new learning environments, providing greater control over their learning process.^{26,27} In a complementary manner, interactive approaches that combine technology and human interaction demonstrate a positive impact not only on cognitive self-regulation, but also on motivational self-regulation, reinforcing the importance of a balance between digital feedback and structured pedagogical support.³¹

The integration of feedback as a central tool in self-regulated learning is essential for the academic and professional development of medical students. The diverse approaches discussed in the studies analyzed highlight that adapting feedback to the individual needs of students is essential to optimize their learning and promote lasting results. To maximize its impact, it is essential that educational institutions encourage a culture of continuous, structured feedback aligned with learning objectives, ensuring that students become autonomous and reflective professionals.

Pedagogical Strategies in Medical Education

Pedagogical strategies in medical education have evolved significantly with the incorporation of competency-based models and structured feedback. In the context of simulation-based training, studies

indicate that deliberate practice in clinical reasoning significantly improves the diagnostic justification of preclinical students, allowing for more robust and progressive learning.⁹ This model highlights the importance of starting training from the early years of medical training, ensuring that structured feedback is an essential tool for building clinical competencies.⁸ Furthermore, evidence suggests that integrating active feedback into simulation training strengthens learning retention and enhances the development of diagnostic and decision-making skills.¹⁶

A recent study explored the impact of immediate feedback on a structured clinical examination based on Entrustable Professional Activities (EPAs). The results indicated that verbal feedback provided immediately after the activities was highly aligned with competency milestones, promoting residents' autonomy and increasing their confidence in independent practice.⁸ Similar findings were observed in studies that applied the Mini-CEX and structured feedback in medical training, indicating that immediate feedback favors the development of specific clinical skills and contributes to the consolidation of professional autonomy.^{20,21} These results reinforce the value of feedback as an essential instrument for improving clinical practice in authentic learning contexts.

In small group teaching, the application of constructive feedback strategies has been shown to have a positive impact on learning dynamics. The use of the "ABCs" model — which emphasizes appreciation, balanced contributions, and collaboration — has been shown to be effective in creating a positive and participatory learning environment.¹⁰ In addition, the comparison between peer and teacher feedback has been the subject of research, especially in the teaching of technical skills, such as laparoscopy. Studies indicate that both types of feedback are equally effective for learning, reinforcing the importance of collaborative learning and the diversity of evaluative perspectives.¹⁵ These findings are consistent with evidence from the literature indicating

that constructive feedback in collaborative contexts favors student engagement, self-regulation of learning, and strengthening academic confidence.¹

Advances in pedagogical strategies in medical education reflect the growing appreciation of practices focused on the integral development of students. The integration of collaborative and reflective approaches points to an education that is more responsive to individual and collective needs, promoting autonomy and technical competence. Aligning formative feedback with innovative methods, such as workshops, simulations and continuous assessments, creates an environment that encourages self-reflection and continuous improvement, preparing future professionals for the challenges of the dynamic clinical context.^{26,27,35} It should be separated from the results and present interpretations of the results in light of current and pertinent literature. Present the relevant aspects and interpretation of the data obtained. Discuss with research results on the topic, implications and limitations of the study. It should not repeat the data presented in the results.

CONCLUSION

This study reinforces the relevance of formative feedback in promoting self-regulated learning in medical education. The review shows that structured and continuous feedback not only corrects errors, but also guides students in their academic and professional trajectory, developing reflective and strategic skills essential for clinical practice. Furthermore, the findings highlight that effective feedback must be frequent, personalized and aligned with the individual needs of students, strengthening their autonomy and engagement in the learning process.

However, structural and methodological challenges persist that limit the implementation of this practice. The lack of teacher training, academic overload and the predominance of traditional assessment models hinder the adoption of more dynamic and dialogical feedback approaches.

To overcome these barriers, it is essential that institutions invest in teacher training, foster an institutional culture of feedback and integrate innovative methodologies, such as the use of educational technologies and multi-source feedback, to ensure a more efficient and meaningful assessment process.

In the field of research, this review contributes to filling important gaps in the literature, consolidating evidence on the interaction between formative feedback and self-regulation of learning. However, there is still a need for more in-depth investigations on the impact of different feedback formats and dynamics, especially in the digital context and in clinical settings. Longitudinal studies that follow the academic trajectory of students throughout the medical course can provide more robust evidence on the effectiveness of feedback in professional training.

Therefore, the strategic implementation of assessment practices based on formative feedback represents an essential path to training more prepared, reflective and autonomous doctors, capable of dealing with the challenges of a constantly changing professional environment.

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Integrative Review

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The Influence of Formative Feedback on the Development of Self-regulated Learning in Medical Education

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