ANALYSIS OF THE EFFECTIVENESS OF IMPLEMENTING ACTIVE METHODOLOGIES IN HIGHER EDUCATION: AN INTEGRATIVE REVIEW ON THE CASE OF HISTOLOGY

ANÁLISE DA EFICÁCIA DA IMPLEMENTAÇÃO DE METODOLOGIAS ATIVAS NO ENSINO SUPERIOR: UMA REVISÃO INTEGRATIVA SOBRE O CASO DA HISTOLOGIA

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Abstract. Histology teaching traditionally uses expository methods, but active methodologies have been introduced to promote more meaningful and contextualized learning through a deep understanding of concepts, longer-lasting retention of knowledge, stimulating the development of cognitive skills. The objective of this integrative review was to evaluate the effectiveness of implementing active methodologies in teaching histology. The integrative review was conducted through an extensive review in the Capes Periodicos and Lilacs databases, including articles published in English and Portuguese, between the years 2020 and 2024, using combinations of controlled descriptors. A total of 18 articles were found for final selection, including 11 articles and excluding 07 articles. The results indicated that active teaching methodologies contribute to greater knowledge retention and improved academic performance. The review suggests that implementation improves students' academic performance and motivation, although more experimental studies are needed to confirm these findings in varied contexts.

Keywords: Renewing pedagogical approach. Active Learning. Academic performance.

Resumo. O ensino de histologia tradicionalmente utiliza métodos expositivos, mas as metodologias ativas vêm sendo introduzidas para promover uma aprendizagem mais significativa e contextualizada através da compreensão profunda dos conceitos, retenção mais duradoura do conhecimento, estimulando o desenvolvimento de habilidades cognitivas. O objetivo desta revisão integrativa foi avaliar a eficácia da implementação de metodologias ativas no ensino de histologia. O estudo foi conduzido através de uma análise extensiva nas bases de dados Capes Periódicos e Lilacs incluindo artigos publicados em inglês e português, entre os anos de 2020 e 2024, utilizando combinações de descritores controlados. Foram encontrados 18 artigos para seleção final, dos quais 11 foram incluídos e 7 excluídos. Os resultados indicaram que as metodologias ativas de ensino contribuem para uma maior retenção de conhecimento e melhora do desempenho acadêmico. A revisão sugere que a implementação melhora o desempenho acadêmico e a motivação dos estudantes, embora mais estudos experimentais sejam necessários para confirmar esses achados em contextos variados.

Palavras-chave: abordagem pedagógica renovadora; aprendizagem ativa; desempenho acadêmico.

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INTRODUCTION

The beginning of the 21st century brought new reflections on the teaching and learning process, with special emphasis on the new generations, especially the so-called "Generation Alpha", composed of individuals born from 2010 onwards, considered to be members of the technology age and who tend to be more independent as they grew up in a highly connected environment (CUNHA et al., 2024).

Society is in constant evolution, which demands that education adapt to these comprehensive transformations. In this scenario, the imperative need for a pedagogical practice based on more active and participatory approaches emerges (DAROS; CAMARGO, 2021).

Active learning methodologies support placing the student at the center of the teaching-learning process, developing autonomy through active practices, with the teacher acting as a facilitator during the learning process. One of the striking characteristics of this approach in higher education is problem-solving, where students apply prior knowledge to real-world situations, bringing learning closer to professional practice. Another central aspect of active methodologies is the development of transversal skills, such as time management, teamwork, and resource organization. These practices not only prepare students for the professional environment, but also stimulate interdisciplinarity. Students can articulate varied content by solving problems which integrate multiple fields of knowledge, acquiring a comprehensive and contextualized vision. Thus, students prepare themselves to face real-world issues by participating in which promote greater interaction with the study object and context. Teacher guidance and active student engagement in activities contribute to an academic education closer to professional practice, strengthening autonomy and the ability to solve complex problems (SCHLICHTING; HEINZLE, 2020). It is evident that a student's entry into higher education is a challenging experience. It is essential that students are motivated and engaged to accomplish the various academic tasks in the university environment. Motivation to learn can be seen as a dynamic and multifaceted phenomenon, playing a crucial role in knowledge acquisition and academic performance at different education levels. In this context, learning goals represent the factors that motivate students to engage in learning-related activities, with the aim of consolidating information and mastering academic content. This process generates positive emotions, which in turn stimulate interest in new learning. Furthermore, learning goals can be organized into: performance-approach: where students are more focused on the outcome of their performance, aiming to stand out positively in relation to others; and performance-avoidance: in which students aim to avoid negative outcomes and protect themselves from judgment, acting in a way that prevents them from being considered the "worst" among their peers (PEREIRA et al., 2022).

The implementation of active learning methodologies has gained prominence as a promising alternative in higher education, especially in disciplines which require in-depth understanding and practical application, such as histology. Thus, methodologies that utilize information and communication technologies can assist in the teaching and learning process, resulting in the development of various competencies by students (SILVA et al., 2022). According to Camargo and Daros (2021), elaborating passive or active knowledge is built at different levels of possibilities and modifying understanding, where "the teacher's journey is a permanent learner of learning", therefore the facilitating teacher becomes an active learner in the face of challenges, new circumstances, new technologies, and digital natives.

In doing so, one of the essential pillars in the educational process is found in collaborative learning strategies, which foster cognitive development among peers and engage them in the pursuit of shared goals. These pedagogical approaches not only facilitate assimilating knowledge, but also cultivate an environment of cooperation and interdependence, which are essential for flourishing a community of learners committed to collective advancement. Collaborative pedagogical actions establish an environment conducive to exchanging experiences, sharing prior knowledge, and fostering engagement and motivation of participants. As group members mature, the sense of belonging, mutual trust, and freedom to collaborate intensify, making the sharing of discoveries, ideas, and projects a stimulating and enriching activity (CAMARGO; DAROS, 2021).

Histology involves the study of the tissue components which compose the organism, explaining how tissue morphology is directly related to the functions they perform (JUNQUEIRA; CARNEIRO, 2023). The study of histology is fundamental to the academic training of students in the biological and health sciences, as it provides

detailed understanding of the structure and function of the organs and systems of the human body in an in-depth manner. Thus, its study provides the necessary basis for identifying tissue anomalies and pathologies, favoring resolution of a diagnosis and enabling treatment adaptation, which makes histology knowledge important in understanding diseases, in addition to helping in developing new therapies and medications (SILVA et al., 2023).

Histology is the field of knowledge which deals with understanding the microscopic composition of the human body through identifying tissues and cells. The study of tissues requires the use of microscopes, which constitutes an additional difficulty for beginners. Thus, new study methods have been proposed in an attempt to overcome this initial difficulty and make learning more attractive, such as the use of technological resources in virtual learning environments (FONSECA, 2022). Histological slides and optical microscopes are used in practical histology activities, requiring specific skills for focusing the images on the slides for proper use of this equipment. Students need to develop these skills, understanding the components of the microscope and applying focusing techniques which are fundamental for studying and comprehending histological content. In addition to correct handling of the microscope, it is important to understand the spatial organization of the material to be examined, since the slides present two-dimensional structures, making it difficult to conceive how this tissue fits within the organ being studied (SILVA, 2024).

Therefore, prior knowledge of coloring techniques and methods is fundamental to achieving a precise and realistic definition of the observed image. Several studies on these methodologies have generated new approaches, such as "active learning", a term coined by the Englishman Reginald William Revans (1907-2003). This process involves students actively participating in their knowledge construction, reinforcing that teaching goes beyond a mechanical action: it is a collaborative process which promotes quality education, capable of developing critical and reflective thinking (GUIMARÃES et al., 2023).

According to Sant'anna (2022), learning histology is considered difficult due to the level of abstraction required (molecular and microscopic scale). Interpreting histological images is a task which requires mastery of specific knowledge and vocabulary, skill in microscopy techniques, understanding three-dimensional structures, variation as a function of the cutting angle and staining techniques, and integration with their respective functions. One proposal considered as an effective methodology for teaching histology is deliberate practice. This practice is defined as training to increase performance through repetition and successive refinements. This approach makes it possible to design learning environments and create opportunities for training, unlike content-based information that is passive, stagnant in the fact of a process which cannot sustain itself.

According to Camargo & Daros (2021), continuous reflection on the act of educating, which may sometimes seem to suggest abandoning traditional content teaching practices, actually implies that every educational process inevitably results in knowledge acquisition, content assimilation, and effective learning. Therefore, strategies which dynamize concepts are essential to establish effective and substantial paths that culminate in the ultimate goal of learning.

Active methodologies present learning strategies and are able to obtain the best student engagement, and with good strategies the study of histology can be transformed into an engaging environment, blending the curiosity of wanting to know and wanting to share. The triad of strategy, competence, and knowledge makes all the difference in the educational process.

Innovation in histology education has been driven by technological advancements which transform the way students interact with study materials, facilitating content comprehension. Thus, the use of virtual microscopes, digital atlases with their high-definition images, and interactive games are becoming increasingly accessible and integrated into teaching, enriching the dynamics and engagement for learning.

In order to evaluate the effectiveness of implementing active methodologies in histology teaching, this study was developed to highlight the importance of these innovative pedagogical approaches in promoting more meaningful and in-depth learning. The current study seeks to contribute to the reader's understanding of how these practices can enrich the educational process in histology by emphasizing the relevance of active methodologies, facilitating assimilating knowledge and developing essential skills.

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The general objective of this article is to evaluate the effectiveness of implementing active methodologies in histology teaching through an integrative review. In addition, as specific objectives: to compare the effectiveness of active methodologies with the traditional method in histology teaching; to identify the main active learning methodologies applied to the teaching of histology that most engage and motivate students; and to analyze the difficulties faced by teachers and students in adopting active learning methodologies.

This study is presented through a systematic literature review, focusing on answering the question of the effectiveness of implementing active methodologies in teaching histology. It aims to identify and synthesize evidence from primary studies, offering valuable insights into how these methodologies influence engagement, knowledge retention, and academic performance for future decision-making. To this end, it follows a rigid and predefined protocol to ensure methodological rigor and reproducibility due to the need to meet methodological standards, detailed search, and analysis. Thus, the purpose of conducting this systematic review is not only to contribute to advance scientific knowledge in the field, but also to support educators in adopting effective pedagogical intervention strategies aligned with students' needs, ensuring reliability in decision-making.

METHOD

Research question and search strategy

The traditional, teacher-centered teaching method still has a strong presence in the current educational context and is widely used, although it is not always the most suitable for promoting knowledge construction and intellectual independence in students. Active learning proves to be more effective compared to the traditional methodology, as it facilitates understanding complex concepts, especially in approaches that traditionally prioritize memorization and a broad view of static systems. In this context, students engage in various activities, such as reading, discussion, writing, and skill development, emphasizing the objective and reflective processes of analysis, synthesis, and content evaluation. On the other hand, methodologies are seen as valuable opportunities to generate positive results in the learning process. In this new perspective, students cease to be mere recipients of information and begin to interact with both the teacher and the rest of the class, so that active methodologies allow them to experience deeper learning situations (MARQUES et al., 2021).

It has been observed that the student assumes a passive posture in the traditional teaching method, often listening and receiving information without actively participating in the learning process. This limits their capacity to reflect, critically analyze, and practically apply acquired knowledge. For example, in teaching histology, it is essential that the student develops skills such as handling microscopes and interpreting histological slides, constituting competencies which require more active participation. Thus, active methodologies contribute to a more dynamic and meaningful learning experience, motivating students and enriching the educational process.

Teaching histology was chosen as the central theme of this study. An adapted version of the PICO strategy was used to formulate the guiding question, considering that this is a non-clinical study. The structuring elements of the strategy were defined as follows:

- Population (P): undergraduate students in health sciences courses
- Intervention (I): active learning methodologies
- Context (C): histology teaching
- Outcome (O): learning

In this context, the central question of this study arises: Does implementing active methodologies effectively contribute to learning in histology?

Integrative review

This study is configured as an integrative literature review based on an analysis of articles published in the last five years with the objective of providing a rigorous evaluation of the effectiveness of active methodologies in teaching histology. The research was conducted in several meticulous stages. First, the central theme of the investigation was identified. The guiding question was subsequently formulated aligned with the study objectives. Next, a systematic search

of the academic literature was conducted, identifying articles relevant to the topic in question. The selected material was then subjected to a critical analysis and detailed discussion of its results, aiming to synthesize the available evidence and offer a comprehensive and in-depth understanding of the impact of active methodologies on learning histology.

Inclusion and exclusion criteria

The following inclusion criteria were used to define the sample: descriptors relevant to the scope of the selected theme, complete articles published between 2020 and 2024, articles in Portuguese and/or English, and articles which answered the research question. Articles that did not correspond to the theme were excluded.

Article selection

Articles with satisfactory information in their abstracts were selected for full-text reading. The results were compiled after selecting articles by title and abstract, and excluding articles which did not meet the pre-established criteria.

Data collection

The research question was delimited in order to search for evidence in the literature. The following descriptors relevant to the topic were used: Aprendizagem ativa AND Histologia; Aprendizagem ativa AND Desempenho acadêmico; Histologia AND Desempenho in the Capes periodicals database, and the descriptors in cross-referenced terms: Active learning AND Histology; Active learning AND Academic performance; Histology AND Academic performance, entered in the Lilacs database. In addition, inclusion and exclusion criteria were used to select the topic objectives.
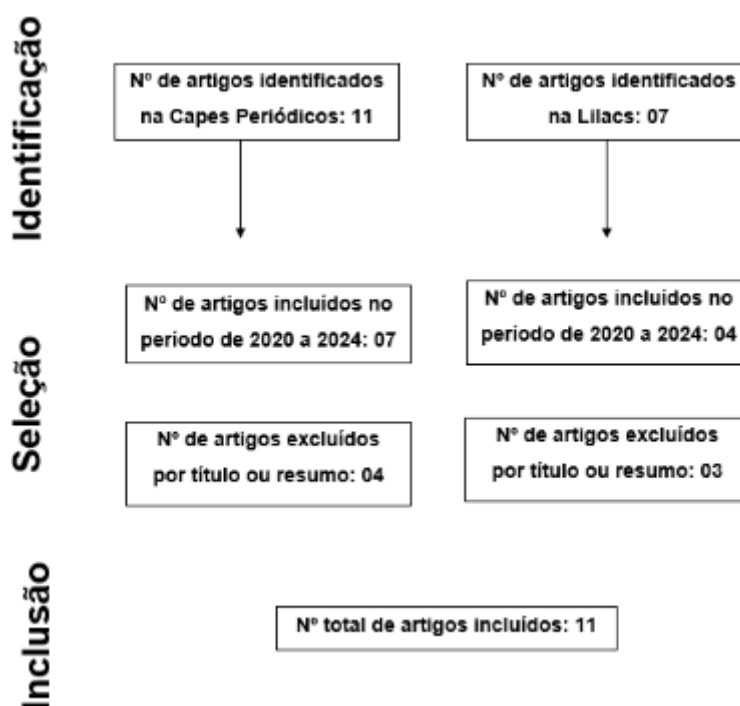
Information from the selected studies was recorded during data collection, including authors, year of publication, main results, and conclusions.

Data analysis

According to Figure 1, the literature review flowchart shows that 11 articles were identified in the Capes Periodicals database. Of these, 7 articles, covering the period from 2020 to 2024, were included in the analysis, while 4 articles were excluded based on the title or abstract. In turn, 7 articles were identified in the Lilacs database, of which 4, also from the period of 2020 to 2024, were included, while 3 articles were excluded using the same criteria. Thus, a total of 11 articles met the inclusion criteria defined for the period from 2020 to 2024.

Table 1 shows the inclusion and exclusion criteria for the articles collected from the database using the cross-referenced terms of the descriptors. Therefore, based on the exclusion criteria, articles which did not correspond to the publication period in the years (2020-2024), and titles or abstracts that did not correspond to the study's theme were excluded. Finally, a total of 15 articles were selected for analysis in the review.

Figure 1 - Literature review flowchart.

Source: Elaborated by the authors.

The data analysis seeks to understand the analyzed documents, thereby constituting a qualitative, bibliographic, interpretative research approach with a reflective perspective which had articles that address the theme as its analysis object.

The qualitative methodology consists of a set of instruments applied to various types of discourse, with the objective of identifying indicators which enable inferring knowledge about the conditions of the population and the reception of these messages. The methodology is composed of three phases: pre-analysis, material exploration, and treatment of results and interpretation. The method uses systematic and objective procedures to describe the content of the messages, facilitating interpretation and understanding of the data (VALLE; FERREIRA, 2024). After data extraction and organization, the information from the articles was compared to generate tables in order to more didactically and representatively visualize and analyze the data obtained. Furthermore, this data was also used to perform the risk of bias analysis and to assess the quality of the evidence generated.

Risk of bias assessment is considered an extremely important component of an integrative review. This process helps to identify potential flaws in the evidence from each study and contributes to the certainty of the overall evidence (Sterne et al., 2019). The AMSTAR-2 instrument was used for this risk analysis, which is an assessment tool developed to improve the quality and reliability of systematic reviews. This tool primarily focuses on the correct methodology to ensure reliable results and functions as a summary checklist for high-quality reviews.

Risk of bias and quality of the publications

Artigo	Objetivo	Métodos	Resultados	Qualidade	Risco de Viés
Martins, 2020	Claro	Limitado	Consistente	Alta	Baixa
Fonseca, 2022	Claro	Limitado	Consistente	Média	Baixa
Medeiros, 2024	Claro	Limitado	Consistente	Alta	Baixa
Dias et al. 2021	Claro	Limitado	Consistente	Alta	Baixa
Spalding et al. 2020	Claro	Limitado	Consistente	Média	Baixa
Queiroz et al. 2023	Claro	Limitado	Consistente	Alta	Baixa
Monteiro et al. 2023	Claro	Limitado	Consistente	Média	Baixa
Donoso et al. 2024	Claro	Limitado	Consistente	Média	Baixa
Cobo et al. 2024	Claro	Limitado	Consistente	Média	Baixa
Souza e Silva, 2024	Claro	Limitado	Consistente	Alta	Baixa
Lião, 2019	Claro	Limitado	Consistente	Média	Baixa

Source: Elaborated by the authors.

Ethical aspects

An integrative systematic review does not involve direct data collection from human participants, but it does consider ethical aspects when selecting, analyzing, and reporting information from consulted works. It is not practical in nature and therefore does not require submission to a Research Ethics Committee (REC). Thus, a systematic review demands an ethical commitment that includes respect for copyright, methodological rigor, and transparency, ensuring honest and responsible scientific contribution. Although an integrative review does not involve direct data collection from human participants, it requires an ethical commitment to scientific integrity, demanding careful consideration when selecting, analyzing, and reporting information from consulted sources. Consequently, this type of review requires an ethical commitment that transcends the mere organization of data, demanding rigorous respect for copyright, which implies correctly citing all sources and honoring the intellectual property of each work used.

RESULTS AND DISCUSSION

Table 1 shows the inclusion and exclusion criteria for the articles collected from the database using cross-referenced terms and keywords. The inclusion criteria adopted were original articles published in the last 5 years in Portuguese and English, in electronic media. The exclusion criteria was articles which did not correspond to the publication period within the last five years, or titles or abstracts that did not correspond to the study's theme, thus totaling 11 articles for analysis and final selection.

Table 1 - Distribution of articles according to the database, cross-referenced terms of the descriptors.

Database	Cross-referenced terms / Keywords	Articles
Capes Periódicos	Active learning / Histology	Total number of articles found: **06** Total number of articles included in the period from 2020 to 2024: **04** Total number of articles rejected due to title or abstract: **02**
	Histology / Academic performance	Total number of articles found: **05** Total number of articles included in the period from 2020 to 2024: **03** Total number of articles rejected due to title or abstract: **02**
Lilacs	Active learning / Histology	Total number of articles found: **04** Total number of articles included in the period from 2020 to 2024: **02** Total number of articles rejected due to title or abstract: **02**
	Histology / Academic performance	Total number of articles found: **03** Total number of articles included in the period from 2020 to 2024: **02** Total number of articles rejected due to title or abstract: **01**

Source: Elaborated by the authors.

Table 2 presents the main conclusions of the selected articles considering the publication year and the study objective for analysis. After reading the collected material, references were selected according to the publication year to ascertain the type of methodological study, as well as to discuss the main conclusions of each article analyzed.

Next, Table 2 represents the main aspects addressed in each listed study. The reference to the author and year highlights the relevance and contemporaneity of the findings. The objectives of each study contribute to the field of knowledge. In turn, the study design is essential for the reliability of the results presented.

Quadro 2 - Distribuição dos artigos de acordo com autor e ano de publicação, objetivos, tipo de estudo e principais resultados, revista e Qualis

Author and year	Objectives	Study design	Main results	Journal	Qualis
Martins, 2020	To produce and analyze a didactic sequence in Histology using the concept of Blended Learning for deaf students in inclusive classes, assuming this methodology as a contribution to the teaching and learning process of other students in the inclusive Biology class.	The methodology consisted of developing Histology content using Blended Learning with investigative activities and the use of Digital Educational Objects (DEOs), such as webquests, Sway, Kahoot, and self-assessment. Hearing students and one deaf student from the 1st year of morning high school at the Amyntas de Barros State College, in the municipality of Pinhais, participated. The study used qualitative-quantitative approaches; however, the quantitative analysis was not conducted with the objective of comparing groups, but rather to measure the students' difficulties.	The study showed that the histology teaching sequence using the Blended Learning approach for deaf students in inclusive classes contributed to the teaching and learning process for both hearing and deaf students in the inclusive Biology class. 80% were more interested in the activities with QR codes, the practical lesson, and the Kahoot game.	Prática docente	B1

Fonseca, 2022	To understand and evaluate the teaching-learning process of Anatomy and Histology by students of the Dentistry course.	The method adopted was a literature review regarding the importance of teaching Anatomy and Histology in Dentistry, in addition to active learning methodologies applicable to the teaching-learning process of these subjects. Searches were carried out in the PubMed, Scielo, Lilacs, and Google Scholar databases, using the keywords "dentistry", "histology", "anatomy", and "teaching", in Portuguese and English, without a publication time limit. The data were interpreted qualitatively.	It is concluded that active learning methodologies can promote greater learning in Morphological Sciences.	Archives of Health Investigation	B3
Medeiros, 2024	To promote the development of individual skills and abilities: student protagonism x decision-making x interpersonal communication.	This study presents an experience report on the collective construction of a digital portfolio of basic human tissue histology by undergraduate health students from a private higher education institution in Rio de Janeiro as a curricular assessment tool based on an active learning methodology, stimulating the advanced theoretical study of the discipline and promoting development of basic technical skills in photographic documentation using digital smartphone cameras.	The active teaching approach had a positive impact on the development of the skills and competencies of dental students. Students adopted a collaborative spirit, showed enthusiasm and great interest in academic activities, felt more liberated, more questioning, and assumed responsibility and commitment. The collaborative development of the digital histological portfolio proved effective in maintaining student engagement, encouraging them to actively seek knowledge throughout the course.	Observatorio de La Economía Latinoamericana	A4
Dias et al. 2021	To evaluate the perception of students in the Histology discipline of the Dentistry course at the State University of São José dos Campos/SP, after application of pedagogical strategies different from traditional expository classes.	Pedagogical strategies were developed using methodologies such as: case study with the "hot potato" group dynamic, flipped classroom, Team Based Learning (TBL), problem-solving, in addition to the use of the virtual learning environment, which included distance-directed studies and a virtual histology atlas.	The transition from the conventional method to active methodologies can cause some discomfort, as in this case, students need to leave their "comfort zone" and develop greater autonomy, moving from mere spectators to protagonists in the teaching-learning process.	Revista Docência do Ensino Superior	A4

Spalding et al. 2020	To present the different possibilities of pedagogical strategies and tools that have been used, as well as to analyze the academic performance and engagement of students.	This is a descriptive, qualitative and quantitative experience report study, developed from the need for sudden adaptation of pedagogical strategies in the face of government regulations on social isolation resulting from the new coronavirus pandemic.	The flipped classroom proved to be effective. Interactive tools with quizzes applying questions, in which the teacher interacts with the students, increase student engagement, while also offering the possibility of immediate feedback from the teacher. The following indicators were used to analyze student engagement: attendance and completion of assigned activities. Performance was verified through analysis of the average scores obtained by students in formal course assessments and diagnostic assessments conducted on Kahoot. Attendance in online classes was above 97% in all months, demonstrating significant student participation. Students also showed good performance in the tests conducted with Kahoot.	Research, Society and Development	C
Queiroz et al. 2023	The objective was to present the different possibilities of pedagogical strategies and tools that have been used, as well as to analyze the academic performance and engagement of students.	This descriptive, qualitative, and quantitative experience report study was developed from the need for a sudden adaptation of pedagogical strategies in the Histology and Embryology Discipline of the Dentistry Course at a Brazilian public university.	Of the 38 students who agreed to participate in the study to evaluate the applied methodology, 42.11% considered Concept Maps as a tool that contributed to the teaching/learning process and would recommend it to other colleagues. In the students' self-assessment of performance, 81.58% rated their performance as satisfactory, while 18.42% rated it as unsatisfactory.	Contribucion es a Las Ciencias Sociales	A4
Monteiro et al. 2020	To report on a learning experience associated with games and digital technologies in the content of basic health science subjects.	The study is formatted as an experience report on the use of Kahoot! in the context of teaching histology in medical education.	The use of the game through ICTs so that students could mobilize the content proved to be a promising tool in encouraging motivation and engagement during the study process. The students' experience and performance were favorable, demonstrating that Kahoot is an applicable technology in higher health education in the content of basic subjects. Finally, it is suggested that further studies be developed to deepen the possibilities of using this technology.	Revista Saúde Digital Tecnologias Educacionais	B4
Gonzales et al. 2024	To investigate the impact of an e-learning histology course on the satisfaction and performance of medical, nursing, and obstetrics students.	The sample included 424 Chilean medical, nursing, and obstetrics students from two cohorts. A Likert-type survey was applied at the end of the course. We performed exploratory analysis and ordinary least squares regression. In this study, we present a positive experience of an e-learning histology course. Exploratory factor analysis revealed three main factors related to "satisfaction with e-learning," "face-to-face activities," and "course design and teaching quality."	In this study, the positive and significant relationship between students' perceptions of the adaptation of the traditional histology course to an e-learning format and their academic performance. E-learning histology courses that integrate lectures and practical sessions can be a valuable teaching method for learning histology.	Revista Internacional de Morfologia	B3

Cobo et al. 2024	To investigate the short- and long-term academic performance of students in two practical sessions of the Histology course, which included an escape room activity.	Control group or experimental group.	The results demonstrate that this playful methodology not only improves students' grades in the short term, but also contributes to greater knowledge retention in the long term, especially in complex areas such as nervous tissue and plant histology. These findings highlight the potential of gamification to overcome some of the challenges inherent in learning complex scientific disciplines, offering a more engaging and participatory approach.	Revista Internacional de Morfologia	B3
Silva, 2024	To compare student performance in the histology subject when compared to the traditional teaching methodology and its association with game-based learning and a basic histology teaching platform.	Systematic review including relevant information on the use of technologies in histology teaching.	It was found that virtual environments and other teaching resources based on Information and Communication Technologies (ICTs) seek to meet the current trend of complementing face-to-face teaching, which can optionally be used in continued extracurricular study.	Anatomical Sciences Education	A1
Lião, 2019	To introduce histology to medical students using the barrier-based learning (BBL) method or the traditional teaching method.	Control group and experimental group.	This study shows that the BBL teaching method is superior to the traditional teaching method in histology. A good teaching and learning method are the main drivers of student learning outcomes in a histology course. However, the student's background has a significant additional impact on learning outcomes.	Revista Internacional de Morfologia	B3

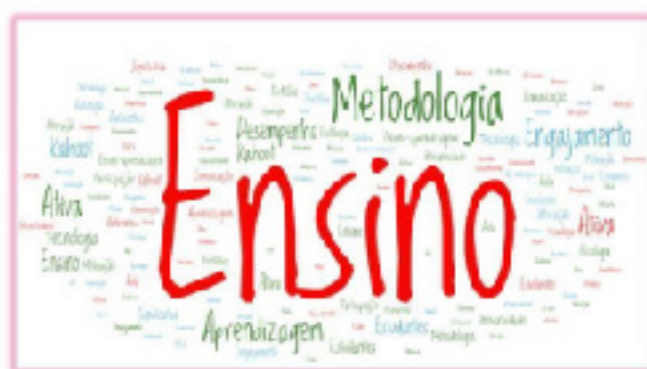**Source:** Elaborated by the authors.

Empirical studies, systematic reviews, and qualitative and quantitative analyses were considered to analyze the research results. In this regard, it is verified in the study by Martins (2020) that the use of technological resources expands the possibilities of learning, allowing students to explore different ways of acquiring knowledge. This includes playful methods, which make learning more engaging, and strategies based on active search, collaborative participation, and interaction through Digital Information and Communication Technologies (DICT). The use of QR codes based on the concept of mobile learning can transform teaching and learning processes, introducing an innovative dynamic capable of engaging and motivating students.

According to Fonseca (2022), learning means that the student becomes capable of finding alternatives and creating their own explanations using their autonomous thinking. Problem-Based Learning also seeks to apply the interdisciplinarity of the curricular structure, meaning that the same problem situation can be addressed in different curricular components, capturing the particularities of each thematic area. Teaching and learning are processes which should be understood as a series of interconnected activities, where the different participants increasingly share responsibilities and commitment. To this end, it is essential to overcome the linear conception of teaching, where content is simply transmitted and memorized by students, as well as to avoid uncommitted and limitless practice, where individuals are left to their own devices, without guidance.

It is observed that creating a digital histological portfolio was effective in maintaining student engagement, encouraging them to actively seek knowledge. Students not only demonstrated significant development in the cognitive skills of recalling, understanding, applying, analyzing, evaluating, and creating, but also in the socio-emotional competencies of motivation, autonomy, resilience, interpersonal communication, and self-control.

In recognizing the student as the protagonist in the teaching-learning process, active approaches place them at the center of the educational experience, removing them from a passive role and encouraging them to take responsibility for their own construction of knowledge. In this context, the teacher acts as a mediator, guiding and offering support in the difficulties encountered by the student (MEDEIROS, 2024).

Figure 2 – Word cloud of the main words.

Source: Elaborated by the authors.

According to the authors on active learning, the analysis in the study highlights the effectiveness of this approach by placing students at the center of the educational process, promoting the search for information, reflection, and problem-solving. These benefits can be directly correlated to teaching histology, especially in the context of learning complex and integrative concepts, characteristic of this discipline.

Histology study is aimed at the microscopic, structural, and functional aspects of tissues, organs, and systems. Many students do not identify the relevance of the discipline to their future career, judging it difficult to study, especially without prior experience with the subject. The use of digital resources for practical activities which go beyond the use of optical microscopy laboratories for observing slides, involving information and communication technologies, has been a focus to stimulate students' interest. By using active methodologies, it is possible to encourage the teaching-learning process in a critical-reflective conception of education,

resulting in the student's involvement in the search for knowledge, in addition to stimulating production of knowledge based on the solution of practical and complex problems (DIAS, 2021).

The problem-based learning process promotes active student participation, resulting in collaborative knowledge construction. This method facilitates communication among those involved, expanding information and experience exchanges.

Students have the opportunity to reason critically, propose different solutions to the problems presented, and discuss them with colleagues and tutors. This collaborative environment stimulates developing hypotheses and strategies for solving clinical problems, essential skills in professional practice. In addition, the student becomes more able to continue their learning autonomously after graduation. This practice significantly contributes to developing the ability to make decisions independently, a crucial aspect in professional performance, especially in clinical contexts (FERRAZ JÚNIOR, 2023).

Furthermore, the study by Ferraz Júnior (2023) found that problem-based learning promotes developing the ability to think critically, analyze and reflect on solutions to problems, which contributes to developing the ability to learn and stay updated autonomously.

According to Spalding et al. (2020), the flipped classroom methodology has shown positive impacts on student learning, allowing the teacher to develop activities during face-to-face meetings focused on the higher levels of Bloom's Taxonomy, such as analysis, evaluation, and creation. The content in this model is made available beforehand, before the face-to-face class, which gives students the opportunity to familiarize themselves with the material independently. The focus during the meeting is directed towards practical application, interaction between students and teacher, and deepening the content, promoting greater engagement and active involvement of students in the learning process.

Student engagement with new learning based on understanding, interest, and the possibility of choice is essential for expanding their opportunities to exercise freedom and autonomy in decision-making throughout different stages of the educational process. Behavioral engagement can be assessed through instruments such as student assessments and self-reports, considering indicators such as active involvement in activities, effective participation, persistence in the face of challenges, completion of homework, class attendance, and attention during classroom interactions. These elements reflect the student's level of commitment and dedication in the learning context (SPALDING et al., 2020).

Improving the teaching and learning process requires a continuous search for new pedagogical methods and tools which promote deeper understanding of the content by students. Teaching should prioritize critical reflection over simple memorization of presented material, encouraging students to question, interpret, and apply the concepts learned. Furthermore, teaching materials should be potentially meaningful, allowing for clear connections to the learner's prior knowledge. This approach fosters more contextualized and relevant learning, capable of generating a more solid and lasting understanding (QUEIROZ, 2023).

In the study by Queiroz (2023) which analyzed the impact of pedagogical tools on academic performance and student engagement, it was found that concept maps are a valuable contribution to the teaching and learning process. The results indicated that this tool not only facilitates organizing and understanding content, but was also well received by students, who recommended its use to other colleagues. Students rated their performance as satisfactory in the self-assessment, reinforcing the potential of concept maps as an effective pedagogical strategy in the educational environment.

According to Monteiro (2020), Kahoot is a valuable formative tool which practically and interactively directs studying, which in turn contributes to better student performance, promotes motivation and engagement, and allows students to reflect on their performance, thereby promoting autonomous learning. The use of educational games, such as Kahoot, can be highly effective in histology, providing significant results.

An escape room implemented in teaching histology offers an innovative opportunity to address the complexity of the content of this discipline. Histology, which studies the microscopic structure of animal and plant tissues, presents significant challenges for students, especially regarding understanding, assimilation, and correct identification of structures in histological preparations. The escape room as a teaching tool can significantly increase student motivation, as they are driven by the desire to solve challenges and complete an engaging narrative (COBO, 2024).

According to the aforementioned author, this playful and interactive format contributes to greater knowledge retention and potentially to improved academic performance. The proposal combines the principles of gamification with

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the subject matter, creating an immersive learning experience. In this dynamic, students solve puzzles and acquire information in a thematic environment with the goal of achieving a specific objective within a limited time. This methodology transforms the learning process into a stimulating activity that promotes collaboration, critical thinking, and practical application of knowledge.

In addition, the escape room stands out for its ability to engage different profiles of participants. It attracts both players motivated by extrinsic rewards and those seeking social interaction and collaboration as a form of fun. Thus, it is a versatile and inclusive pedagogical strategy with great potential to enrich teaching histology (COBO, 2024). Game-based learning has become an effective strategy in health science courses, with the use of the Kahoot platform standing out among other tools. This methodology not only promotes a significant improvement in learning, but also increases student engagement during classroom activities. The use of strategies such as game-based learning transforms studying into an active and dynamic experience. This results in a more interactive environment where students feel motivated to participate and engage with the content. In turn, this engagement directly impacts the quality of learning and students' willingness to assimilate new knowledge. By combining playful and pedagogical elements, these innovative approaches help to spark interest, make the teaching process more attractive, and contribute to strengthening student motivation (SOUZA; SILVA, 2024).

Histology is an essential morphological discipline, generally addressed by medical students in the initial stages of their training. Its focus is on the study of microstructures and related functions, encompassing different organizational levels such as tissues, cells, organelles, and molecules. The BBL (Barriers-Based Learning) teaching model is a specific methodology for learning histology based on the analysis of the barriers of the human body. These barriers (present in various organs and tissues) offer a structured starting point for study. By taking them as the center and approaching them creatively, students can identify and understand the primary structures of each system. This approach highlights the intrinsic relationship between structure and function. Using barriers as pedagogical clues represents an effective and accessible teaching method, contributing to a deeper understanding of the discipline (LIÃO, 2019).

FINAL CONSIDERATIONS

Active methodologies which place students as the protagonist of their own learning have proven promising in various knowledge areas. Therefore, it is believed that their application in teaching histology can bring significant benefits in promoting more engaged and meaningful learning.

It was found that virtual environments and other teaching resources based on Information and Communication Technologies (ICTs) meet the current trend of complementing face-to-face teaching. These resources can be used optionally in continued extracurricular study, offering students the opportunity to deepen their knowledge and develop skills independently. Thus, ICTs significantly contribute to constructing a more inclusive and diverse educational environment.

The most used methodologies according to the results of the articles include: the Flipped Classroom, which stands out for promoting student protagonism in the learning process, allowing them to access content autonomously and use classroom time for practical activities, discussions, and clarification of doubts. Furthermore, the incorporation of Problem-Based Learning (PBL) contributes to developing critical and problem-solving skills by encouraging students to work in groups to solve complex situations based on real-world problems. Gamification and Team-Based Learning (TBL) are methodologies which have shown significant results in terms of student engagement and active participation. Another methodology was the Concept Map, which helps students organize and visually represent their ideas and knowledge, facilitating understanding and information retention.

Finally, the use of portfolios also stood out, allowing students to continuously reflect on their progress and learning, recording and reviewing their skills and knowledge over time.

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