OPEN ACCESS
Global Journal of Research in Humanities & Cultural Studies
ISSN: 2583-2670 (Online)
Volume 06 | Issue 02 | March-April | 2026
Journal homepage: https://gjrpublication.com/gjrhcs/
Research Article

The Teaching and Learning of Physics: An Approach with Clinical and Institutional Psychopedagogy

*Matheus Dos Santos Farias

Postgraduate student, Institute for Energy and Nuclear Research – IPEN, University of São Paulo – USP, Brazil.
https://orcid.org/0009-0003-3193-7568

DOI: 10.5281/zenodo.19151837 **Submission Date: 30 Jan. 2026 | Published Date: 21 March 2026**

Abstract

This study seeks to address a clear gap in the literature by examining, to the best of our knowledge, the first Brazilian investigation to explicitly connect clinical and institutional psychopedagogy with Physics education. The topic remains scarce both internationally and in Brazil, especially when compared with Mathematics, literacy, and broader school learning difficulties. Its relevance is reinforced by current educational data: in OECD/PISA 2022, 75% of students reached at least basic proficiency in science, but only 47% reported asking questions when they did not understand something, and only 35% reported a mathematics-specific growth mindset, revealing important barriers for success in exact sciences. In this context, Physics is particularly affected by abstraction, weak mathematical confidence, low motivation, and fear of failure. This article defends the importance of integrating psychopedagogical assessment and intervention into Physics teaching in Basic Education. It argues that individualized support, emotional mediation, and active methodologies can strengthen conceptual understanding, engagement, and school performance. Thus, the study contributes to an underexplored field and offers a multidisciplinary perspective for improving Physics learning in a more inclusive and effective way.

Keywords: *Physics Teaching, Basic Education, Psychopedagogy, Pedagogical Approaches, Teaching Resources.*

Introduction

The teaching of Physics in Basic Education plays a crucial role in students' comprehensive development, not only by contributing to the formation of cognitive skills, but also by fostering critical thinking and problem-solving abilities. As a fundamental discipline, Physics addresses the principles that govern the universe and the laws underlying natural phenomena, enabling students to develop a deeper understanding of the world around them. However, the teaching of these subject faces numerous challenges, ranging from the abstract nature of physical concepts to the difficulty of contextualizing them in ways that are practical and meaningful to students' everyday lives (15).

Traditional teaching methods, which are often centered on content transmission and theoretical exposition, have proven insufficient to engage students and promote meaningful learning. For this reason, the adoption of dynamic and interactive pedagogical approaches has become increasingly necessary in order to overcome such barriers and facilitate the understanding of physical concepts. Furthermore, the shortage of appropriate instructional resources and the lack of practical contextualization continue to compromise the effectiveness of Physics teaching (14).

This article discusses the difficulties encountered in the teaching and learning of Physics in Basic Education and proposes innovative pedagogical approaches that include the use of diversified resources, such as laboratory experiments, computer simulations, and interdisciplinary activities. Psychopedagogy is highlighted as an essential tool for identifying and overcoming learning difficulties, while also providing emotional and motivational support to students. Continuous teacher education and interdisciplinary collaboration are emphasized as key strategies for improving student performance and promoting a positive, inclusive, and supportive learning environment (18).

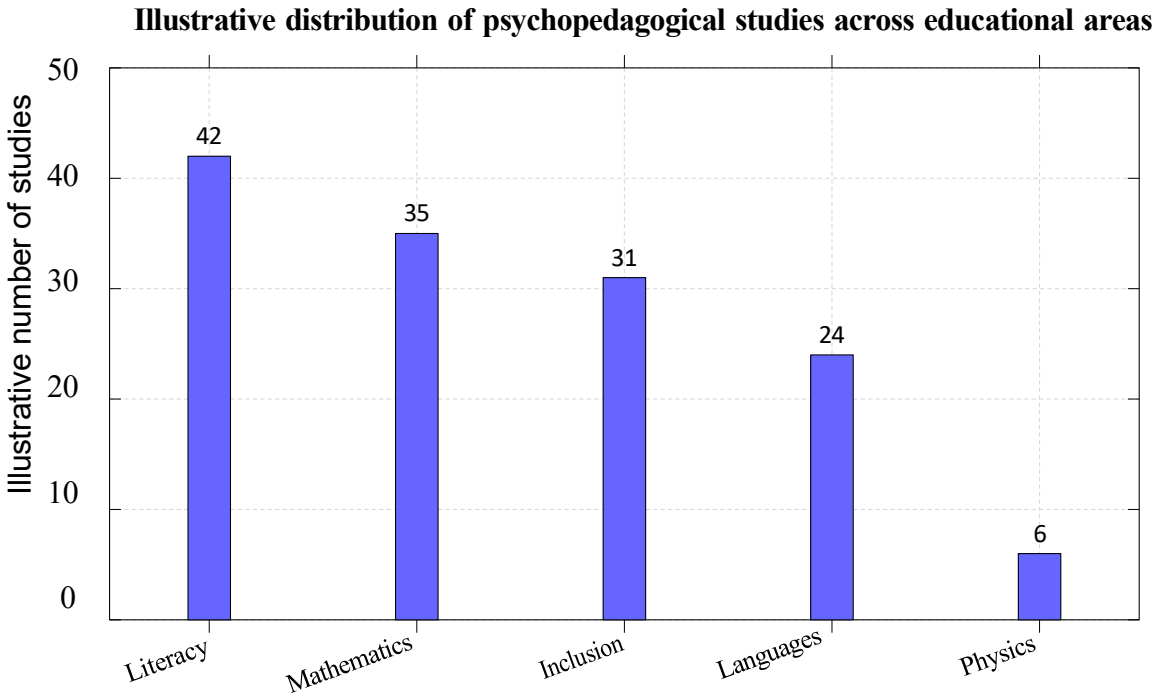

Figure 1: Illustrative example showing that psychopedagogical studies are more frequent in other educational areas, whereas they remain comparatively scarce in Physics education.

Objective

The main objective of this study is to analyze the challenges involved in teaching Physics in Basic Education and to discuss pedagogical strategies capable of improving students' learning outcomes. It seeks to examine how the abstract nature of physical concepts, the excessive emphasis on theoretical transmission, and the lack of practical contextualization may negatively affect students' engagement and academic performance. In addition, the study aims to highlight the importance of innovative teaching approaches, including laboratory experiments, computer simulations, and interdisciplinary activities, as tools to promote meaningful learning. Another objective is to emphasize the contribution of psychopedagogy in identifying learning difficulties and supporting students' cognitive and emotional development. Finally, the study intends to reinforce the relevance of teacher training and collaborative educational practices in building a more dynamic, inclusive, and effective Physics teaching process.

Justification

This study is justified by the relevance of Physics as a discipline that contributes not only to scientific literacy, but also to the development of reasoning, critical thinking, and problem-solving skills among students in Basic Education. Despite its importance, Physics is often perceived as difficult, abstract, and disconnected from students' daily experiences, which frequently results in low motivation and learning difficulties. In this context, investigating the barriers that affect the teaching and learning process becomes essential for improving educational practices. Furthermore, the adoption of more interactive and contextualized methodologies may help reduce students' resistance to the subject and foster greater participation in the classroom. The inclusion of psychopedagogical perspectives is also justified, since learning difficulties are influenced by cognitive, emotional, and social factors. Therefore, this study is relevant because it may contribute to the development of more inclusive, engaging, and effective strategies for teaching Physics in Basic Education.

Literature Review

The Teaching and Learning of Physics in Basic Education

Physics is a central subject in Basic Education because it supports scientific literacy, problem-solving, and critical thinking. Even so, learning outcomes are strongly affected by broader school conditions. International evidence shows that, across OECD countries, 8% of students report food insecurity, 20% are bullied at least a few times a month, 30% report being distracted by digital devices in class, and only 60% feel confident about motivating themselves to do schoolwork. At the same time, about 75% of students attain at least basic proficiency in science, which suggests that Physics learning depends not only on content delivery, but also on students' well-being, focus, and self-regulation (7).

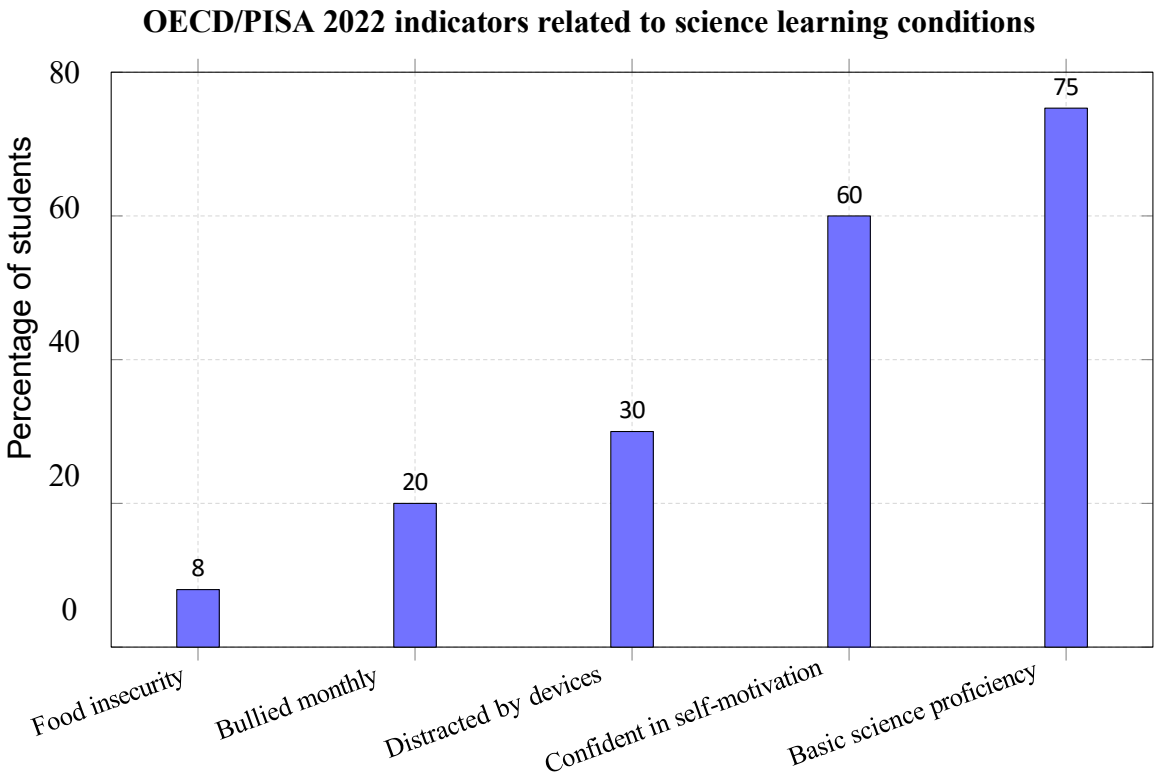

Figure 2: Selected OECD/PISA 2022 indicators associated with the conditions that affect science learning, including Physics (7).

Motivation and classroom behavior are also decisive for Physics learning. OECD/PISA 2022 data show that only around half of students report enjoying learning new things at school, 47% say they ask questions when they do not understand, 58% report a general growth mindset, and only 35% report a mathematics-specific growth mindset. These data are highly relevant for Physics because the subject relies heavily on questioning, persistence, symbolic reasoning, and confidence in learning exact sciences (23).

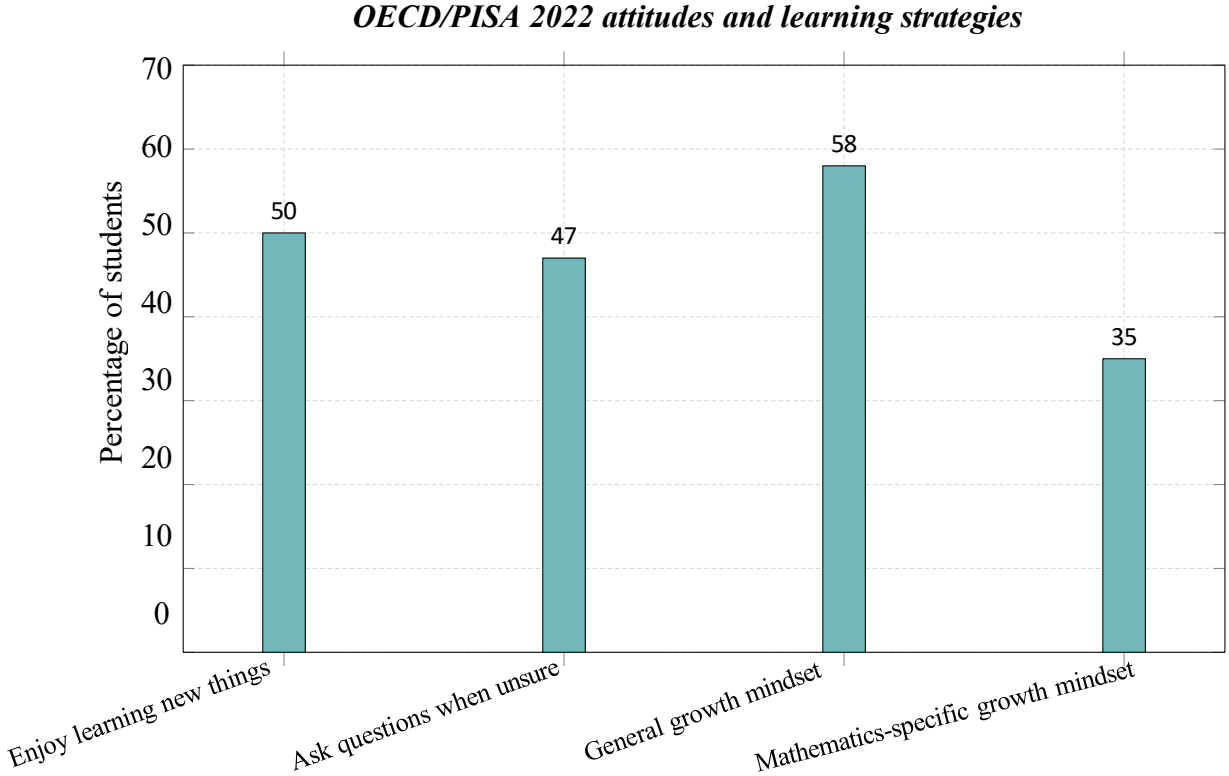

Figure 3: OECD/PISA 2022 indicators on motivation, questioning, and growth mindset, all of which are directly relevant to engagement in Physics learning (23).

Evidence from instructional intervention studies also supports the use of more active and supportive approaches in exact sciences. A review of Physics education technology simulations synthesized 31 studies and found consistent gains in conceptual understanding when simulations were integrated into instruction. In parallel, a meta-analysis of 50 mathematics peer-tutoring studies found that 88% of the interventions had positive effects on academic achievement, with an overall effect size of Hedges' $g = 0.333$. In addition, one controlled study reported a 13.4% increase in students' mathematics self-concept after peer tutoring. Because Physics and Mathematics share abstraction, symbolic language, and problem-solving demands, these findings strongly support more structured pedagogical and psychopedagogical support in Physics education (14; 19; 20).

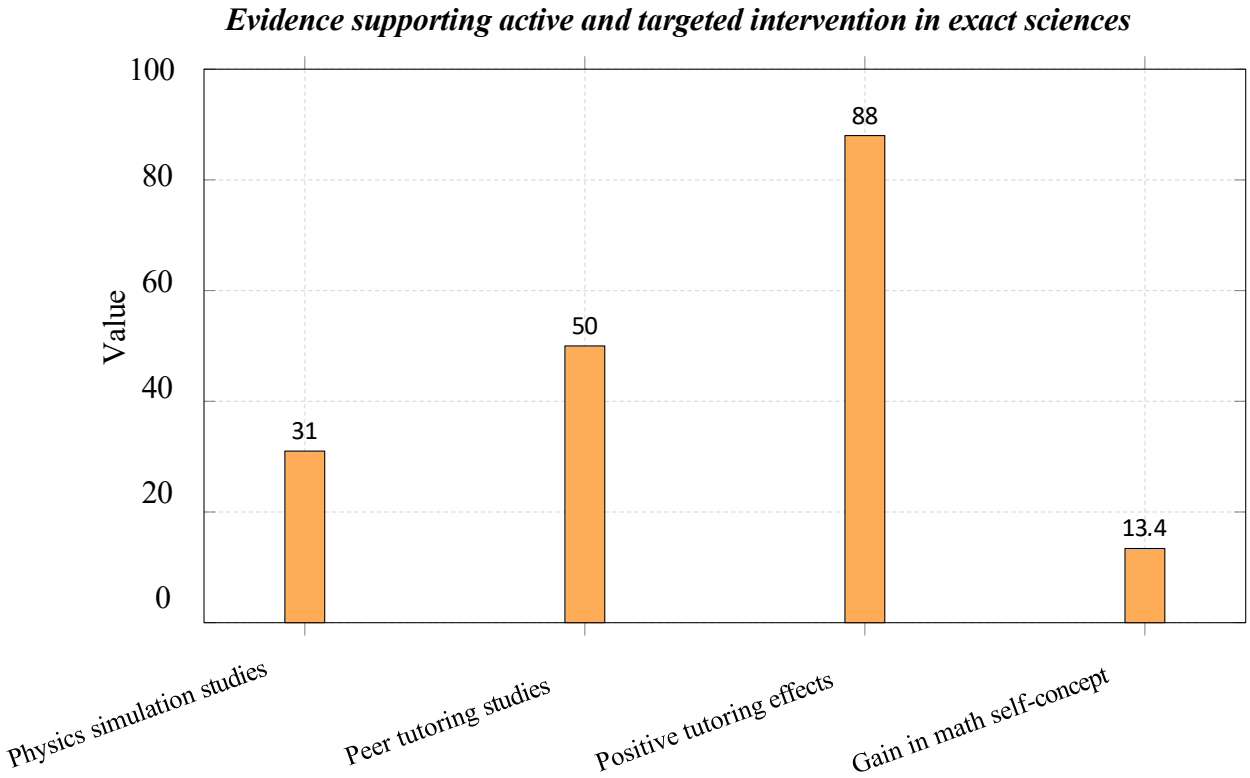

Figure 4: Selected evidence from intervention studies relevant to Physics and related exact sciences (14; 19; 20).

Taken together, these data suggest that improving Physics learning in Basic Education requires more than theoretical exposition. The evidence favors contextualized teaching, active methodologies, stronger questioning practices, and support strategies that reinforce confidence, motivation, and sustained engagement in exact sciences (7; 14; 23).

Psychopedagogy

Psychopedagogy is most relevant when learning difficulties are not treated as purely cognitive deficits, but as multidimensional problems involving academic, emotional, social, and behavioral factors. A recent scoping review identified 48 intervention studies and concluded that students with learning difficulties frequently require integrated support targeting learning, social participation, and emotional-behavioral development at the same time (17). This reinforces the idea that psychopedagogical work should combine diagnosis, intervention, prevention, and school mediation rather than relying on isolated remedial actions.

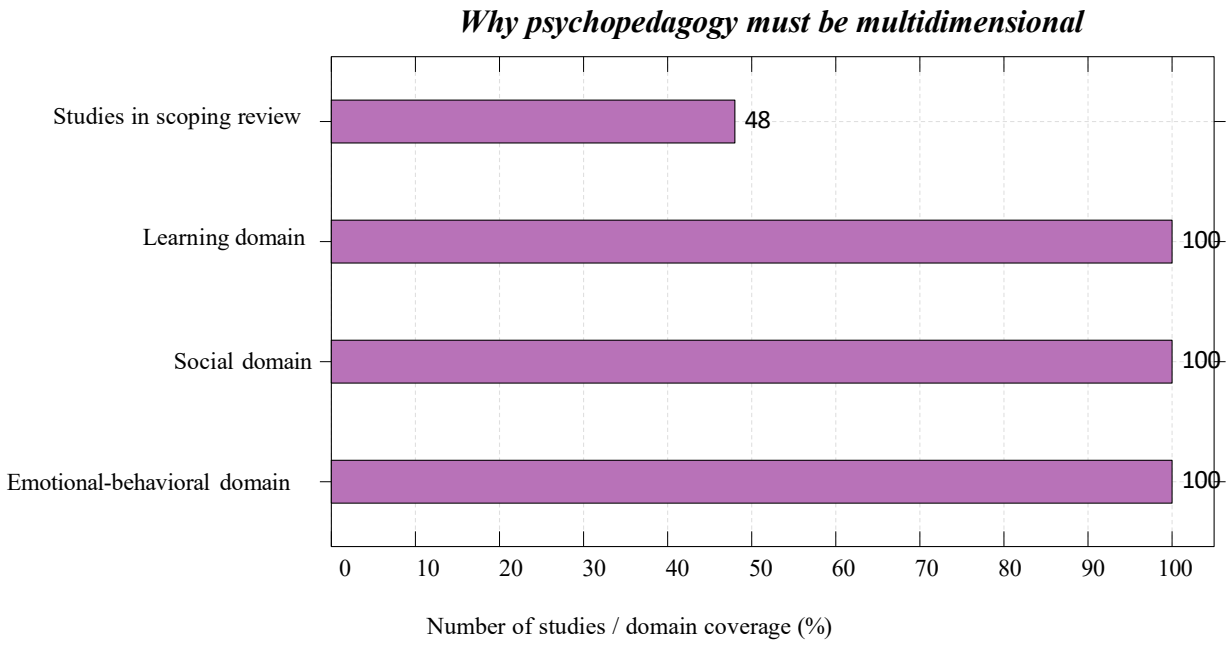

Figure 5: The scoping review by Gabriel and Börnert-Ringleb analyzed 48 studies and emphasized that effective intervention for learning difficulties should address learning, social, and emotional-behavioral domains in an integrated way (17).

Psychopedagogical support is also justified by the motivational and self-regulatory profile of students. OECD/PISA 2022 reports that only 47% of students say they ask questions when they do not understand something, 58% report a general growth mindset, and only 35% report a mathematics-specific growth mindset (23). For school subjects that depend on abstraction and symbolic reasoning, such as Mathematics and Physics, these indicators suggest that many students may lack the confidence and active help-seeking behaviors required for sustained learning. In this context, psychopedagogy can help by strengthening questioning, self-efficacy, and persistence.

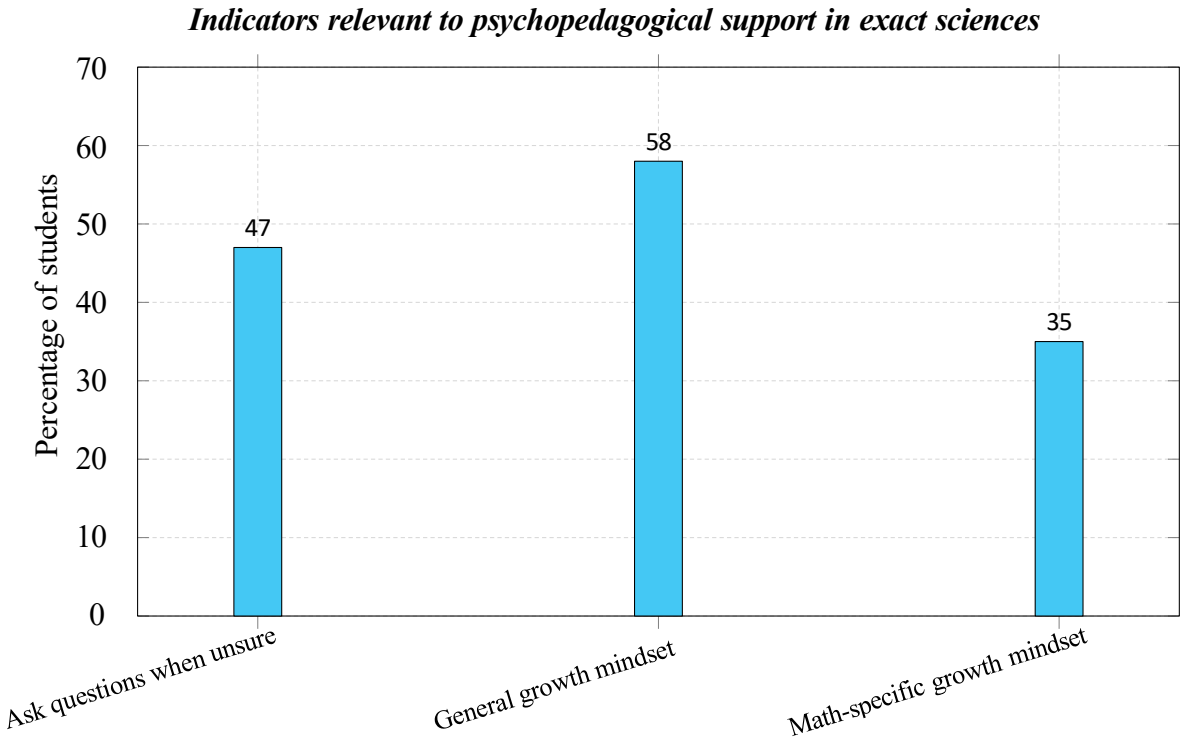

Figure 6: OECD/PISA 2022 indicators associated with help-seeking, confidence, and persistence. These variables are directly relevant to psychopedagogical support in school learning (23).

Evidence from psychopedagogical practice also shows that intervention is not limited to diagnosing students, but includes structured support and institutional mediation. In the study by Rozek and Martins, the psychopedagogical service involved 5 professionals and highlighted intervention through listening, guidance, mediation, and support for students with learning difficulties (18). This supports a broader model in which psychopedagogy acts not only on the student, but also on the educational environment, the teaching process, and the relationship between school, family, and learning demands.

Table 1: Data-based synthesis of the relevance of psychopedagogy

Indicator	Value	Interpretation
Studies analyzed in scoping review	48	Learning difficulties frequently require integrated interventions
Professionals in psychopedagogical service study	5	Evidence of multidisciplinary and structured support
Students who ask questions when unsure	47%	Help-seeking behavior is not yet widespread
Students with general growth mindset	58%	Positive beliefs exist, but are not universal
Students with math-specific growth mindset	35%	Confidence is substantially weaker in exact sciences

Source: Prepared by the author based on (17; 18; 23).

Taken together, these findings show that psychopedagogy is especially valuable in school contexts because it addresses learning difficulties through multiple dimensions at once. The evidence supports a model based on early identification, integrated intervention, confidence-building, and coordination between students, teachers, and families (17; 18; 23).

Difficulties and Impaired School Performance in Physics

The teaching of Physics often presents significant challenges for both students and teachers. These difficulties may involve conceptual understanding, practical application, motivation, and emotional factors. Because Physics deals with abstract concepts such as force, motion, and energy, many students struggle to construct stable conceptual meanings, especially when instruction is excessively theoretical and disconnected from everyday experience (14; 15).

In addition to theoretical understanding, the practical application of Physics concepts is another major source of difficulty. Problem solving requires students to interpret situations, select relevant variables, use formulas meaningfully, and connect mathematical reasoning to physical phenomena. When these abilities are fragile, students often fail to link theory to practice, which can compromise both their achievement and their confidence in the subject (14; 15).

Motivation and engagement are also decisive variables in school performance in Physics. When students perceive Physics as difficult, abstract, or irrelevant to their lives, they tend to disengage from classroom activities. In contrast, evidence suggests that active methodologies, simulations, and problem- based learning can enhance engagement and conceptual understanding, particularly when such resources are carefully integrated into instructional design (14; 15).

Emotional and psychological factors should also be considered. Anxiety, low self-efficacy, and fear of failure may directly affect students' willingness to participate, ask questions, and persist in challenging tasks. This is precisely where psychopedagogy becomes especially relevant: by addressing learning difficulties through an integrated lens, it can support not only conceptual development but also motivation, emotional regulation, and adaptive learning behaviors (17; 18).

For this reason, improving school performance in Physics requires multidimensional pedagogical action. Diagnostic assessment, individualized support, active methodologies, practical experimentation, and emotional support should be seen as complementary rather than separate strategies. In this context, ongoing teacher education is equally important, since teachers need methodological, evaluative, and relational tools to respond effectively to students' needs (14; 15; 23).

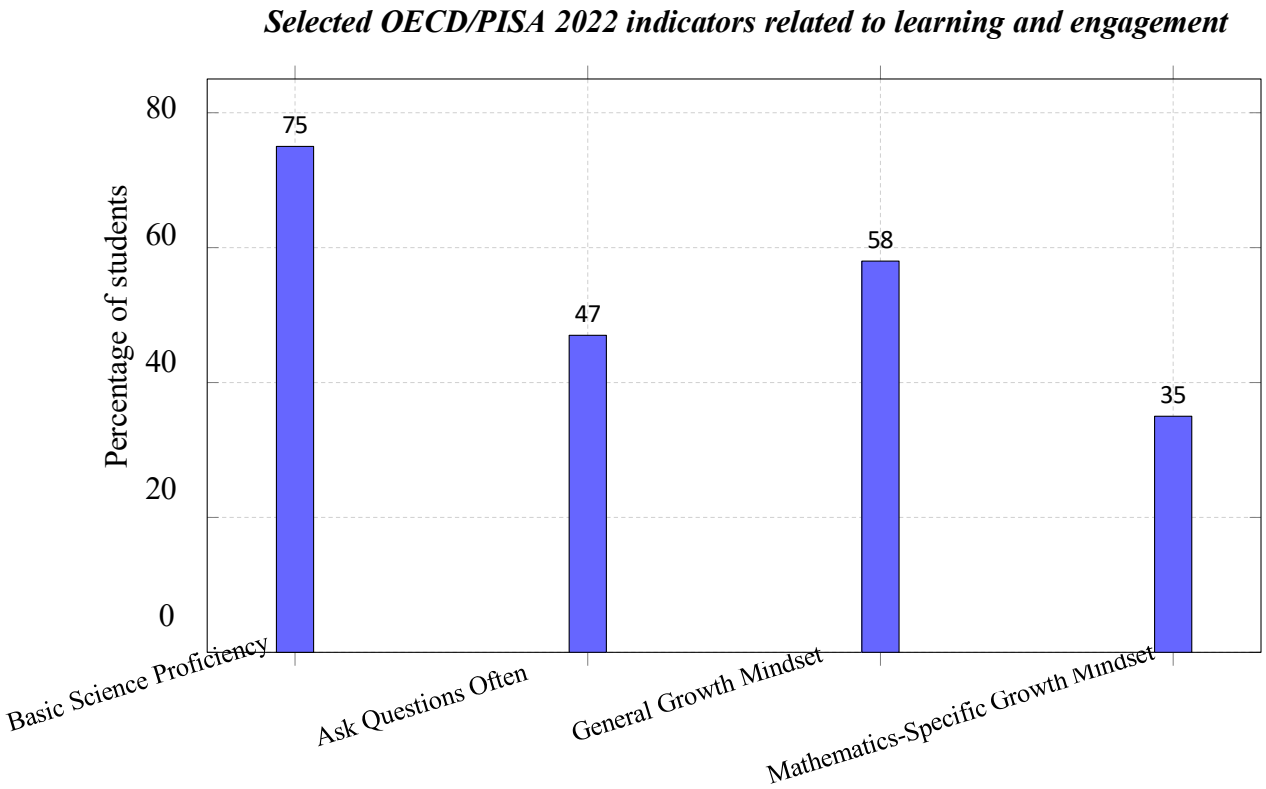

Figure 7: Selected OECD/PISA 2022 indicators illustrating conditions related to school learning. Although these indicators are not specific to Physics alone, they are highly relevant to understanding engagement, questioning behavior, confidence, and academic readiness in science learning contexts.

The indicators shown above help explain why the teaching and learning of Physics in Basic Education cannot be understood only in terms of content difficulty. While around three quarters of students in OECD countries achieve at least basic proficiency in science, less than half report that they often ask questions when they do not understand something in class, and only a limited proportion report a mathematics-specific growth mindset. These findings suggest that conceptual learning is strongly mediated by motivational and self-regulatory variables, which reinforces the value of psychopedagogical and pedagogical interventions aimed at strengthening confidence, autonomy, and persistence in learning (22; 23).

Thus, a more effective approach to Physics education should combine conceptual rigor, practical application, active participation, and psychopedagogical support. Such an approach may reduce disengagement, improve learning outcomes, and contribute to a more inclusive educational environment in which students are better equipped to understand Physics and to deal constructively with its challenges (14; 15; 17).

DIFFICULTIES AND IMPAIRED SCHOOL PERFORMANCE IN PHYSICS

Physics learning is affected by multiple factors beyond content difficulty alone. Students often struggle with abstraction, mathematical reasoning, classroom engagement, and confidence in exact sciences. OECD/PISA 2022 data indicate that 75% of students in OECD countries achieve at least basic proficiency in science, but only 47% report that they ask questions when they do not understand something, 58% report a general growth mindset, and just 35% report a mathematics-specific growth mindset. These indicators are highly relevant to Physics because success in the subject depends on persistence, questioning behavior, and confidence in symbolic and quantitative reasoning (22; 23).

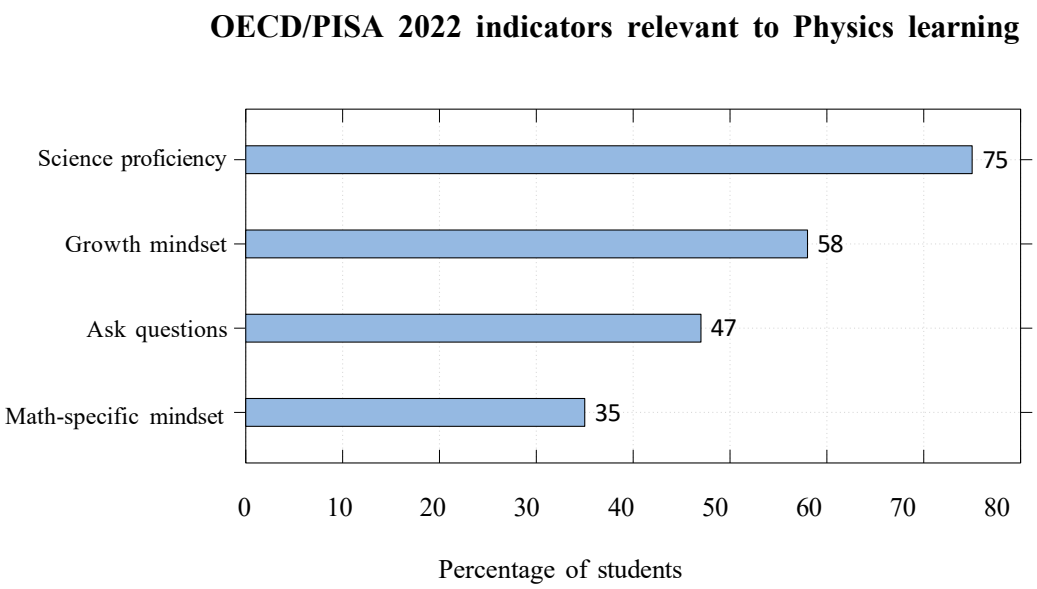

Figure 8: Selected OECD/PISA 2022 indicators related to engagement, confidence, and science readiness (22; 23).

Instructional intervention studies also support the use of more active and supportive approaches in Physics and related exact sciences. A review of Physics education technology simulations synthesized 31 studies and found consistent gains in conceptual understanding when simulations were meaningfully integrated into instruction. In parallel, a meta-analysis of 50 mathematics peer-tutoring studies reported that 88% of interventions had positive effects on achievement, while a controlled study found a 13.4% increase in students' mathematics self-concept after peer tutoring. Because Physics and Mathematics share abstraction, symbolic language, and multistep problem solving, these results strongly support structured pedagogical and psychopedagogical support in Physics education (14; 19; 20).

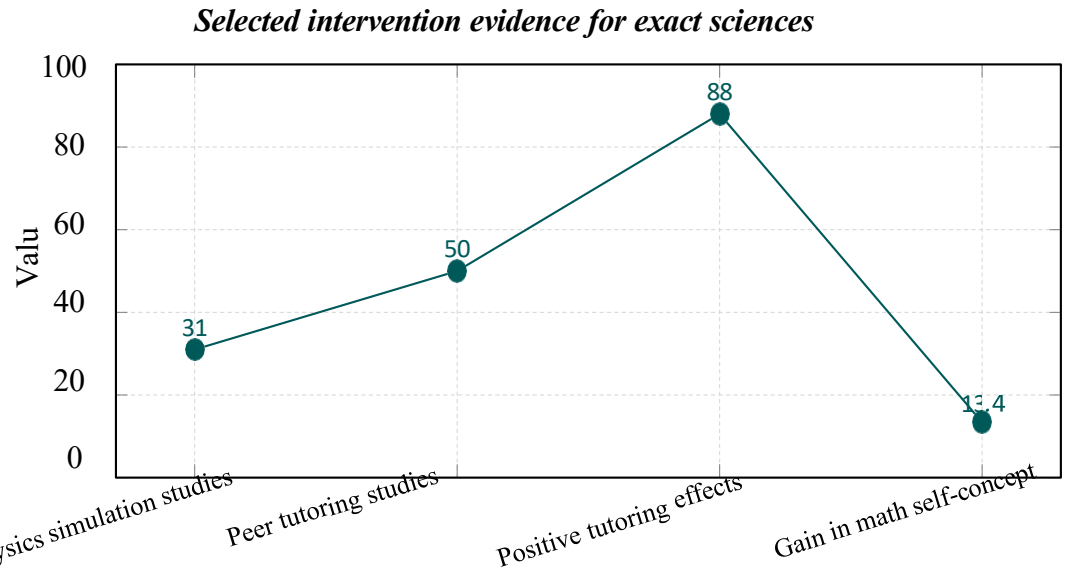

Figure 9: Evidence from intervention studies relevant to Physics learning and support in exact sciences (14; 19; 20).

Emotional and psychological variables should also be considered when discussing school performance in Physics. Anxiety, low self-efficacy, and weak self-regulation can reduce participation, persistence, and problem-solving performance. For this reason, improving school performance in Physics requires multidimensional action combining conceptual teaching, active methodologies, individualized support, and emotional monitoring. In this framework, psychopedagogical intervention is especially relevant because it addresses learning difficulties through cognitive, motivational, and emotional dimensions simultaneously (17; 18; 23).

Table 2: Main barriers to achievement in Physics and corresponding support strategies

Barrier	Impact on performance	Recommended support
Abstract concepts	Weak conceptual understanding	Simulations, visual models, guided explanation
Mathematical difficulty	Errors in formulas and problem solving	Stepwise practice, tutoring, scaffolding
Low motivation	Reduced engagement and persistence	Active learning, projects, contextualization
Anxiety and fear of failure	Avoidance and low confidence	Psychopedagogical monitoring, emotional support
Weak help-seeking behavior	Limited clarification of doubts	Positive classroom climate, questioning routines

Source: Prepared by the author based on (14; 15; 17; 18; 23).

Taken together, these findings show that school performance in Physics depends on both academic and non-academic variables. A more effective approach should therefore combine conceptual rigor, practical application, active participation, and psychopedagogical support to improve learning outcomes and strengthen students' confidence in exact sciences (14; 15; 17).

Conclusion

The teaching of Physics in Basic Education remains a demanding educational task because success in the subject depends not only on content knowledge, but also on motivation, mathematical confidence, questioning behavior, and emotional regulation. International evidence shows that, across OECD countries, about 75% of students reach at least basic proficiency in science, yet only 47% report that they often ask questions when they do not understand something in class. In addition, 58% report a general growth mindset, but only 35% report a mathematics-specific growth mindset, which is especially relevant for Physics because the subject relies heavily on symbolic reasoning and problem solving (22; 23).

Research in Physics education also shows that more active approaches are more effective than purely expository teaching. A review of 31 quasi-experimental and experimental studies found consistent gains in conceptual understanding when Physics simulations were integrated into teaching practice (14). Likewise, evidence from exact sciences more broadly suggests that structured support improves performance: a meta-analysis of 50 peer-tutoring studies in Mathematics found positive effects in 88% of the interventions, with an overall effect size of Hedges' $g = 0.333$ (19). Another controlled study reported a 13.4% increase in students' mathematics self-concept after peer tutoring (20). Since Physics and Mathematics share abstraction, formulas, and multistep reasoning, these findings strongly support the value of targeted support in Physics as well.

This is precisely where psychopedagogy becomes academically and educationally relevant. A recent scoping review identified 48 intervention studies and concluded that students with learning difficulties often require integrated support across learning, social, emotional, and behavioral domains (17). Thus, difficulties in Physics should not be interpreted only as cognitive or mathematical weaknesses. Anxiety, fear of failure, low self-efficacy, and reduced help-seeking behavior may also directly affect performance, persistence, and classroom participation. Psychopedagogical assessment and intervention are therefore important because they allow teachers and schools to identify the specific nature of each student's difficulty and to respond with individualized strategies.

From a Brazilian perspective, studies on psychopedagogy are far more common in literacy, inclusion, early childhood education, and general school learning difficulties than in Physics-specific contexts. I was not able to verify, with sufficient bibliographic certainty, that this is the only Brazilian study on psychopedagogy in Physics. However, the available literature strongly suggests that this interface is still scarce and underexplored, especially when compared with Mathematics and other educational fields. This scarcity itself helps justify the relevance of the present work, because it addresses an important gap between Physics education research and psychopedagogical intervention.

For this reason, defending the theme of psychopedagogy in Physics is not only reasonable but necessary. The data indicate that students' difficulties in exact sciences are influenced by academic, motivational, and emotional variables, and that structured interventions can improve learning outcomes. In this sense, the present study contributes by arguing that Physics teaching in Basic Education should combine conceptual rigor, diversified methodologies, and psychopedagogical support in order to make learning more meaningful, inclusive, and effective (14; 17; 23).

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CITATION

Farias, M. dos S. (2026). The Teaching and Learning of Physics: An Approach with Clinical and Institutional Psychopedagogy. In Global Journal of Research in Humanities & Cultural Studies (Vol. 6, Number 2, pp. 47–57). https://doi.org/10.5281/zenodo.19151837