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Diagnosis of the Effectiveness of Pedagogical Processes for Meaningful Learning of Physics in High School: A Case Study at Unidad Educativa Aníbal San Andrés Robledo, Jaramijó, Ecuador

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RESUMEN

La Física es una ciencia que busca explicar los fenómenos del universo. En el Ecuador, los resultados del aprendizaje de la Física no alcanzan los objetivos propuestos por el Ministerio de Educación en instituciones públicas. Esto podría darse por el deficiente uso de herramientas didácticas en los docentes. Además, muchos profesores de Física no cuentan con la formación adecuada, ni con la pedagogía necesaria para que los conceptos sean relevantes. La falta de estrategias didácticas es un problema recurrente ya que a menudo, la enseñanza de la Física se basa en la memorización, sin conectar estos conocimientos con aplicaciones. Esto no solo dificulta el aprendizaje significativo, sino que también desmotiva a los estudiantes, quienes no ven la relevancia de esta asignatura. Por esta razón, en la siguiente investigación se realizó un diagnóstico de la enseñanza de la Física en estudiantes de segundo de bachillerato de la Unidad Educativa Aníbal San Andrés Robledo, con el uso de entrevistas dirigidas a dos docentes de la institución. Además, se observó el desarrollo de tres clases de Física y la aplicación de un test para medir el conocimiento. Los resultados del diagnóstico mostraron que en la institución no se alcanza el aprendizaje, por la deficiente aplicación de estrategias didácticas, acompañado de que el docente no cuenta con la formación adecuada, esto indica la necesidad de desarrollar una estrategia didáctica para alcanzar el aprendizaje significativo.

Palabras clave: *Física, aprendizaje significativo, diagnóstico, estrategia didáctica.*

***A*BSTRACT**

Physics is a science that seeks to explain the phenomena of the universe. In Ecuador, learning outcomes in Physics do not reach the objectives proposed by the Ministry of Education in public institutions. This may be due to the deficient use of teaching tools by teachers. In addition, many Physics teachers lack adequate training and the pedagogical preparation necessary to make concepts relevant. The lack of didactic strategies is a recurring problem, since Physics teaching is often based on memorization without connecting knowledge to real applications. This not only hinders meaningful learning but also demotivates students, who fail to see the relevance of the subject. For this reason, the present study conducted a diagnosis of Physics teaching among second-year high school students at Unidad Educativa Aníbal San Andrés Robledo, using interviews with two teachers, classroom observation of three Physics lessons, and the application of a test to measure knowledge. The diagnostic results showed that meaningful learning is not achieved due to the inadequate application of didactic strategies and insufficient teacher training, indicating the need to develop a didactic strategy to promote meaningful learning.

***Keywords**: Physics, meaningful learning, diagnosis, didactic strategy.*

1. INTRODUCTION

Meaningful learning constitutes a fundamental pillar of the educational process (Rocha, 2021), particularly in subjects such as Physics, where abstract and theoretical concepts must be understood, contextualized, and applied to practical situations (Lino-Calle et al., 2023; Tocto-Flores et al., 2024). In the Ecuadorian educational context, Physics teaching faces challenges related to student motivation, the perceived difficulty of content, and low academic performance, as reported by the National Institute for Educational Evaluation (INEVAL, 2024). Additionally, there is a disconnection between theoretical concepts and their applicability to everyday life (Castro & Vega, 2021), compounded by insufficient teacher training and inadequate Physics laboratories.

These barriers limit the construction of meaningful learning and negatively affect academic performance and students' attitudes toward the subject. This research aims to diagnose meaningful learning of Physics among second-year high school students at Unidad Educativa Aníbal San Andrés Robledo in Jaramijó, Ecuador. The main objective is to identify teaching practices, resources used, student perceptions, and the main obstacles that hinder effective teaching, as well as students' levels of conceptual understanding, practical application, and integration of Physics content into their cognitive structures.

This diagnosis is essential for designing pedagogical strategies that strengthen Physics instruction, making it more relevant and accessible. The study seeks to evaluate how students relate Physics knowledge to their prior experiences and daily context. The findings will provide key information to improve methodological approaches in the classroom, contributing to the development of scientific competencies and the strengthening of critical thinking skills. Ultimately, this work aims to make a meaningful contribution to the educational community and to the continuous improvement of Physics education at the high school level.

2. STATE OF THE ART

2.1.1. Physics as a Subject in Context.

Physics is an experimental science that contributes to the development of scientific knowledge by fostering observation, understanding, and prediction of natural phenomena (Lino-Calle et al., 2023; Vera et al., 2015). Physics concepts are grounded in mathematics; therefore, understanding this subject requires the acquisition of mathematical skills that allow students to recognize and describe natural events and phenomena (Domínguez et al., 2024; Melo, 2015). Furthermore, Physics serves as the foundation for other sciences such as Chemistry and Biology (Moreira, 2020).

Through classroom experiments, Physics recreates conditions that generate knowledge, as experimentation becomes a means of validating scientific theories learned in class (Briceño et al., 2021; Melo, 2015). In Ecuador, Physics is often perceived as a difficult subject, particularly in rural institutions that lack the necessary resources for experimentation and practical activities (Castro & Vega, 2021).

In the context of high school education at Unidad Educativa Aníbal San Andrés Robledo in

Jaramijó, meaningful learning is frequently compromised by several interrelated factors. One of the main issues is the lack of adequate teacher training, particularly in didactics, which leads to the use of inappropriate strategies and limits the promotion of active and relevant learning (Ríos Huaricachi et al., 2022). Consequently, teaching practices tend to be traditional and unidirectional, failing to engage students.

On the other hand, student disinterest constitutes an additional barrier. Learners exposed to unmotivating educational environments often display apathy toward learning (Torres et al., 2023), which negatively affects both academic performance and attitudes toward education (Aguilar et al., 2015). The disconnection between instructional content and students' daily lives further reduces the perceived usefulness of acquired knowledge

Additionally, demotivation is another critical piece of this puzzle. Without an educational system that inspires them, both teachers and students fall into a spiral of discouragement (Torres et al., 2023). Teachers, lacking the necessary support, feel unable to innovate in their teaching methods, while students, without adequate stimuli, become demotivated to actively participate in the educational process (Rojas, 2019). This cycle of demotivation and disinterest perpetuates the problem, hindering the implementation of truly meaningful learning among second-year high school students (Tang & Hu, 2022).

Moreover, the problem of unachieved meaningful learning among high school students due to demotivation and disinterest has its roots in several interrelated causes. First, the inappropriate use of didactic strategies by teachers is a primary factor. When teaching methods are traditional and rigid, students are not actively engaged in the learning process (Galván-Cardoso & Siado-Ramos, 2021). Classes dominated by memorization and mechanical repetition of content become monotonous and disconnected from students' everyday reality (Rengifo et al., 2023). This disconnection leads to disinterest and demotivation when students fail to find relevance in what they are taught and, consequently, their participation decreases. This apathy not only affects their academic performance but also their long-term attitude toward education (Aguilar et al., 2015).

2.1.2. Meaningful Learning

Meaningful learning is closely related to neuroscience, encompassing emotional, motivational, and cognitive processes (Arana et al., 2023). Students actively construct knowledge through psychological processes that promote interaction between new information and prior knowledge (Ordóñez Olmedo & Mohedano, 2019). Meaningful learning occurs when new information is integrated into a student's cognitive structure, generating an assimilation process that links previously acquired knowledge (Ausubel, 1968).

Meaningful learning generally involves addressing real-world problems that students are required to solve, confronting them critically with the knowledge they have acquired, and thereby strengthening that knowledge (López, 2019).

2.1.2.1. Types of Meaningful Learning

This study addresses three types of meaningful learning: representational learning, propositional learning, and conceptual learning. Representational learning focuses on assigning meaning to symbols or representations; propositional learning involves constructing meaning through statements; and conceptual learning develops ideas that acquire meaning throughout life (Baque Reyes & Portilla Faican, 2021).

Conceptual learning develops from an idea throughout life; for example, it is a representation that acquires meaning over time (Baque Reyes & Portilla Faican, 2021).

2.1.2.2 Forms of Generating Meaningful Learning in Physics

In this study, three forms of meaningful learning are considered, and their inclusion in the classroom will be diagnosed: the subordinate form, the superordinate form, and the combinatorial form. Each of these is explained below for better understanding.

The subordinate form considers knowledge through assimilation and information anchoring, assuming that all assimilation is constructed and that any approach to reality requires an assimilation framework (Moreira, 2020). New information is linked and represented, as the new concept is related to an existing one, although it may be considered an extension, modification, or limitation of that concept (Cañaveral et al., 2020). In this type of learning, a progressive differentiation of previously existing concepts occurs and, according to Ausubel, it constitutes the primary way of acquiring knowledge (Arriassecq & Santos, 2017).

The superordinate form requires processes of abstraction, induction, and synthesis that lead to new knowledge; in this case, knowledge is acquired that is linked to new theories, involving relationships and differences among contents (Moreira, 2020). In this type of learning, established concepts are considered examples of a new concept. This new concept represents a set of subordinate ideas (Moreira-Choez et al., 2021). It is a process inverse to differentiation, as an integrative reconciliation occurs among the characteristics of a series of concepts, giving rise to the formation of a more general concept (Arriassecq & Santos, 2017).

The combinatorial form involves the combination of multiple meanings and theories to construct a new one, allowing interaction among knowledge elements (Moreira, 2020). In this case, the new concept is related to existing ones, although not in a hierarchical manner, as it is neither more inclusive nor more specific than them (Abu-Ghaneema, 2018). However, it is assumed that the new concept shares certain defining attributes with preexisting concepts (Arriassecq & Santos, 2017).

To achieve these forms of learning, a didactic strategy is required, including a planned sequence of materials to be used. It is also necessary to create an environment that incorporates rewards and sanctions, in accordance with Bruner's instructional theory; this facilitates meaningful learning through the subordinate, superordinate, and combinatorial forms (Ubillús et al., 2020).

2.2.3. Didactic Strategy

Teaching strategies consist of procedures aimed at facilitating student learning. In contrast, learning strategies involve the mental processes that students must follow in order to learn. A didactic strategy integrates both teaching and learning processes (Trimiño & Zayas-Quesada, 2016). Didactic strategies are often used to promote curiosity and interest. Furthermore, they enable the implementation of activities that allow students to analyze the consequences of problems and to experiment with reality (Delgado, 2021).

2.2.3. Relationship Between Meaningful Learning and Didactic Strategies

Meaningful learning promotes the construction of knowledge when concepts are connected to cognitive structures, generating deeper understanding that endures over time (Richter et al., 2022). Didactic strategies make it possible to design activities that facilitate meaningful learning, as they can activate prior knowledge for the integration of new ideas (Vargas-Hernández & Vargas-González, 2022). Moreover, strategies support initial assimilation, renewal, and the long-term retention of learning (Baque Reyes & Portilla Faican, 2021; Cuzzolino et al., 2019).

Studies indicate that active strategies such as debates, collaborative projects, or case studies enhance meaningful learning, as these didactic strategies can be oriented toward achieving better educational outcomes (Wright et al., 2024). The planning of didactic strategies that grant students a leading role helps stimulate reflection, autonomy, and the ability to connect learned content with real-world contexts (Colomer et al., 2020). In this way, instructional planning is essential, as it directly responds to the goal of achieving learning, making it necessary to combine pedagogical strategies with Ausubel's cognitive framework.

3. METHODOLOGY

3.1 Research Scope and Design.

This study employed an explanatory research design aimed at describing the main characteristics of the object of study (Osorio-González & Castro-Ricalde, 2021). A mixed-methods approach was used, integrating quantitative and qualitative data analysis to gain a comprehensive understanding of the phenomenon (Guelmes & Nieto, 2015).

In this regard, the study sought to understand the context of Physics teaching and learning, from teachers' perceptions to the collective perceptions of students.

3.2. Research Techniques and Instruments.

Data collection techniques included semi-structured interviews, structured classroom observation, and a knowledge test were applied. To correlate the results, a structured observation was carried out in order to document the teaching actions in the classroom and the students' actions. These instruments were validated by education professionals and applied to diagnose Physics teaching and learning processes (Maray-Hernández et al., 2022).

The interview guide was developed according to the requirements of didactic processes, based on the structure proposed by the components of teaching and learning, as well as the most relevant stages of the didactic process (Ortiz, 2017). This allowed for the analysis of teachers' knowledge regarding the didactic strategies used in the teaching–learning process.

The observation guide was designed in accordance with the most relevant stages of the didactic process and the components of teaching and learning. Both data collection instruments were validated by ten professionals in the field of education. Classroom observation was conducted in three different Physics lessons of second-year high school at the educational institution. Additionally, the test was developed in accordance with the knowledge assessed in the summative evaluation of the second academic term and was prepared by Physics professionals based on the skills required at the second-year high school level. Furthermore, the test was reviewed and approved by the academic committee of Unidad Educativa Aníbal San Andrés Robledo in accordance with its annual planning for the subject.

3.3 Population and Sample

The study population consisted of 345 students and 15 teachers from the high school level. The sample included 74 second-year high school students at Unidad Educativa Aníbal San Andrés Robledo in Jaramijó, selected through non-probabilistic convenience sampling. On the other hand, the interview was applied to two teachers.

3.4 Data Analisys

For the interview, the results were coded, the key ideas from each question were selected, and then the most relevant information obtained was chosen for comparison with the proposed teaching methodology based on the teaching and learning process. For the observation, the data were quantified according to the required information, with each moment of the class being rated according to the didactic requirements of the teaching and learning processes and components. The results were then processed using Excel software, where each question was graphed. For the test, the results were also quantified and then processed in Excel.

4. RESULTS AND DISCUSSION

The results obtained in this research show that meaningful learning of Physics was not achieved among second-year high school students at the Aníbal San Andrés Robledo Educational Unit in Jaramijó. This result is supported by the low average score obtained on the test (Table 2). This insufficient performance was further analyzed and contextualized through systematic classroom observation (Figure 1) and semi-structured interviews (Table 1). These tools allowed for the identification of pedagogical and structural factors that negatively impacted Physics learning.

One of the main findings from the interviews was the lack of specialized teacher training in the subject's didactics. While the teachers at this educational institution held undergraduate degrees in engineering, which guarantees a conceptual understanding of the subject matter, they lacked pedagogical knowledge of the content.

The findings indicate that meaningful learning of Physics was not achieved among second-year high school students. Low test scores, classroom observations, and interview results revealed insufficient use of didactic strategies and limited pedagogical training among teachers, which negatively affected student motivation and engagement.

Results of the interview applied to teachers	
Teacher Training	Engineering degree, no master's degree.
Objectives, Processes, and Didactic Stages	The teacher understands the importance of lesson objectives but lacks clarity regarding procedures and didactic stages.
Didactic Resources Used	Blackboard, pencil, markers, notebooks, calculator, ruler.
Didactic Strategies Used	Methods were based on consulting topics and then explaining definitions in class, with problems solved on the board. There is limited knowledge of didactic strategies.
Adequacy of Practical Resources	Resources were sufficient; however, there was insufficient time to practice exercises on the board.
Integration of Real-Life Problems	Stories, walking activities, board exercises, and everyday solutions explained through Physics.
Feedback Activities Applied	Brainstorming, questions and answers, and in-class lessons with explanations of problem-solving procedures.
Development of Classroom Practice	Exercises carried out on the board, with students showing signs of boredom. Practice was supplemented with homework assignments.
Student Engagement and Participation	Low student participation, although commitment and interest were present.
Teacher Guidance and Support	Guidance and support provided through board explanations, complemented by videos shared on digital platforms.
Results and Conclusions in Class	Results and conclusions were clear; students showed difficulties with numerical aspects but demonstrated understanding of the physical phenomena.

Table 1. Teacher Interview Results

Knowledge of didactic strategies during the teaching–learning process directly influences the strengthening of Physics learning (Vásquez-Calderón, 2024). Although classroom observation showed that learning objectives were clearly defined and various didactic resources were used, it was found that the theoretical explanation of Physics was not adequate. This is because the practical component is based primarily on the numerical explanation of the studied phenomenon, focusing on the memorization of formulas and the mechanical resolution of problems. This finding corroborates the lack of knowledge of didactic strategies identified in the interviews, which contributes to low levels of meaningful learning in Physics, as a well-planned strategy fosters the meaningful construction of knowledge (López, 2022). Furthermore, classroom observation confirmed what was reported in the interviews: although there is teacher support and commitment, the class is perceived as boring.

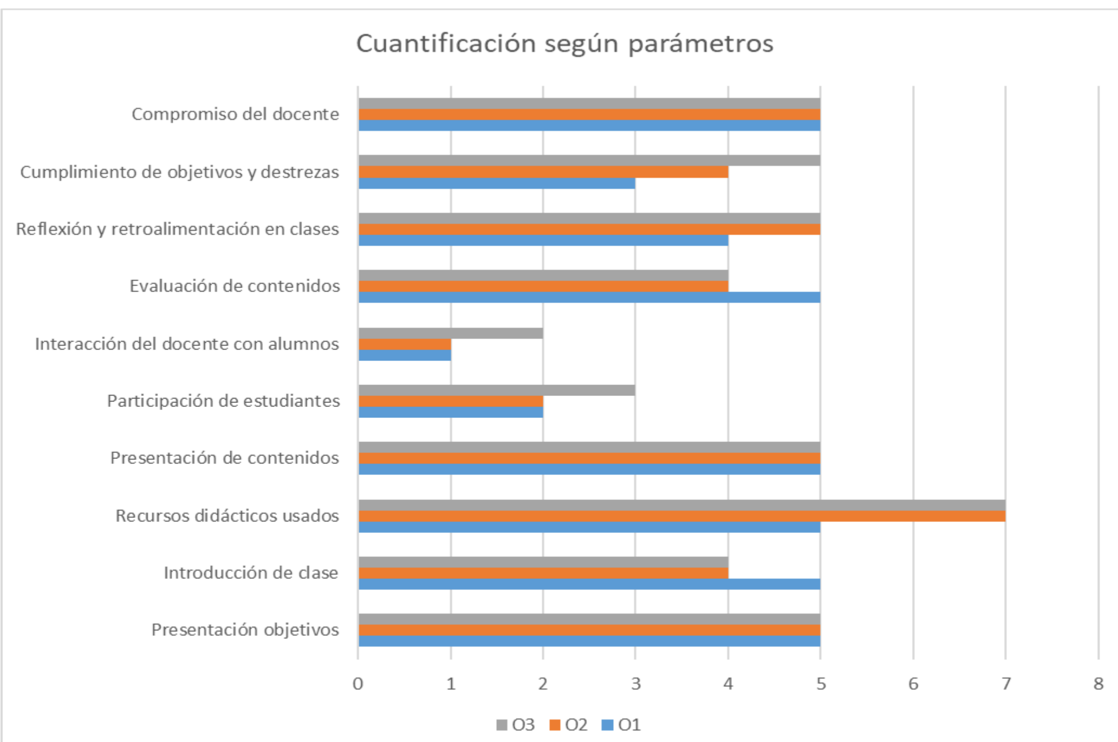

Figure 1. Results of the observation of second-year high school classes based on quantification.

The parameter related to didactic resources presents values above 5. For the remaining parameters, a score of 5 indicates compliance, while 0 indicates absence. O1, O2, and O3 correspond to the observation numbers.

The results of the test presented in Table 2 showed low academic performance, with the class average score being 6.65 out of 10, indicating that students did not achieve the required learning outcomes. The test revealed difficulties in the application of formulas, whereas correct responses were observed in the theoretical section. These findings are consistent with studies that warn about the limitations associated with teacher training when instruction is focused exclusively on content, particularly in the absence of training that promotes pedagogical reflection and the design of meaningful learning experiences (Font et al., 2023).

Additionally, classroom observation revealed limited interaction between teachers and students, accompanied by minimal student participation in Physics lessons. This was due to a theoretical explanation that failed to emphasize the importance of physical phenomena and lacked a practical component. Physics instruction was primarily based on explaining formulas on the board, which generated demotivation during class. As research on teacher professionalization indicates, mastery of subject matter alone is not sufficient to ensure effective teaching if it is not accompanied by specific pedagogical competencies that facilitate learning (Villalobos Iturriaga et al., 2025).

	AREA/SUBJECT:	GRADE:	CLASS:	NUMBER OF STUDENTS:
	Physics	2 BGU	C	35
2. ANALYSIS OF LEARNING DIFFICULTIES		**COURSE AVERAGE:**		**6.65**
3. EVALUATION ANALYSIS				

QUALITATIVE SCALE	ACRONYM	QUANTITATIVE SCALE	%	NUMBER OF STUDENTS
Master the required learning	MRL	10-9	0	0
Achieves the required learning outcomes	ARL	8,99-7	50	21
Close to achieving the required learning outcomes.	CARL	6.99-5	31	11
does not achieve the required learning outcomes	NARL	<4,99	9	3
		TOTAL	**100**	**35**

Table 2. Results of the Test Applied to Second-Year High School Students

All the problems in achieving meaningful learning in the Physics subject stem from the inappropriate use of didactic strategies for teaching and learning, where physical phenomena are difficult to understand. This highlights the need to develop strategies focused on student participation and motivation, allowing students to apply principles and solve problems according to the context. Continuous teacher training is required to strengthen students' experiences, as strategies must be based on inquiry, with their application depending on context and needs, all aimed at fostering student engagement and comprehension (Flores et al., 2021).

The results revealed a critical factor that needs to be addressed: the failure in the use of didactic strategies when teaching Physics. This, coupled with the absence of practical components, influences student motivation and disinterest, as evidenced by low student participation. Therefore, it is necessary to employ a didactic strategy that fits the context of the educational institution to achieve meaningful learning.

The consequence of this issue is related to the quality of teaching, as it declines, and students fail to develop critical skills such as analytical thinking, creativity, and problem-solving. Furthermore, this situation affects both students and teachers. Teachers, not seeing progress in their students, may feel frustrated and demotivated, perpetuating a cycle of ineffective teaching (Cáceres et al., 2020).

The critical factors contributing to this problem include the lack of continuous and updated teacher training, inadequate didactic strategies, and a curriculum that does not meet the needs and contexts of students (Aguirre-Canales & Carcausto, 2021). Socioeconomic and familial factors also play a role, potentially impacting students' motivation and interest (Morales et al., 2024). To address this issue, it is crucial to implement dynamic and participatory didactic strategies that are student-centered and connect learning to real-world situations. This can not only revitalize students' interest and motivation but also improve the quality of learning and the classroom environment.

5. Conclusions

Based on the diagnosis of meaningful learning of Physics among second-year high school students at Unidad Educativa Aníbal San Andrés Robledo, it is concluded that students do not achieve meaningful learning due to the application of didactic strategies that are inappropriate for the context. In addition, it was found that the teacher lacks the required training, which results in unidirectional instruction without the practical application of concepts. Furthermore, the findings indicate the need to develop a didactic strategy tailored to the educational demands of the institution's context.

6. References

Abu-Ghaneema, E. (2018). Meaningful Learning: The Main Constitutive and Consecutive Components and their Presence in Science Teaching. *Yearbook of Pedagogy*, *41*(1), 183–192. https://doi.org/10.2478/rp-2018-0013

Aguilar, Y. P., Valdez, J. L., Gonzalez, N. I., Rivera, S., Carrasco, C., Gómora, A., Pérez, A., & Vidal, S. (2015). Apatía, desmotivación, desinterés, desgano y falta de participación en adolescentes Mexicanos. *Enseñanza e Investigación En Psicología*, *20*(3), 326–336. https://www.redalyc.org/pdf/292/29242800010.pdf

Aguirre-canales, V. I., & Carcausto, W. (2021). La formación continua de los docentes de educación básica infantil en américa latina: una revisión sistemática. *INVESTIGACIÓN VALDIZANA*, *15*(2), 101–111. https://doi.org/https://doi.org/10.33554/riv.15.2.890

Arana, R., Gómez, V., Sánchez, M., Henríquez, E., & Morán, J. (2023). Neurociencia y su aporte determinante en la educación. *Journal of Science and Research*, *8*(2528–8083), 444–452.

Arriassecq, I., & Santos, G. (2017). Nuevas tecnologías de la información como facilitadoras de aprendizaje significativo. *Archivos de Ciencias de La Educación*, *11*(12), 1–13. https://doi.org/https://doi.org/10.24215/23468866e030

Ausubel, D. P. (1968). Educational psychology: a cognitive view. In *Educational psychology: a cognitive view.* New York.

Baque Reyes, G. R., & Portilla Faican, G. I. (2021). El aprendizaje significativo como estrategia didáctica para la enseñanza-aprendizaje. *Polo Del Conocimiento*, *6*(5), 75–86. https://doi.org/10.23857/pc.v6i5.2632

Briceño, J., Duran, R., Pereira, A., & Silvio Rutz, S. (2021). El laboratorio como Herramienta Didáctica para el Aprendizaje de Conceptos y Principios de Física. *RELACult - Revista Latino-Americana de Estudos Em Cultura e Sociedade*, *6*(3), 1–18. https://doi.org/10.23899/relacult.v6i3.1828

Cáceres, M., Nussbaum, M., & Ortiz, J. (2020). Integrating critical thinking into the classroom: A teacher's perspective. *Thinking Skills and Creativity*, *37*, 100674. https://doi.org/https://doi.org/10.1016/j.tsc.2020.100674

Cañaveral, L., Nieto, A., & Vaca, J. (2020). *EL APRENDIZAJE SIGNIFICATIVO EN LAS PRINCIPALES OBRAS DE DAVID AUSUBEL: LECTURA DESDE LA PEDAGOGÍA*. Universidad pedagógica Nacional.

Castro, V. H., & Vega, J. O. (2021). LA MOTIVACIÓN Y SU RELACIÓN CON EL APRENDIZAJE EN LA ASIGNATURA DE FÍSICA DE TERCERO EN BACHILLERATO GENERAL UNIFICADO. *Revista Educare*, *25*(2), 279–305. https://orcid.org/0000-0001-5727

Colomer, J., Serra, T., Cañabate, D., & Bubnys, R. (2020). Reflective learning in higher education: Active methodologies for transformative practices. *Sustainability (Switzerland)*, *12*(9), 1–8. https://doi.org/10.3390/su12093827

Cuzzolino, M. P., Grotzer, T. A., Tutwiler, M. S., & Torres, E. W. (2019). An agentive focus may limit learning about complex causality and systems dynamics: A study of seventh graders' explanations of ecosystems. *Journal of Research in Science Teaching*, *56*(8), 1083–1105. https://doi.org/10.1002/tea.21549

Delgado, C. (2021). Estrategias didácticas para fortalecer el pensamiento creativo en el aula. Un estudio meta- analítico. *Revista Innova Educación*, *4*(1), 51–64. https://doi.org/10.35622/j.rie.2022.01.004.en

Dominguez, A., De la Garza, J., Quezada-Espinoza, M., & Zavala, G. (2024). Integration of Physics and Mathematics in STEM Education: Use of Modeling. *Education Sciences*, *14*(1). https://doi.org/10.3390/educsci14010020

Flores, L., Gomez, Y., Chacaltana, R., Prado, P., Jurado, E., & Huayta, Y. (2021). *Desafíos en la formación continua docente : Una revisión sistemática Challenges in continuing teacher education : a systematic review*.

Font, V., Calle, E., & Breda, A. (2023). Uso de los Criterios de Idoneidad Didáctica y la metodología Lesson Study en la formación del profesorado de matemáticas en España y Ecuador. *Revista Paradigma*, *XLIV*, 378–397.

Galván-Cardoso, A. P., & Siado-Ramos, E. (2021). Educación Tradicional: Un modelo de enseñanza centrado en el estudiante. *Cienciamatria*, *7*(12), 962–975. https://doi.org/10.35381/cm.v7i12.457

Guelmes, E., & Nieto, L. (2015). Algunas reflexiones sobre el enfoque mixto de la investigación pedagógica en el contexto cubano. *Revista Universidad y Sociedad*, *7*(2), 23–29. http://rus.ucf.edu.cu/

INEVAL. (2024). *POLÍTICAS TRANSFORMADORAS: hacia el nuevo Ecuador, desde la evaluación educativa* (Vol. 1). www.evaluacion.gob.ec

Lino-Calle, V. A., Barberán-Delgado, J. A., López-Fernández, R., & Gómez-Rodríguez, V. G. (2023). Analítica del aprendizaje sustentada en el Phet Simulations como medio de enseñanza en la asignatura de Física. *MQRInvestigar*, *7*(3), 2297–2322. https://doi.org/10.56048/mqr20225.7.3.2023.2297-2322

López, M. L. (2019). La pedagogía crítica como propuesta innovadora para el aprendizaje significativo en la educación básica. *ReHuSo: Revista de Ciencias Humanísticas y Sociales*, *4*(1), 87–98. https://doi.org/10.33936/rehuso.v4i1.2120

López, T. (2022). *ESTRATEGIAS DIDÁCTICAS ACTIVAS PARA FOMENTAR EL PENSAMIENTO CRÍTICO EN LOS ESTUDIANTES DEL SEGUNDO SEMESTRE DE LA CARRERA DE EDUCACIÓN BÁSICA DEL PERIODO ABRIL - SEPTIEMBRE 2022*. UNIVERSIDAD TÉNICA DE BABAHOYO.

Maray-Hernandez, V., Berrios-Ayala, F., Santos-Reyes, J., & Cabrera-Maray, P. (2022). Instalación de un proceso de observación de aula: experiencia y desafíos. *Revista de Estudios y Experiencias En Educación*, *21*(46), 429–448. https://doi.org/10.21703/0718-5162.v21.n46.2022.024

Melo, L. (2015). *Desarrollo del conocimiento didáctico del contenido sobre el campo eléctrico con* *profesores de física colombianos de bachillerato, mediante un programa de intervención* [Universidad de Extremadura]. https://dialnet.unirioja.es/servlet/tesis?codigo=45480&info=resumen&idioma=SPA

Morales, H., Alvarado, P., & Camacho, O. (2024). La influencia del nivel socioeconómico de las familias en el rendimiento académico de los estudiantes : un análisis comparativo en entornos urbanos y rurales. *Revista Latinoamericana de Ciencias Sociales y Humanidades*, *V*(5), 3106–3117.

Moreira-Choez, J., Beltro-Cedeño, R. A., & Beltrón-Cedeño, V. C. (2021). Aprendizaje significativo una alternativa para transformar la educación. *Dominio de Las Ciencias*, *7*(2), 915–924. https://dominiodelasciencias.com/ojs/index.php/es/article/view/1835/html%0Ahttps://dominiodelasciencias.com/ojs/index.php/es/article/view/1835/xml%0Ahttps://dominiodelasciencias.com/ojs/index.php/es/article/view/1835

Moreira, M. A. (2020). Aprendizaje Significativo: la Visión Clásica, otras Visiones e Interés. *Proyecciones*, *14*, 010. https://doi.org/10.24215/26185474e010

Ordóñez Olmedo, E., & Mohedano, I. (2019). El aprendizaje significativo como base de las metodologías innovadoras. *Revista Educativa Hekademos*, *26*, 18–30.

Ortiz, F. (2017). *Procesos didácticos y aprendizaje significativo del área de matemática de los estudiantes del 2º Grado de Secundaria de la Institución Educativa Francisco Bolognesi*. Universidad César Vallejo.

Osorio-Gonzalez, R., & Castro-Ricalde, D. (2021). Aproximaciones a una metodología mixta. *Revista Universitaria de Administración*, *13*(22), 65–84. https://doi.org/http://dx.doi.org/10.20983/novarua.2021.22.4

Rengifo, W., Escobar, J., Anaya, K., & Téllez, R. (2023). *Fortalecimiento de la física en grado 11 con una aplicación móvil*. *25*(2024), 41–60.

Richter, T., Berger, R., Ebersbach, M., Eitel, A., Endres, T., Ferri, R. B., Hänze, M., Lachner, A., Leutner, D., Lipowsky, F., Nemeth, L., Renkl, A., Roelle, J., Rummer, R., Scheiter, K., Schweppe, J., Aufschnaiter, C. Von, & Vorholzer, A. (2022). How to Promote Lasting Learning in Schools: Theoretical Approaches and an Agenda for Research. *Zeitschrift Fur Entwicklungspsychologie Und Padagogische Psychologie*, *54*(4), 135–141. https://doi.org/10.1026/0049-8637/a000258

Rios Huaricachi, K., Rojas Landa, Y., & Sánchez Trujillo, M. (2022). Las estrategias de enseñanza en los procesos de interacción de estudiantes de primaria. *Educación*, *31*(60), 258–274. https://doi.org/10.18800/educacion.202201.012

Rocha, J. C. R. (2021). Importancia del aprendizaje significativo en la construcción de conocimientos. *Revista Científica de FAREM-Estelí*, 63–75. https://doi.org/https://doi.org/10.5377/farem.v0i0.11608 63

Rojas, O. (2019). Rol del maestro en los procesos de innovación educativa. *Revista Scientific*, *4*(2542–2987), 54–67.

Tang, Y., & Hu, J. (2022). The impact of teacher attitude and teaching approaches on student demotivation: Disappointment as a mediator. *Frontiers in Psychology*, *13*. https://doi.org/10.3389/fpsyg.2022.985859

Tocto-Flores, M. J., Vivanco-Ureña, C., León-Bravo, F., & Oviedo-Vera, A. J. (2024). Material didáctico para el proceso de enseñanza aprendizaje de Física en Bachillerato. *Polo Del Conocimiento*, *9*(8), 1547–1567. https://doi.org/Material didáctico para el proceso de enseñanza aprendizaje de Física en Bachillerato

Torres, A. C., Quílez-Robres, A., & Cortés-Pascual, A. (2023). Motivación y rendimiento académico en la adolescencia : una revisión sistemática meta-analítica Introducción El concepto motivación aparece de manera. *Revista Electrónica de Investigación y Evaluación Educativa*, *29*, 1–23.

https://doi.org/http://doi.org/10.30827/relieve.v29i1.25110

Trimiño, B., & Zayas-Quesada, Y. (2016). Trimino,B&ZayasQuezada,Y.(2016).Estrategia didáctica para el fomento de la lectura en las clases. *EduSol*, *16*(Estrategia diáctica para el fomento de la lectura en las clases), 54–62. https://www.redalyc.org/articulo.oa?id=475753050015

Ubillús, J., Cerna, C., Espinoza, F., & Chunga, G. (2020). Teoría de la instrucción de Bruner y su incidencia en el aprendizaje significativo de los estudiantes del doctorado en educación. *Diálogo*, *43*, 51–62. https://doi.org/http://dx.doi.org/10.18316/dialogo.v0i43.6452

Vargas-Hernández, J. G., & Vargas-González, O. C. (2022). Strategies for meaningful learning in higher education. *Journal of Research in Instructional*, *2*(1), 47–64. https://doi.org/10.30862/jri.v2i1.41

Vásquez-Calderón, Y. (2024). Estrategias didácticas para un aprendizaje significativo en una institución educativa, Perú. *Revista Electrónica de Ciencias de La Educación, Humanidades, Artes y Bellas Arte*, *VII*, 244–262. https://doi.org/https://doi.org/10.35381/e.k.v7i1.3733

Vera, F., Rivera Campos, R., Fuentes, R., & Romero Maltrana, D. (2015). Estudio del movimiento de caída libre usando vídeos de experimentos. *Revista Eureka Sobre Enseñanza y Divulgación de Las Ciencias.*, *12*(3), 581–592. https://doi.org/10.25267/rev_eureka_ensen_divulg_cienc.2015.v12.i3.14

Villalobos Iturriaga, I. C., Acosta García, K., Castro-Ceacero, D., Contreras Hernández, P., & González Sanzana, Á. (2025). Importance of Pedagogical Practice in Teaching Satisfaction. *Education Sciences*, *15*(3), 1–12. https://doi.org/10.3390/educsci15030286

Wright, A. L., Irving, G. L., Pereira, S., & Staggs, J. (2024). An Instructional Innovation That Embeds Group Learning in Case Teaching: The Table Case Method. *Journal of Management Education*, *48*(3), 526–563. https://doi.org/10.1177/10525629231216642