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The pedagogical model for developing research/ investigation competence in primary school students (Natural Sciences)

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ABSTRACT. The article presents the theoretical foundation of the pedagogical model for developing research/investigation competence in primary school students (Natural Sciences) - DCCI-ECP (NS). This model is based on instructional theories, learning theories, educational paradigms focused on competence, socio-constructivist and cognitive approaches, as well as didactic principles. Its structure follows the logical and scientific argumentation of the components of the educational process involved in the development of research/investigation competence (RIC). The normative framework provided by educational policy documents integrates the epistemology and teleology of RIC. The originality of the model lies in its integrated approach through STEAM project-based activities in the Natural Sciences subject for primary school students, addressing all structural components of RIC: cognitive, conative, behavioral, objective/reflexive components. The article highlights the relevance of RIC for the development of young students as a general school competence within the Romanian educational system.

Keywords: school competence, research/investigation competence, didactic principle, educational paradigms, STE(A)M activities.

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INTRODUCTION

In Romania, the Pre-university Education Law no. 198/2023 (Parliament of Romania, 2023) includes core competencies in mathematics, science, and technology as part of the national curriculum for primary and secondary education. These competencies are among the eight key areas that shape the student's educational profile. The first evaluation targeting competencies in the field of sciences is scheduled at the end of the sixth grade, through a transdisciplinary test covering language and communication, mathematics, and science. Although the study of sciences begins in an integrated manner in preschool education and in a disciplinary manner from the third grade of primary education.

Another significant assessment of science competencies is conducted through PISA. The PISA (OECD, 2022) results indicate that 44% of Romanian students who participated do not reach level 2 in science, meaning they are unable to apply everyday knowledge and basic procedures to identify and explain scientific phenomena. They also struggle to interpret data and formulate questions within a simple experiment. Furthermore, they are unable to draw valid conclusions from the provided data. These students do not demonstrate an understanding of the scientific process, as evidenced by their inability to formulate investigative questions (PISA, 2022).

In this context, it is imperative to develop scientific competencies from the primary education level to enhance students' ability to investigate scientific aspects and concepts in a reflective manner, preparing them as future engaged citizens. A student with scientific literacy is more likely to participate in an argumentative dialogue regarding science and technology. This participation requires specialized competencies to interpret and evaluate phenomena from a scientific perspective, as well as to design research, interpret data, and rigorously assess evidence.

Research/investigation competence in the educational context represents a contemporary pedagogical approach, which holds significant importance across all curricular areas. This competence encourages students to explore, question, analyze, and interpret information, thereby fostering critical thinking, problem-solving skills, and scientific curiosity. However, despite the concept being adopted in educational practice for over a decade, there remains a lack of cohesion and a solid theoretical and epistemological foundation that would provide a unified direction for its application across various disciplines and educational levels.

Research in Moldova highlights a significant recognition of the importance of research/investigation competence as an essential element in the educational process, both for young students (Teleman, 2010) and high school graduates (Sclifos, 2007).

In academic work, including doctoral theses, researchers in Moldova have approached and defined this concept in various ways, reflecting its diversity and complexity. Sclifos explores the concept of "scientific research competence" (Sclifos, 2007, p. 27) as a school competence expressed by "a totality of semantic orientations, knowledge, skills, habits, and students' action experience in relation to certain types of objects from the surrounding world, necessary for productive activities of personal, academic, and social significance". Beyond this approach, we consider that an important aspect for developing research/investigation competence (RIC) within the primary education process is the cognitive component, which the author mentions as an "integrated set of mental operations activated during research" (Teleman, 2010, p. 43).

Teleman defines "exploration/investigation competence" in terms of school competence as a completed structure, composed of "declarative, procedural, and conative components (savoir-dire, savoir-faire, savoir-être), generated by mobilizing a quantum of internal resources of the subject (knowledge, skills, attitudes) within a framework of significant situations (pedagogically intended or spontaneous, with disciplinary or inter-transdisciplinary character), which manifest in significant and intentional evaluation situations through school performance" (Teleman, 2010, p. 62).

Franțuzan describes scientific literacy as a fundamental educational concept central to modern pedagogical practices. It is approached as a multidisciplinary and transdisciplinary competence that integrates elements of different disciplines in the field of Science. The concept emphasizes not only the acquisition of concrete knowledge, but also the application of interactive learning methods and pedagogical models designed to stimulate critical thinking, analytical skills and systemic development of the world (Franțuzan, 2009).

Table 1. *Framework for Research Competence Development*

Category	**Description and Contribution**
Theoretical Foundations	
Research Results in Educational Republic of Moldova	"Integrated set of mental operations activated during research" (Teleman, 2010, p. 43).
	"A totality of semantic orientations, knowledge, skills, habits, and students' action experience in relation to certain types of objects" (Sclifos, 2007).
	The competence of scientific knowledge includes research competence as a component (Franțuzan, 2009).
Educational Policy Frameworks	
OECD PISA 2022	Assesses research competence as part of scientific literacy, focusing on inquiry-based problem-solving and critical analysis.
Education Code (Moldova, 2014)	Establishes the legal and policy framework necessary to prioritize and standardize the teaching of research competence across institutions.
Education Law (Romania, 2023)	Provides practical guidelines for implementing research competencies in curricula, ensuring equitable access and interdisciplinary learning (Parliament of Romania, 2023).
Curriculum Guidelines	
Reference Framework of the National Curriculum (Moldova, 2017)	Guides competency development in primary education, fostering inquiry-based learning, critical thinking, and foundational investigation skills (Guțu, Bucun, Ghicov et al., 2017).
Curriculum Paradigm – School Competence	Focuses on embedding research processes in competency-based learning through interdisciplinary, project-based approaches (Ministry of Education, Culture and Research of the Republic of Moldova, 2019).
National and Regional School Documents	
Romania: Natural Sciences Curriculum (Grades III-IV)	Aims to develop foundational research skills through observation, experimentation, and reporting in scientific exploration (Prahova County School Inspectorate, 2024).
Methodological Letter (2024)	Offers guidance for implementing research-focused teaching practices aligned with national standards.
Optimization Guide (2015)	Provides strategies for enhancing teaching practices to foster research competence in students (Botgros, Guidelin Franțuzan & Simion, 2015).
Other Educational Systems	
Finland: National Core Curriculum (2014)	Research competence integrated into all subjects; promotes active learning, experimentation, and collaboration (Ministry of Education and Culture, 2014).
Australia: Australian Curriculum (2000)	Highlights inquiry-based learning, interdisciplinary projects, and technology for supporting early research skills (Australian Curriculum Authority, 2000).

Definition

The definition of Research/Investigation Competence (RIC) accepted in our research aligns with the normative framework in Romania, represented by the Pre-university Education Law no. 198/2023, the Primary Education Framework Plan, and the curriculum for Natural Sciences for grades III-IV. This framework conceptualizes school competence as a structured ensemble of knowledge, skills, and attitudes. In Romania (Guidelines for Designing, Updating, and Evaluating the National Curriculum, 2019), RIC as a general competence studied over a school cycle is formulated as "Investigating the surrounding environment using specific tools and procedures" (Ministry of National Education, 2014., p. 4). In the Republic of Moldova, as a specific competence for grades II-III-IV, it is articulated as "Exploring-investigating the surrounding environment, demonstrating curiosity and interest in utilizing specific methods and tools for collecting and organizing results" (Ministry of Education, Culture, and Research of the Republic of Moldova, 2018., p. 72).

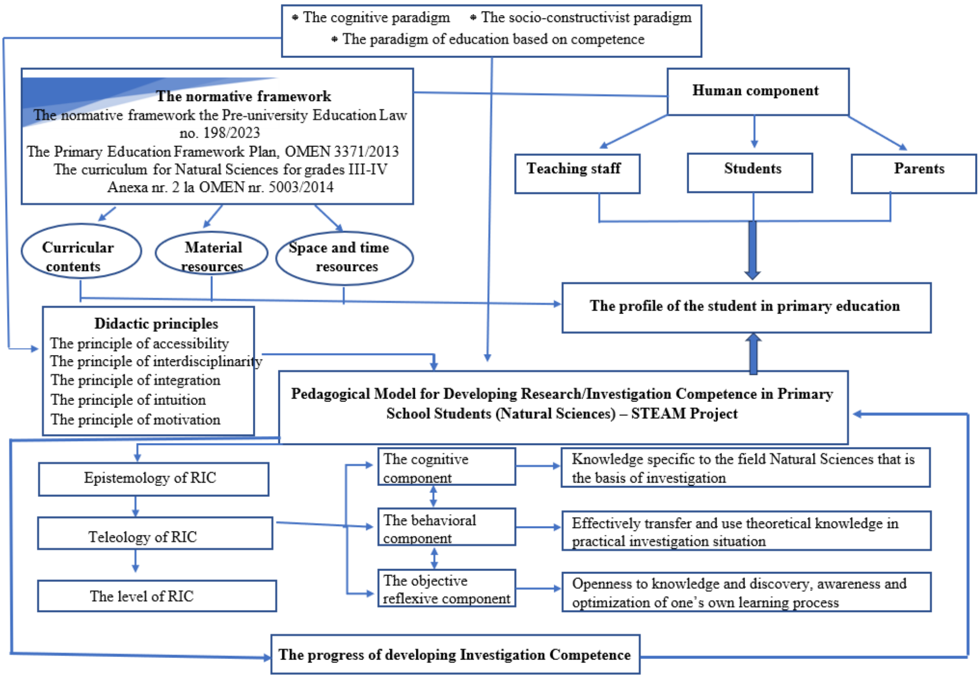

Figure 1. Pedagogical Model for Developing RIC in Primary School Students (Natural Sciences) - DCCI-ECP (NS)

The pedagogical model developed, titled "Pedagogical Model for Developing Research/Investigation Competence in Primary School Students (Natural Sciences) – PMDRIC-PS(NS)" (fig. 1), aims to structure and implement an instructional framework that systematically facilitates the development of this essential competence, integrating it as a central element in the educational trajectory of students. This involves identifying and applying optimized pedagogical methods that encourage critical thinking, analytical skills, and scientific investigation abilities, thus aligning with contemporary educational goals (Cristea, 2003).

The model reflects the essential characteristics of the phenomenon studied through a tripartite composition, as defined by Ionescu (1995). This structure is organized into input flows, consisting of human resources - participants in the educational process - and output flows, representing the learning outcomes that form the objective of our pedagogical intervention.

The Teleology of Research/Investigation Competence in Natural Sciences

The teleology of research/investigation competence in the context of scientific education focuses on the acquisition of specific knowledge and the development of skills, as well as the formation of attitudes and values that contribute to a deep and responsible understanding of the natural world and humanity's place within it. The primary goals of developing this competence in scientific education include (Ciascai & Dulama, 2013):

- **Fostering Critical Thinking and Scientific Mindset**: Encouraging students to adopt an evidence-based approach to understand phenomena, ask relevant questions, and critically evaluate information.
- **Developing Autonomy in Learning**: Promoting self-learning abilities and independent investigation skills among students.
- **Cultivating Responsibility and Environmental Awareness**: Emphasizing the understanding of human impact on the environment and promoting an ethic of care and conservation of natural resources.
- **Promoting Cooperation and Teamwork**: Encouraging collaborative learning and teamwork, with an emphasis on idea exchange in the scientific process.
- **Enhancing Communication Skills**: Improving the ability to effectively communicate scientific investigation results, both in written and oral forms.
- **Applying Knowledge to Real-Life Situations**: Utilizing scientific knowledge and research/investigation skills to approach and solve concrete problems in daily life and professional environments.
- **Stimulating Curiosity and Innovation**: Encouraging creative exploration and innovation in sciences.

Figure 2. Components of Research/Investigation Competence (RIC) in the Natural Sciences Discipline

The components of Research/Investigation Competence (RIC) within the Natural Sciences discipline include:

- **Cognitive Component**: This involves the knowledge and understanding of concepts, principles, and processes specific to this field, as well as the ability to identify and apply the correct steps in an investigative approach. This component is crucial as it provides the theoretical foundation necessary for formulating research questions, developing hypotheses, planning experiments, collecting and analyzing data, and drawing conclusions. It consists of domain-specific knowledge that students need to acquire, such as key concepts in biology, chemistry, physics, and Earth sciences. This component allows students to approach complex questions in Natural Sciences in a structured and informed manner, contributing to the development of critical thinking and problem-solving skills.
- **Conative Component**: The conative component of research/investigation competence in Sciences is essential for fostering a proactive attitude toward learning and scientific practice. It refers to the aspects related to motivation, attitudes, values, and dispositions that influence how primary school students engage in research and investigative activities. This includes the desire to explore, scientific curiosity, perseverance in the face of challenges, openness to new ideas, and the ability to apply knowledge to solve complex problems and develop creative thinking.

These components work together to create a comprehensive framework that supports students in developing their research and investigation skills in Natural Sciences, equipping them with the tools needed to engage deeply with scientific content and processes.

- **Conative Component (Continued)**: This component stimulates interest and commitment to exploring natural phenomena and understanding scientific principles. It encourages students to persist in their investigations even when faced with difficulties or failures, learning from mistakes and persevering in the pursuit of solutions. Curiosity is highlighted as the driving force behind scientific inquiry, fostering the desire to learn more and discover new things. This component promotes the development of a critical and creative approach to problem-solving, encouraging innovation and the application of knowledge in new and unexpected ways. It also emphasizes the importance of teamwork and the exchange of ideas, which are essential for advancing scientific knowledge.
- **Behavioral Component**: The behavioral component refers to the concrete actions, practices, and behaviors that young students exhibit during an investigative process. It is essential for transforming theoretical knowledge and intentions into effective actions that lead to solving scientific problems. This component involves a range of practical skills, from rigorous planning and execution of experiments to the critical analysis of data and effective communication of results. These practices contribute to advancing knowledge in the natural sciences and developing a deeper understanding of natural phenomena.
- **Objective/Reflective Component**: This component involves cultivating a proactive and curious attitude toward learning and discovery. It includes developing an open-mindedness that encourages students to be receptive and enthusiastic about new information and challenges, aiming to stimulate active engagement in investigative activities. By nurturing this component, the goal is to develop not only a solid foundation of scientific knowledge in students but also essential competencies such as critical thinking, problem-solving, creativity, and learning autonomy. Students become more capable of initiating and leading their own investigations, formulating hypotheses, collecting and analyzing data, and drawing relevant conclusions, guided by an intrinsic curiosity and a constant desire to explore and understand the world around them.

Epistemology of Research/Investigation Competence (RIC) in Young Students

The epistemology of Research/Investigation Competence (RIC) in young students refers to how they understand and apply scientific research methods and processes to explore the natural world. This learning process involves not only the accumulation of knowledge but also the development of critical thinking skills and the application of scientific methods. During the research/investigation process, students must be capable of identifying and applying the following steps (Ivan, A.-O., 2016):

- **Formulating a Research Question**: Transforming natural curiosity into a specific, clear, and investigable question.
- **Constructing a Hypothesis**: Developing a prediction based on existing knowledge that will guide the investigative process.
- **Planning the Investigation**: Establishing methods and procedures for collecting the data needed to test the hypothesis, including the selection of appropriate tools and materials.
- **Data Collection**: Conducting experiments or observations, systematically gathering data.
- **Data Analysis**: Carefully examining and interpreting the collected data, using appropriate methods to identify patterns or trends.
- **Drawing Conclusions**: Based on the analysis, students determine whether the data support or refute the initial hypothesis.
- **Communicating Results**: Presenting the findings, either through a written report, an oral presentation, or other forms of expression.

This structured approach not only aids in the development of scientific knowledge but also fosters essential skills such as critical thinking, problem-solving, and effective communication. By engaging in this process, students become more skilled at understanding the natural world through a scientific lens, preparing them for more complex investigations in the future.

The Pedagogical Model

The pedagogical model was developed within the framework of the competence-centered pedagogy paradigm, the socio-constructivist paradigm, and the cognitive paradigm, which provides an important theoretical and practical foundation for the development of research competence in the field of natural sciences. These paradigms emphasize social interactions, cultural environment, learning support, and the significance of language and context in the learning and research process.

Students are exposed to diverse social and cultural environments that help them construct knowledge and develop research skills in a relevant and contextualized manner. They gain an understanding of complex concepts by applying them in practice through research and collaborative activities. This approach ensures that the learning process is both meaningful and aligned with the students' real-world experiences, fostering deeper engagement and comprehension.

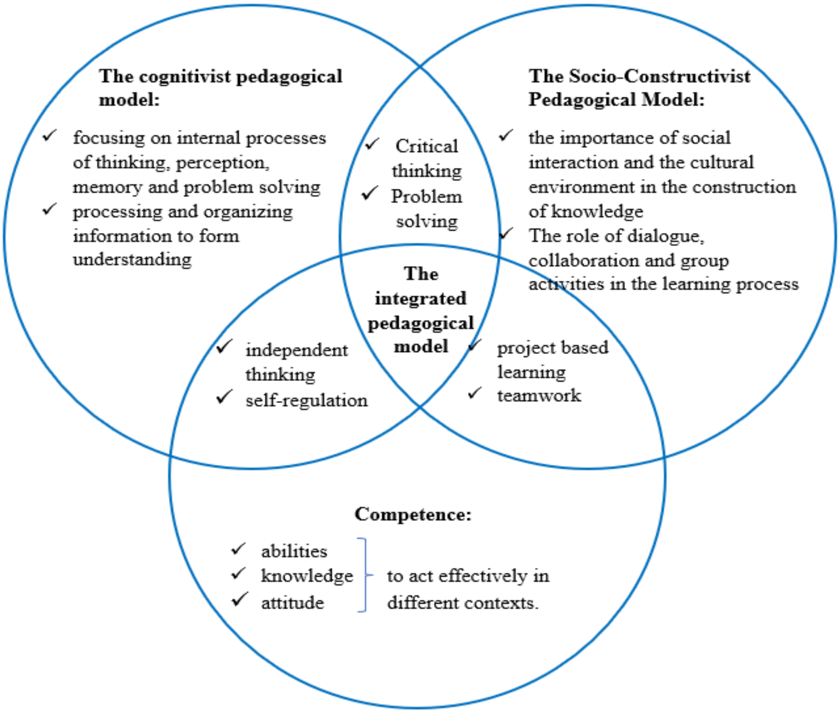

Figure 3. The Key of the Pedagogical Paradigm

This conceptual diagram highlights how integrating these pedagogical paradigms can provide a solid foundation for designing and implementing an effective pedagogical model that promotes meaningful learning and prepares students for the complex challenges of the modern world.

In the educational context of the Republic of Moldova, Guțu makes a significant contribution by describing the educational paradigm regarding the approach to school competence, analyzing it from the perspective of a triple logic: the logic of action in a situation, the curricular logic, and the logic of learning (Guțu, 2018). This approach aligns with the Reference Framework specific to the Republic of Moldova, the dynamics of PISA evaluation, the targeted competencies, and the theory and methodology of teaching and learning. Based on these theoretical and methodological foundations, an orientated pedagogical intervention model is developed, grounded in the principles of the general theory of education, with a focus on the rigorous conceptualization of fundamental school competence, specifically research/investigation competence (RIC). **Independent thinking** is a cornerstone of effective investigation, enabling individuals to approach problems critically, question assumptions, and arrive at conclusions based on evidence. It ensures that the investigative process is not merely a repetition of existing knowledge but a pathway to discovering new insights and solutions. In the context of investigation, it involves a willingness to challenge existing theories, explore alternative perspectives, and rely on one's reasoning skills to derive conclusions (Miclea, 2002; Neacșu, 2015).

From these paradigms, important principles applicable to education in general, and the study of sciences in particular, can be derived. The principles of the educational process for developing RIC in science represent essential axioms, directives, and fundamental norms that guide the structuring, organization, and conduct of the teaching-learning process, aiming to achieve the established educational objectives. These principles constitute the methodological basis for teaching and learning science disciplines, including Natural Sciences, contributing to the optimization of educational objectives (Ministry of National Education, 2013; Ministry of Education, Culture, and Research of the Republic of Moldova, 2018). They represent the foundation upon which the efficient development of RIC is built within formal education, promoting an integrated and applied approach to learning. These principles shape a framework for RIC development, laying the groundwork for solid scientific education, tailored to the needs and characteristics of students, and fostering a deep and applied understanding of science in the context of everyday life and the challenges of contemporary society.

General Principles of Education, Organizational Principles of Scientific Education, and Investigative Principles

The general principles of education, organizational principles of scientific education, and investigative principles interact synergistically in the process of designing, organizing, and implementing educational activities. Therefore, in the design phase of educational activities, it is imperative to pay close attention to adhering to these principles and conditions, treating them as "guiding and normative reference points" (Gînju, 2021, p. 38). These principles underlie the achievement of general and specific competencies, as well as operational objectives, thereby contributing to the optimization of the educational process and the improvement of performance among young students.

Moreover, focusing on the functions of designing STE(A)M activities within the context of Natural Sciences classes emphasizes the praxiological value of this anticipatory approach, which is essential for ensuring the efficiency and quality of the educational process. This establishes a normative framework for the curricular development of research/investigation competence (RIC), ensuring an effective and coherent approach to education.

The development of RIC within the context of formal education is based on principles characterized by global, holistic, and systemic approaches. In the current educational paradigm, which prioritizes student-centered learning, we propose the following specific principles for the model of RIC development:

Principle of Ensuring Scientific Rigor in the Context of Accessibility

This principle involves adapting the educational process to the age and individual characteristics of students, ensuring scientific accuracy through the formulation of educational objectives, the selection of didactic content, the design of learning tasks, and the development of activity methodologies, while simultaneously ensuring the accessibility and relevance of these elements for students.

This approach guarantees that the educational activities are both scientifically rigorous and accessible, making the learning experience meaningful and effective for all students, regardless of their individual learning needs.

Principle of Interdisciplinarity and Transdisciplinarity

The principle of interdisciplinarity and transdisciplinarity (Manolescu, 2013; Ursu & Cutasevici, 2019; Pahome, 2023) aims to highlight the connections between different school subjects and various dimensions of education, promoting a holistic and integrated approach to learning that transcends traditional disciplinary boundaries. It emphasizes the importance of establishing multidimensional links between various academic disciplines (such as biology, physics, chemistry, geography, psychology, and sociology) and social sectors (such as education, economy, industry, and health), recognizing that without integrating knowledge from these areas, scientific education would be limited. Additionally, it acknowledges the value of connections with arts (such as visual arts, music, and literature), facilitating the application of STE(A)M approaches.

Principle of Integrating Scientific Culture and Scientific Consciousness

The principle of integrating scientific culture and scientific consciousness focuses on cultivating a scientific culture and consciousness through axiological values, encouraging the formation of appropriate scientific attitudes and behaviors. It emphasizes experiential learning, thereby facilitating the internalization of scientific knowledge and methods through direct and applied experiences. This approach ensures that students not only learn scientific facts and theories but also adopt the mindset and ethics of scientific inquiry, fostering a deeper appreciation for the scientific method and its applications.

Principle of Holistic Integration

The principle of holistic integration promotes a comprehensive approach to scientific education, encouraging the recognition of connections between various scientific phenomena and concepts. It supports the development of a deep and multidimensional understanding of the natural world. This principle encourages the application of interdisciplinary knowledge in addressing complex problems and underscores the importance of an integrated education that fosters the holistic growth of students. The integration of theoretical knowledge, the development of research skills, and the cultivation of positive attitudes and ethical values are essential in this process. This pedagogical model prepares students to tackle contemporary ecological and social challenges, providing a solid foundation for understanding the complexity and interconnections within the scientific world.

By applying these principles, educators can design and implement educational activities that not only impart knowledge but also develop critical thinking, creativity, and ethical awareness, equipping students with the skills and mindset needed to navigate and address the complexities of the modern world.

Crouch's (2017) Seven Fundamental Principles in STEM Education

Crouch author, 2017 (apud Chiriac, 2022) emphasizes seven fundamental principles in STEM education that support teachers in efficiently planning lessons while enhancing the educational experience of students without negatively impacting task completion. These principles include:

1. **Active Student Engagement**: Involving students in hands-on projects that allow them to apply STEM concepts practically, fostering deeper understanding and retention.
2. **Relevance to Students' Future Careers**: Addressing the relevance of the subject matter to students' future professional lives, helping them see the value and applicability of what they are learning.
3. **Connecting Abstract STEM Concepts to Prior Knowledge**: Linking new, abstract STEM concepts to students' existing knowledge to maintain their interest and enhance comprehension.
4. **Modeling a Positive Attitude Towards STEM**: Teachers and parents alike should model a positive attitude toward STEM subjects, which can influence students' perceptions and engagement.
5. **Keeping Up with the Latest Trends**: Teachers must stay informed about the latest trends in curriculum development, technology, and pedagogy to provide the most current and effective education.
6. **Transdisciplinary Integration**: Promoting a transdisciplinary approach that connects STEM subjects with other disciplines, offering a more holistic understanding of the material.
7. **Promoting Continuous Learning**: Encouraging a culture of continuous learning, preparing students for a world that is constantly evolving and requiring ongoing adaptation.

By adhering to these principles, STEM education becomes more structured and relevant, providing students with a solid foundation for their academic and personal development. This approach ensures that students are better equipped to face the challenges of a rapidly changing world (Chiriac, 2022).

Figure 4. Didactic Principles in the Context of Investigative Approach and STE(A)M Activities

This diagram serves as a visual guide for integrating didactic principles into the planning and implementation of learning activities, emphasizing the connections between these principles and the focus on an investigative approach.

- **Contextual Relevance**: Demonstrates how STE(A)M activities are connected to real-world problems that are relevant to students, facilitating the understanding of the applicability of knowledge in real-life contexts.
- **Active Learning**: Highlights how STE(A)M activities engage students in active learning through experiments, projects, and exploration, stimulating curiosity and motivation.
- **Individualized Learning**: Involves adapting the educational process to the unique needs, interests, and learning pace of each student, allowing for personalized learning experiences.
- **Cooperative Learning**: Emphasizes the importance of teamwork and collaboration among students in STE(A)M projects, promoting the exchange of ideas and mutual learning.

- **Interdisciplinarity in Learning**: Shows how STE(A)M activities integrate knowledge and skills from multiple disciplines (science, technology, engineering, art, and mathematics), offering a holistic view of learning.
- **Reflection and Self-Assessment in Learning**: Stresses the importance of personal reflection and self-assessment in the learning process, encouraging students to evaluate their own progress and become autonomous learners.

Originality of the Model

The originality of the model lies in the adaptation of the curriculum and teaching methods for the development of Research/Investigation Competence (RIC) through STE(A)M activities, aiming not only to transmit knowledge but also to cultivate critical thinking, creativity, and the ability to solve complex problems.

- **Creating Unified Themes**: Develop unified themes that address topics from multiple STE(A)M disciplines simultaneously, emphasizing the connections between them and the application of knowledge in real contexts.
- **Using Project-Based Learning Methods**: Encourage collaboration, critical thinking, and practical application of knowledge through project-based learning.
- **Integrating Digital Tools in the Learning Process**: Utilize educational software, simulations, augmented reality (AR), or virtual reality (VR) to facilitate the exploration and understanding of complex concepts.
- **Encouraging Inquiry-Based Learning**: Promote student inquiry by encouraging them to ask questions, formulate hypotheses, and conduct experiments, thereby cultivating essential research/investigation skills.
- **Teaching Data Collection, Analysis, and Interpretation**: Instruct students on how to collect, analyze, and interpret data using scientific and mathematical methods.
- **Teamwork**: Highlight the importance of interdisciplinary collaboration and idea exchange for problem-solving.
- **Competence-Oriented Assessment**: Use competence-oriented assessments, such as project portfolios, presentations, research reports, and self-assessments, to reflect progress in developing RIC.
- **Open and Exploratory Learning Environment**: Foster an open and exploratory learning environment that encourages experimentation and discovery.

This model prepares students to engage deeply with STE(A)M subjects, equipping them with the skills and mindset necessary to navigate and address the challenges of the modern world effectively.

CONCLUSIONS

The proposed approach demonstrates a clear capacity to improve students' learning in natural sciences, developing critical thinking, learning autonomy and transversal skills essential for the future.

The RIC pedagogical model, based on well-defined didactic principles – such as scientific rigor, interdisciplinary integration, scientific culture and holism – provides a clear guide for teachers in designing educational activities. Visualizing the central elements of the model – cognitive, conative, behavioral and reflective components – supports teachers in understanding the relationships between them and in their differentiated application, depending on the needs and characteristics of their class. Participating teachers reported an increase in student motivation, enjoyment of learning, and confidence in their own abilities.

However, implementing the model also raised challenges, such as the time required for planning, integration into existing curricula, and the use of unconventional educational spaces. These challenges highlight the importance of managerial support and a clear institutional strategy for the effective integration of the model.

The proposed model is designed to facilitate the understanding and effective application of research/investigation competence, providing teachers and students with a structured framework for scientific inquiry. By integrating the logic of action into real-life situations, the model encourages students to apply theoretical knowledge in practical contexts, promoting experiential learning and problem-solving. Curricular logic ensures coherence and continuity in the development of competencies across different educational levels, while the logic of learning focuses on adapting instructional processes to the cognitive and motivational characteristics of students.

The pedagogical model represents a valuable resource for improving educational practices, offering an integrated perspective on the development of research/investigation competence in primary school students within the Natural Sciences discipline. By promoting this model, the aim is not only to enrich the educational experience for students but also to enhance the effectiveness of the educational process in line with contemporary educational standards and requirements.

In conclusion, this model provides an innovative example of integrating RIC into STE(A)M education, demonstrating its potential in contributing to a more holistic and relevant education for contemporary challenges. It remains open to revision and adaptation, and future research is needed to extend its applicability to diverse educational contexts.

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