

## SCIENTIFIC COMPETENCIES AMONG STUDENTS IN FLEXIBLE METHODOLOGIES AND REGULAR CLASSROOMS: AN ANALYSIS BASED ON CURRENT LEGAL REGULATIONS

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### Summary

The present article, the result of an exploratory study, analyzes the levels of development of students enrolled in the Learning Acceleration Program regarding the scientific competency Explanation of Phenomena, based on current legal regulations. The study focuses on programs that use a flexible curriculum methodology for overage students who are outside the formal school system, comparing their level of development in this competency with that of students from regular sixth-grade classrooms in secondary education. For this purpose, a theoretical analysis was conducted on two key categories related to the research problem: scientific competencies and learning acceleration. The study was approached from an interpretive paradigm and a qualitative research perspective, using a diagnostic test as the data collection technique. The results indicate that students participating in the Learning Acceleration Program exhibit lower performance in the area of Natural Sciences regarding the development of scientific competencies compared to students from regular classrooms.

**Key words:** educational model, competencies, natural sciences, flexible curriculum, Inclusive education.

### INTRODUCTION

Scientific and technological knowledge is as vital as scientific knowledge to develop competencies in students, and its teaching requires a deliberate basis (Yue, M., Jong, M.SY. & Ng, DTK, 2024), this knowledge, in the current educational context. has become an essential element for the functioning of modern societies and is part of the most important educational objectives of this century, because today more than ever it is necessary to promote and disseminate scientific literacy in all cultures and in all sectors of society. It is also essential to teach young people to understand their environment and to participate in social decisions.

This article makes a comparative analysis of the level of development of scientific competencies between students of learning acceleration (recognized in the legal regulations as flexible educational models MEF) and students from regular classrooms (who come from 5th grade of Basic Primary Education). MEFs in Colombia are immersed in current educational practices, which support the idea according to (Salinas, De Benito, & Lizana, 2014; Benítez, Santamaria, & Sotomayor, 2020) that students are the center of training and are managers of their learning and aim to achieve quality education for all, as contemplated by the Ministry of National Education (MEN) in the Ten-Year Education Plan 2016-2026, this quality is achieved, from a multidimensional construction, which is developed simultaneously and comprehensively through the strengthening of the cognitive, affective, social, communicative and practical dimensions of the students included in these programs.

In this order of ideas, it is important to highlight that the MEFs allow students located in the ranges of 9 and 17 years old and who, due to their age, are older to be in regular classrooms, to develop basic skills such as: interpreting, arguing and proposing in reading, writing and arithmetic; in accordance with the characteristics and conditions of the population served in order to maintain a coherent order between the educational, psychological and contextual needs of the individual through the pedagogical project strategy, which articulates the four basic areas of the curriculum interdisciplinarily.

In accordance with the above, for the MEN (2018), the MEF are a fundamental commitment within formal education with which it seeks to respond to the 4A's for accessible, affordable, acceptable and adaptable education, which guarantees the right to education and serves diverse populations or in vulnerable conditions, who have difficulties in participating in the regular educational offer due to various conditions, whether economic, economic, family and/or psychological. However, according to (Tenti, 2008 as cited in Calvo 2018) despite the flexibility and heterogeneity of these programs, as a strategy for the educational inclusion of young people, they are not the panacea for this purpose. Often, the young people integrated into them experience the stigmatization of belonging to this or that program, reinforcing prejudices and negative expectations on the part of all school actors (from students to families, including teachers and directors of the institutions).

### **FLEXIBLE MODELS OF EDUCATION IN COLOMBIA.**

According to Calvo (2018), MFEs arise with the firm purpose of socially including over-age young people in the education system, as well as the need to break with the homogeneous hegemonic model typical of the founding moment of modern education systems. With this objective in mind, several strategies have been explored in Colombia aimed at diversifying the offer (multiplication of modalities, routes, sequences and pedagogical methods, etc.), which allow offering various educational strategies, in a pertinent and differentiated way to a population group, within a specific context, which in this case corresponds to the flexible model called Learning Acceleration.

The MEF, called Learning Acceleration (AA), has immersed in its structure, principles of new school, in which, according to Khoa Vu et al. (2024), collaborative learning among peers is promoted (giving and receiving feedback, asking questions in class) and how these behaviors tend to persist in secondary education, as well as in the models according to (Filho, 1964; Narváez, 2006), four can be identified, namely: 1. Respect for the personality of the student or the recognition that he or she must have freedom. 2. Admission of the functional understanding of educational action from the individual and social point of view. 3. The understanding of symbolic learning in situations of social life. 4. The variability of the characteristics of each individual is assumed, according to family culture and belonging to neighborhood, work, recreational, and religious groups.

In this sense, it can be said that the MEF AA is a process of adaptation and viable educational innovation, aimed at promoting the integration into the school system of displaced and/or vulnerable and out-of-school children, which according to Narváez (2006), as a model based on the New School, seeks a pedagogical restructuring whose beginnings are considered to have taken place with authors such as Rousseau, Pestalozzi, Froebel, who tried to work pedagogy in a different way from the traditional one that operated at that time and who fought against the oppression of traditionalism by creating new pedagogical strategies that provided and took into account the need of the moment and the social conditions, from which education was approached as the space to guarantee an education that took into account the diversities and needs of students.

In accordance with the above, the authors Germán et. Al (2011), consider that the emergence of this school was: "an opposition to both the dominant movement of the time and the emerging school of the educational systems that emerged in modernity". The new school, as a new form of education, takes into account psychological, philosophical, sociological aspects, as a fundamental part in the humanistic formation of the individual (integral formation) not only in the cognitive, but in all dimensions of the being, where the importance of experiences to learn is highlighted, that is, knowledge does not only come from books (academic), but all practices of the being with its environment can yield learning experiences, which strengthen its formation.

In accordance with the above, it can be said that the MEF AA, according to (El MEN, 2010, Ortiz & Betancourt, 2020), is offered to overage students who have not completed their primary studies. The program is applied through projects that link the different areas and disciplines, and that put the student at the center of the teaching and learning process, with the firm purpose that they can develop, according to L. M. Ortiz-Calderón (2020), as well as the skills and abilities based on the concrete reality of the subject, beyond just explicit knowledge. basic competencies and that they remain in the following grades, the duration of the AA project is normally one year, during which time students develop a module that helps them to level up in the academic field and thus enhance their performance in main skills such as reading, writing and basic mathematics, likewise, the student accesses six complementary and interdisciplinary modules.

At this point, it is important to note that the learning acceleration model is neither lost nor repeated. At the end of the school year, students are promoted to the next grade, which corresponds to the sixth (6th) grade of basic secondary education, and the situations of difficulty that arise for the promotion of students must be defined by the Institutional System of Institutional Evaluation (SIEE). (MEN, 2010). In Colombia, Flexible Educational Models are formal education proposals that make it possible to serve diverse populations or those in vulnerable conditions, who have difficulties participating in the traditional educational offer. These models are characterized by having a conceptual proposal of a pedagogical and didactic nature, coherent with each other, which responds to the particular conditions and needs of the population to which they are addressed.

For the students of the acceleration program, it is evident to take into account the second concept, this due to the conditions of the context in which they develop and the affective needs that are strongly noticeable in behavior. This is how this strategy generates a positive impact on both the affective and cognitive parts, since students with affective needs tend to create a "protection" barrier to avoid being harmed, which prevents the teacher's access to motivate them towards learning.

According to the importance generated by the development of learning, the following must be taken into account for the process: the family context, of which, the author Valenzuela (2011) highlights its importance, considering the family as the first socializing agent, since it is within it where basic learning is acquired, such as: norms, values, motivations, among others. The Social Context, which according to Castells (2002), comprises a series of interactions between people and each of the historical, technological and cultural aspects that in one way or another contribute to the formation of a group of individuals who work for a purpose, that is, the social context generates an influence on the being in formation, At the same time that he gives of what he receives, therefore the in this context, exerts dominion over the construction of the individual, since he tends to replicate what he observes and to copy the acts of his environment. In this way, what the author García (2018) says, who considers that the individual action of each person implicitly entails a broader social behavior that transcends the individual subject and that in turn involves other members of the group.

## **SCIENTIFIC COMPETENCES IN THE NATURAL SCIENCES**

Competencies are defined by UNESCO (2017) as: The development of complex skills that allow students to think and act in various areas in this way, the acquisition of knowledge through action is promoted, the result of a solid base culture that can be put into practice and used to explain what is happening. In the same way, authors such as Gamboa, Lago, and Hernández (2020), assume competencies, as the set of actions that are carried out multidimensionally and in a complex way, with a certain objective within the reality of a context, complying with criteria of effectiveness framed by decision-making and foreseeing consequences, as well as authors such as Oyao K-Y. et al. (2025) consider the importance of these, since they must be developed so that students respond to risks through science: scientific knowledge, thinking, data-based inquiry, collaborative resolution and decision-making

For its part, science is, according to Toescu, E. C., & Tuboly, A. T. (2023) a complex social practice with values, contexts, institutions, and norms, as well as (Izquierdo 2000; Di Mauro, Fourman, & Bravo, 2016), is a human activity, which seeks to make sense of the world around us, according to

(Adúriz Bravo, 2005; Dimauro, Fourman, & Bravo, 2016) through theoretical ideas, but also traversed by expectations, values, ideologies, prejudices, and cultural biases, which are a group of knowledge and conceptualizations that has been generated throughout the history of humanity, as a process.

In accordance with the above, it can be said that scientific competencies are, according to (DeBoer, 1991; Dimauro, Fourman, & Bravo, 2016), as a know-how includes the set of skills and ways of thinking through which knowledge has been constructed. In accordance with the above, it can be considered that scientific competencies provide the skills that entail and promote a critical attitude towards real situations, which are linked to the context, establishing a reciprocal relationship between it and the student, since these have the purpose of promoting proven thinking, which allows the individual to contribute to the solution of problems within society.

For the formation of scientific competencies, culture must be taken into account as an inseparable part of societies, for this reason the processes that take place in them contribute to the development of these competencies, as long as the individual involved in these processes is able to establish a bond that allows him or her to develop critical thoughts that promote the transformation of attitudes of the members of society, favoring the growth of knowledge and creating reflective spaces that promote scientific awareness in favor of the development of scientific thought. Likewise, (Álvarez on 2011; Ortega, Passailaigue, Febles, & Estrada, 2017) consider that the development of these competencies promotes in students a significant learning of specialized knowledge and develops research skills, through the use of tools that allow them to design, propose, and execute projects using the results obtained to guide decision-making and solve problems in the context.

In this sense, the author Hernández (2005) establishes that every citizen of today's society must establish a relationship with the environment in which he or she develops that allows him or her to provide solutions to everyday situations, and thus obtain a good relationship with each of the members of the society in which he or she is, in such a way that every student who develops scientific skills must provide solutions to problematic situations in his or her environment. If this does not happen, we are very possibly facing failures in their internal structures of thought or failures in the educational processes experienced by them.

It is important that today's student, who is in contact with scientific advances, is prepared to face each of them, in order to contribute to the improvement of the quality of life, in this sense, the school must be the guarantor that citizens capable of facing the environment in which they live are formed. relate to nature, understand the phenomena that occur in it, develop life skills and promote its conservation, creating in the individual the awareness that sustainability is the means to have a good quality of life. In this sense, scientific competence (Cañal 2012; Pérez & Meneses 2020) facilitates the knowledge and use of processes necessary to approach the study of phenomena from a scientific perspective, the search and selection of relevant information and the production and evaluation of conclusions and arguments.

Likewise, it is considered that the development of scientific competencies, within educational institutions, should tend to the development of individual capacities that every person must possess to understand their environment, regardless of their role within society. As citizens, they would contribute to maintaining a pleasant and safe environment and in the same way the ability to respond to particular situations in their environment would be generated, creating an awareness of conservation and proper management of the world around them. In this way, schools will provide society with people who are aware of their role in nature and committed to its conservation and care.

According to Toro, Reyes, and Martínez (2007), scientific competencies develop skills such as: Comprehensive use of scientific knowledge that becomes evident when a student is able to use knowledge to solve a problem, followed by Inquiry, this competence is related to the individual's ability to reflect on his or her environment by asking questions about it and finally the explanation of phenomena, which is the ability of an individual to expose a natural situation based on concrete arguments, manifesting a reflective and critical attitude of the situation, which does not leave room for doubt.

In accordance with the above, it is necessary for the student to have the skills required to demonstrate in context, the competencies acquired and developed, which are evident according to (Barrios & Lozanos, 2018) through the following indicators: the ability to construct explanations, understand arguments and models that account for the phenomena, maintain a critical and analytical attitude that allows establishing the validity or coherence of a statement, explain the same fact using pertinent conceptual representations of different degrees of complexity, recognize that some situations are a consequence of others, use the information provided by texts, tables, to establish simple relationships between two phenomena according to causality criteria, among other aspects.

**METHODOLOGY**

The study was framed in the interpretative paradigm, which sought to understand the behavior of the people studied, qualitatively interpreting the results of one's own behavior, the behavior of the other and the objects that surround them, the qualitative epistemological approach accounts to a greater extent for the phenomena that are observed in a real context, direct source of information are the actors in the process.

In this way, the interpretative paradigm gave epistemological rigor to the understanding and description of the existing reality in the group of students studied, that is, it addressed a real phenomenon in the educational context, which transcends the social. Monje (2011) highlights that qualitative research tries to make an approximation of reality, to expose and describe it in an inductive way, that is, based on the knowledge that other people involved in it have. Likewise, according to McMillan and Schumacher (2005), this approach aims to conceive the perception, argument, and language of interpretation of the information collected and analyzed in the research process.

This study carried out an approach from an untreated or little-studied perspective regarding the level of development of scientific competencies of students who come from the MEF Learning Acceleration compared to students from regular classrooms, since from the literature there are studies corresponding to the program from the perspective of inclusion, from the development of writing and citizenship skills, but not from the relationship to the development of scientific skills.

For the development of the study, the following objectives were proposed: To characterize the population selected in the non-probabilistic sample from the sociocultural and economic factors. Determine the level of development of scientific competence of students in regular classrooms and Acceleration of learning. Determine the level of development of the living environment, physical environment and science and technology component. as part of scientific competencies.

For the purposes of the study, a non-probabilistic and intentional sample of 36 students was selected: 12 students from the acceleration program, 12 students with basic performance in the area of natural sciences and 12 students with superior performance, who were characterized sociodemographically and a questionnaire of questions based on the evaluation by evidence was applied. in which questions were raised from the three components of the Natural Sciences area, namely: Physical Environment, Living Environment and Science and Technology, each component was evaluated in separate sessions, according to the levels of performance presented by the students from regular classrooms.

**RESULTS**

The results obtained were organized as shown in Table 1, taking into account the purposes of the research work, the postulates of the theoretical framework and the actors involved in the process.

Table N1

Purpose	Results: Students from regular classrooms	Results: MEF Students: Accelerating Learning
To characterize the population selected in the non-probabilistic sample from the sociocultural and economic factors	The students in the sample come from an identical type of population, they are students from the same institution, residents of the Malvinas, Sourdis and El Bosque neighborhoods, considered within neighborhoods	The students in the sample come from an identical type of population, they are students from the same institution, residents of the Malvinas, Sourdis and El Bosque neighborhoods, considered within neighborhoods with a highly

	<p>with a highly vulnerable population, they are located in stratum 1, coming from families with a high degree of dysfunction, with a diversity of problems in the social context, unemployed or underemployed parents with limited resources.</p>	<p>vulnerable population, they are located in stratum 1, coming from families with a high degree of dysfunction, with a diversity of problems in the social context, unemployed or underemployed parents with limited resources.</p>
<p>Determine the level of development of scientific competence of students in regular classrooms and Acceleration of learning</p>	<p>Students from regular classrooms report that they have the following characteristics, which make evident the mastery of scientific competence:                  He is capable of constructing explanations.                  Understand arguments and models that account for phenomena.                  Maintains a critical and analytical attitude that allows the validity or coherence of a statement to be established.                  Explains the same fact using pertinent conceptual representations of different degrees of complexity.                  Recognize that some situations are a consequence of others.                  It uses the information provided by texts, tables, to establish simple relationships between two phenomena according to criteria of causality, among other aspects.</p>	<p>Students coming from Acceleration of Learning:                  Only 28% of students are always able to construct explanations from the phenomena observed in their environment.                  38% of students understand the arguments and models of natural phenomena.                  Regarding the critical and analytical attitude, it was found that 21% of the students always assume this attitude. Only 22% of students explain phenomena using different graphs.</p>
<p>Determine the level of development of the living environment component, as part of the scientific competencies.</p>	<p>In this component, it was evidenced that the students in this group have an advanced level of performance when it comes to understanding that living beings depend on the functioning and interaction of their parts, this is evidenced in:                  They are able to establish relationships between the respective concepts and the theme. They understand that living beings go through different stages during their life cycle, at an advanced</p>	<p>In this component, it was evident that 61% of the students in this group are able to construct an explanation for a natural event. Likewise, 49% of this group understand the arguments and models that support these phenomena.                  55% of students can be considered to critically analyze a statement to establish its validity.                  48% of the students always showed that one situation is a consequence of another.</p>

	<p>level, this they link to aspects of their own development.                  They face situations that lead them to understand that there are relationships between living beings and the environment and that they depend on it</p>	<p>It was observed that 47% of the students always use the information obtained from the texts to relate phenomena.</p>
<p>Determine the level of development of the Science, Technology and Society component, as part of the scientific competencies.</p>	<p>In this component, they have an advanced level of performance, this is observed when the student is able to:                  Understand how different objects work based on their uses and properties                  Assign the function to objects.                  It inquires about the understanding of the importance of human development and its effect on the environment.                  They are interested and committed to their actions on the environment.                  They value and understand the need to follow habits to maintain health since they know the implications of good habits to maintain good health.</p>	<p>According to the test applied, the following results were obtained:                  59% of students always construct explanations.                  Similarly, 61% of students always understand arguments and models that explain phenomena.                  It is evident that only 39% have a critical and analytical attitude to establish the validity or coherence of a statement.                  Similarly, 52% of students are able to explain the same fact using different representations                  It was found that 45% of the students use the information provided to establish causal situations.</p>
<p>Determine the level of development of the Physical Environment component, as part of the scientific competencies.</p>	<p>Students demonstrate a satisfactory level of performance in these concepts:                  They relate it to the activities of their daily life, which allows them to perform better.                  They are interested in understanding the difference between several/diverse types of machines and the different types of energy and their use, in this aspect the students evidenced a satisfactory level of performance however when it comes to understand that there is a great diversity of materials that can be differentiated from their properties, The level reached is minimal, although they identify the materials when it comes to talking about their properties, difficulties are evident in terms of the interpretation of the concepts.</p>	<p>Students coming from Acceleration of Learning:                  They have difficulty understanding the operation of some simple tools and the force-movement relationship, the operation and the difference between different types of machines, electrical circuits and that there are various sources and forms of energy that allow the operation of these with respect to regular classroom students.                  Most of the students of acceleration of learning have difficulties in recognizing the physical phenomena that occur on the surface of the earth, therefore, they are rarely able to recognize the way in which external and internal forces shape the relief of the planet and most of them barely understand that there is a great diversity of materials that can be differentiated from their properties. among them the states of</p>

		<p>matter, that is, solid, liquid and gaseous in the same way as students in regular classrooms.</p> <p>However, more than half of the learning acceleration group understands that there is a great diversity of materials that can be differentiated based on their properties, and compared to students in regular classrooms with both basic and superior performance they demonstrated better levels of comprehension</p>
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Table N1: Level of development of scientific competencies among students in regular classrooms and Acceleration of Learning. Source: Authors' elaboration (2023)

### CONCLUSIONS

From the above results, the following discussions and conclusions can be established:

The results obtained among students from Learning Acceleration show a lower rate in the development of scientific competencies, compared to students from regular classrooms.

This group of students, in terms of their ability to formulate questions, generate hypotheses and thinking skills are very basic, they find it difficult to express themselves in public, they present a high degree of fear of error and of being singled out, precisely because of the insecurity they feel of not having sufficient competencies, however, in the skills necessary for daily life they present a margin of advantage over regular classroom students. since the living conditions they have maintained have forced them to work in fields in which the other group has not participated, such as manipulating objects from their immediate context and giving an account of what they do.

The findings show the need to strengthen intellectual functions in students from Learning Acceleration, such as: attention, abstraction, ability to compare and differentiate, in addition, the reading and writing process, which is why reading comprehension can be affected; since they generally present more difficulties in these processes, which must be reinforced, in favor of a better academic performance of this group of students.

On the other hand, it was evidenced that, in order to develop Scientific Competencies in students from Learning Acceleration, it is necessary to rely on alternative didactic strategies of inquiry, from innovative actions of teachers through meaningful learning and cooperative work, strategies that promote student participation in the construction and appropriation of knowledge. The ideal is that new research generates studies that advance knowledge about new learning strategies and classroom alternatives that enhance the development of scientific competencies.

Likewise, in order to strengthen scientific competencies, educational institutions must approach the teaching of natural sciences from everyday situations, based on what happens in their real and close context, providing it with arguments, theories and laws that support the explanation of this, in this way that a critical attitude is fostered in students. this with the purpose of training individuals with the skills to face the challenges of today's life.

Scientific competencies are manifested at different levels, and that in each of the individuals of each group they develop according to different states of appropriation of information, according to different biological, cultural, social and economic factors and institutions must strengthen their implementation and development, since these are fundamental in the construction of school science and therefore, they allow us to highlight new features in the orientation of the teacher's work and the student's participation in the construction of knowledge.

In educational institutions, the impact that is generated in a student from Learning Acceleration when entering the regular classroom must be analyzed, where they go from having one teacher to having several, from working through projects and for days to working by areas and subjects, where

methodologies vary according to the teacher and are in a classroom where most students are chronologically younger than them and have in most cases a superior performance in the basic subjects.

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