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PROPUESTA PARA EL FORTALECIMIENTO DE LOS SEMILLEROS ESTUDIANTILES DE CARÁCTER CIENTÍFICO TECNOLÓGICO. ESTUDIO DE CASO: SEMILLEROS, DEPARTAMENTO DEL META, COLOMBIA

PROPOSAL FOR THE STRENGTHENING OF STUDENT NURSERIES OF A SCIENTIFIC AND TECHNOLOGICAL NATURE. CASE STUDY: SEEDBEDS, DEPARTMENT OF META, COLOMBIA

Daniel Humberto Rodríguez Ríos[1]

Abstract:

The objective of this article is to reflect on a proposal to strengthen research seedbeds in the Scientific and Technological field of students in secondary and secondary education in the department of Meta, Colombia. This development occurs from the identified variables: seedbed management, the development of scientific-technological talent, the role of the teacher and the scientific-technological competencies of the students; The research, methodologically, addresses the positivist paradigm with a quantitative approach, through the collection of information with a survey technique applied to 36 teachers immersed in the investigative processes in the public educational institutions of the municipality of Meta, Colombia. Once the field work has been completed, the statistical parameters and their corresponding analysis of results have been applied, the conclusions show that, in the Seedbed Management variable, subcategories C and D (ICT Application), have higher percentages in the "regular" categories. " and "insufficient"; As the second variable analyzed, Development of Scientific and Technological Talent, subcategory C (application of ICT), has a higher percentage in the "regular" and "insufficient" categories, relevantly; Now, in the variable about Teacher Role, the results in this category ranged between "regular" and "poor", the relationship with the context, the little attention to the needs and the difficulty of the teacher for development are evaluated as weak. in students of Scientific and Technological Competencies. Finally, the variable Scientific-Technological Competencies, the general measurement for this category ranged between "regular" and "poor", it is noted that most of the projects are weakly articulated with the context. Consequently, the importance and relevance of the proposal raised on the strengthening of scientific-technological seedbeds to impact the population under study is validated.

Keywords: seedbed management, development of scientific-technological talent, role of the teacher, scientific-technological competencies.

Resumen:

El presente artículo tiene como objetivo realizar una reflexión sobre una propuesta para el fortalecimiento de semilleros de investigación del campo Científico Tecnológico de los estudiantes en educación secundaria y media del departamento del Meta, Colombia. Este desarrollo se da a partir de las variables identificadas: gestión del semillero, el

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desarrollo del talento científico tecnológico, el rol del docente y las competencias científico-tecnológicas de los estudiantes; la investigación, metodológicamente, aborda el paradigma positivista con enfoque cuantitativo, mediante la recolección de información con técnica encuesta aplicada a 36 docentes inmersos en los procesos investigativos en las instituciones educativas púbicas del departamento del Meta, Colombia. Superado el trabajo de campo, aplicados los parámetros estadísticos y su correspondiente análisis de resultados, las conclusiones dan cuenta que, en la variable Gestión del Semillero, las subcategorías C y D (Aplicación de TIC), tienen porcentajes más altos en las categorías "regular" e "insuficiente"; como segunda variable analizada, Desarrollo del Talento Científico y Tecnológico, la subcategoría C (aplicación de las TIC), tiene mayor porcentaje en las categorías "regular" e "insuficiente", de manera relevante; ahora, en la variable acerca de Rol del Docente, los resultados en esta categoría oscilaron entre "regular" y "deficiente", se evalúan como débil la relación con el contexto, la poca atención a las necesidades y la dificultad del docente para el desarrollo en los estudiantes de Competencias Científico Tecnológicas. Finalmente, la variable Competencias Científico- Tecnológicas, la medición general para esta categoría osciló entre "regular" y "deficiente", se señala que en su mayoría los proyectos se articulan de manera débil con el contexto. En consecuencia, se valida la importancia y pertinencia de la propuesta planteada sobre el fortalecimiento de los semilleros científico-tecnológicos para impactar la población objeto de estudio.

Palabras clave: gestión del semillero, desarrollo del talento científico tecnológico, rol del docente, competencias científico-tecnológicas.

1. Introduction

The strengthening of research seedbeds in the Scientific and Technological field (hereinafter S&T) of students in secondary and secondary education has become a fundamental pillar for educational development, especially in a world driven by constant and rapid technological advances. In this sense, this research describes and contextualizes the essential role that S&T research seedbeds play in basic and secondary education in the department of Meta - Colombia; evidencing its importance, scope, influence and requirements for the comprehensive training of students.

For expert researchers in S&T [1], the main, among others, leverage factor towards growth, economic development and competitiveness in the current globalized world, regardless of latitude, industry or economic activity, is without a doubt the adoption of programs investment in S&T. This is because the current value chains, both in their primary and secondary or support processes, have systematically replaced manual processes that add little or no value to operations.

According to the report reported in 2021, in the midst of the global Pandemic, the BBVA Financial Group and the Superintendence of Industry and Commerce, SIC, [2], investments in S&T with high content in innovation, facilitate the generation , not only competitive advantages (between organizations) and comparative advantages (georeferencing), but a positive impact on communities and various actors, State, company, academia, therefore greater investment in research and development (R&D), leads to more productivity and therefore, more resources for research.

Without a doubt, this development and economic growth, worldwide, was permeated and eroded by one of the main challenges that humanity recently experienced, with the appearance of the Covid-19 virus, since it has imposed challenges on all economic activities and, in many cases, have seen the need to adapt their productive activities by implementing the methodology of teleworking, working at home and, even, as an alternative to educational alternation between face-to-face and virtual reality in any geographical and economic context from where it is addressed, the new platforms or ICT, belonging to the new trend or Industry 4.0, to face the new world scenario, without risking its productive capacity or sacrificing collaborators [3].

In this way, research groups at the national level, including seedbeds, must bet on Industry 4.0, which has been transforming the ways of approaching different activities, from which the educational sector and the relations of users are not exempt. actors of the academic event. In this sense, it is pertinent to consider how Industry 4.0 has permeated educational institutions (I.E) through the incorporation of ICT to carry out educational and administrative support practices with greater productivity. To do this, it resorts to the unification of the advantages of all types of technologies so that they can be used by institutions, in such a way that they are combined to facilitate the teaching and learning process for teachers and students [4].

Although new fields of knowledge have been developed from R&D for the training of professionals within the framework of Industry 4.0, it

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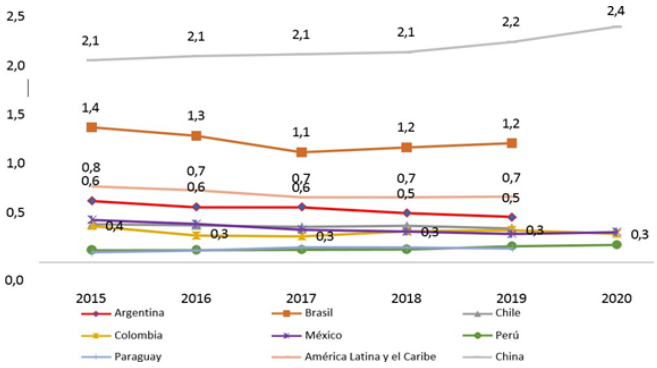
cannot be ignored that all professional careers must somehow enter the spectrum of S&T for the development of skills. And skills required by the labor market [5].

In this sense, no knowledge discipline is exempt from the inclusion of ICT and S&T innovations, which is why there is a significant number of investigations in the international context about the characteristics, benefits and restrictions offered by the sector or industry. 4.0 classified as an international sector; Secondly, but more recently, the last decade, interest has been expressed from academia in addressing this Industry in its academic impact and, in a very particular way, applied to research teams, in the case of seedbeds that, at Within the I.E, they have been betting on projects based on S&T, immersed in Science, Technology, Society (STS) studies [6].

But this growth and economic development is not exclusive to rich countries; on the contrary, assuming R&D processes in an increasingly globalized world means that this decision is not discretionary; it involves third world and emerging economies of which the countries of the Region, Latin America and of them Colombia, are no exception. In fact, if the statistical reports prepared by the World Bank are analyzed for the five-year period 2015-2019, in the midst of the global pandemic caused by Covid-19, the following figure number 1 shows the statistical behavior, respect to the Gross Domestic Product (GDP) that was presented in Latin America for that period [7].

Figure 1. Statistics on investment in R&D, period 2015-2019, Latin America



As can be seen in the previous illustration, in terms of the R&D budget, Colombia reflects a behavior over time that is lower than the records of peer countries in the Region. Hence, if a comparative analysis is carried out with countries that claim to be economic powers, such as China, the difference is completely adverse, in terms of R&D as a percentage share of GDP for Colombia and other countries.

Faced with this scenario, the Region in general is increasingly aware of the urgency in terms of investment in S&T, but not in an atomized way as it has historically been developing, on the contrary, transcendental decisions regarding investment in S&T , demand joint work between the State, the business sector and the academy, the latter curricularly adopting entrepreneurship programs and stimulating the generation of investigative work teams in S&T, which for the case under study, are the research hotbeds invited to generate value in this research value chain towards competitiveness and economic development.

In this sense, Latin America lacks at least one hundred and twenty thousand (120,000) engineers or scientists who supply the global demand in fields such as software development, 3D printing, Big Data and other disciplines associated with the technological field that, since Then, they decrease the transformation that is required for the economic development of nations [9].

Under this context, [10] research hotbeds constitute special learning environments, conducive to identifying and consolidating research vocations, either in a general way or in a specific field. These groups, made up of research teachers and students, seek to address problems or delve into new fields of knowledge. This approach promotes the development of S&T skills, as well as the creation of coherent connections between constructed knowledge, context, interests and learning needs.

Work groups or seedbeds in various regions have played a fundamental role in personalizing teaching and reintegrating those previously excluded into the educational system; However, studies such as the UNESCO report on science towards 2030 highlight the main challenge in the Latin American region, which is to promote a culture of research in new generations to strengthen long-term relationships between university, state and company. This report highlights a serious shortage of S&T skills at all levels, deficiencies in science teaching in educational centers, lack of qualified teachers and appropriate curricula, among other problems [11].

In international UNESCO reports, they highlight the need to focus on education that focuses on the person, their talents and abilities; Thus, they highlight the urgency of reducing the deficit of researchers and promoting the development and investment in teaching processes that

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are based on the discovery and empowerment of life projects framed in S&T [12].

At the national level, it is of utmost importance to recognize the strategy articulated around the Colombian Network of Research Seedbeds (RedCOLSI), which has focused its efforts on enhancing the intellectual production of its participants through the creation of magazines, books and events, with the aim of continuing to support the research work of young entrepreneurs in the RedCOLSI Foundation, however, despite the impact on the country's scientific culture, this initiative has focused on the university population, neglecting the advances that could take place in basic and secondary education. Therefore, it is imperative to address and support the resolution of problems at these educational levels [13].

From the Ministry of Science, Technology and Innovation, Minciencias (formerly Colciencias), the Young Researchers and Innovators program has emerged. This program has facilitated the participation of young people in the scientific field, seeking that future professionals graduated from the country's universities, through research activities, acquire skills and knowledge in S&T [14]. However, this approach does not address education at secondary and middle levels, leaving a gap in the formation of fundamental seeds.

In this sense, and returning to the Ondas program, according to the MEN, considered an initial strategy to involve the school population in scientific activities, it set the objective of promoting Learning Communities (CdeA) where research topics are addressed; This formulation of projects and their respective dissemination of scientific knowledge has presented various problems, that is, they do not focus on the development of strategies for S&T vocations among boys, girls, adolescents and young people (NNAJ), research is highlighted as activities margin of a project that does not follow up and approach with respect to cognitive and social progress that allows articulated positive impacts on students [15].

From the above, this academic exercise seeks to reveal the complexities and nuances of the problems identified in relation to the research hotbeds, so through immersion in the experiences of the participants, teachers from the department of Meta, Colombia, assigned to the I.E of the public sector, we seek to understand the nature, frequency and depth of the challenges that students face in the development of S&T competencies in the educational environment, based on the information provided by the teachers of this discipline themselves.

In summary, this document aims to address these issues, providing a holistic vision of the importance of S&T competencies in education, its application in the training of students and its impact on the current knowledge society. To this end, an analysis of the dimensions immersed in the management of seedbeds in the S&T field, the role of the teacher, the development of talent and S&T competencies are addressed from a specific point of view; Likewise, a diagnosis, based on the teaching team, of the same previous variables; Finally, a characterization of the dimensions to be adopted in the proposal that strengthens the management of seedbeds in the S&T field in the same analysis variables.

2. Development of the theme

2.1 Conceptual bases

2.1.1 Research hotbeds in the scientific-technological (S&T) field.

The first category of Seedbed Management [16] studies coincide in pointing out the importance of managing research seedbeds and establishing management models that unite the institutional, social and cultural context, the actors and the efficiency of the processes. Now, curricular development and its harmonization are fundamental aspects for the interconnection of the different areas that make up the curriculum in the S&T field. The basis of comprehensive communication between these areas is crucial to achieving institutional objectives. To achieve this, it is essential that the mission, vision, horizon and training purposes are coherently integrated into the practices of students and teachers.
In this aspect [17], the Research hotbeds in Colombia, Chile and Brazil began under two determining factors; the first based on the research given when the pioneer members of the hotbed chose objectives corresponding to study phenomena, in this case they concentrated on the analysis of problems derived from the professional field and related to theoretical perspectives derived from the same debate of the hotbed.

2.1.2 Development of talent in science and technology (S&T).

It is necessary to take into account the theory of multiple intelligences. Sternberg and Lubart and the postulates of the triarchic theory of intelligence, Perkins, and the theory of intelligent learning who agree that the development of talent in Science and Technology requires a holistic, multi-dynamic approach that considers the design of learning environments to be fundamental. Learning for talent development [18].

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Along these same lines, Bautista and García recognize that the training of talent for innovation and linkage requires models that could be equated to propellers and that are based on the knowledge society. These models directly affect the macroeconomic environment and a country's ability to generate development. Scientific and technological talent is a variable highly correlated with social development, and in turn, acts as a stimulus for the economic growth of nations. This is because a higher level of competitiveness tends to generate greater economic growth [19].

2.1.3 Talent and competitiveness.

The non-development of talent or the lack of attention to its cultivation can cause the migration of talented individuals, resulting in the so-called brain drain, a fact investigated by those who associate it with the loss of human capital and productivity in the country of origin, such as exemplified by the United States in the 1990s, when it imported highly skilled workers, mainly from India, through H1-B visas in high-tech sectors, generating significant impacts in various economic spheres [20]. In terms of areas of knowledge, migration mainly affects those who carry out research related to high technology, such as engineering, biomedicine, neurology, mathematics and, in general, cutting-edge sciences [20]. The Global Talent Competitiveness Index is proposed and highlights the importance of competitiveness as a key component of the economic development of countries. It highlights the need to nurture talent and establish conditions that encourage their efficient activity to achieve long-term economic sustainability around the world [21]. In this sense, an exhaustive study developed by multiple organizations analyzes 132 economies, including a study at the city level. Among major economies, it is common to find programs dedicated to the identification and development of talent, allowing them to strengthen a person's skills. However, the difference lies in the moment of identifying talent; Some countries do it at higher or postgraduate stages, without guidance or specific care, while other nations, such as China, implement rigorous public policies to identify and strengthen scientific and technological talent from early stages, integrating it into their national education system. , Science and Technology.

2.1.4 Role of the teacher.

Approaches are used that point out the importance of the teacher's role as a key element for teaching science and technology; their abilities to guide students in the development of research projects and their actions as a role model in the research process and overcoming obstacles [22]. From this point, crucial elements are presented for the development of scientific and technological competencies in research hotbeds, seeing these as a feasible environment to develop skills such as problem formulation, information search, data collection, analysis of data and report writing, among others [23]. The leading teacher of the hotbeds of the scientific-technological field not only transmits knowledge, but acts as a facilitator of learning, creating environments conducive to experimentation, discovery and problem solving. This teaching figure plays a fundamental role in encouraging the investigative spirit and the use of technology as a tool for exploration and learning. It stimulates critical thinking and problem solving, in addition to promoting the application of knowledge in real contexts [24]. In summary, the role of the teacher in the field of Science and Technology (S&T) is fundamental to identify and guide talented students in scientific and technological research. To do this, a series of key actions are required, first; The teacher must have the ability to identify those students who stand out for their skills and talent in the scientific and technological field. This process may include classroom observation, dialogues and recommendations from other teachers, administration of tests or evaluations to detect their research potential. In addition, it is essential that the teacher designs a structured and detailed work plan for the research seedbed; this plan must include clear objectives, specific activities and defined deadlines. It should be challenging but achievable to motivate students to overcome obstacles and achieve meaningful goals in their research projects. To carry out scientific and technological research, it is important that students have the necessary resources. The teacher must ensure that they have access to laboratories, specialized equipment, reading material, scientific journals and online databases.

The development of scientific-technological competencies and the consolidation of a scientific culture in the school environment, these competencies involve skills, knowledge, attitudes and values essential to understand, use and participate critically and creatively in the field of science and technology [16]. These skills are aimed at meeting current demands and promoting the comprehensive training of people. The characteristics that define training in S&T competencies, in accordance with contemporary demands, include, especially, solid scientific knowledge, that is, understanding the fundamental concepts, principles and theories in S&T, staying updated to address current and future advances, Likewise, creative and innovative thinking that encourages the generation of original ideas and the proposal of innovative solutions in science and technology [25].

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Scientific-Technological Competencies (SCT) involve the application of knowledge, methodologies and tools, combining digital and technical resources, scientific knowledge, research and information management to solve problems. These competencies, applied in school research seedbed actions in emerging areas such as biotechnology, energy efficiency, nanotechnology and others, strengthen school culture [26].

Training in scientific and technological skills cannot be separated from the technological skills necessary for the knowledge society, where the volatility and speed of advances require updated training. The effective use of technological resources stimulates learning in line with current demands. Scientific competence requires not only basic digital skills, but also the ability to consciously manage technological resources, allowing a true integration of TAC (Learning and Knowledge Technologies) [27].

2.2 Legal bases

Of the different regulations that support research processes, El Conpes 4069 is a public policy document generated in September 2022, which contains the National Science, Technology and Innovation Policy (CT&I) for the period 2022-2031. The document establishes the general guidelines for the development of ST&I in Colombia. In relation to the strengthening of scientific vocations, El Conpes 4069 proposes promoting S&T culture from basic education, proposing the implementation of scientific and technological education programs in schools, the promotion of extracurricular S&T activities, and the training of teachers. In this discipline. In this sense, El Conpes outlines actions to identify and support students with potential for science and technology, through the implementation of scientific and technological talent identification programs, and the offer of enriched and challenging learning opportunities for students with potential, likewise this document encourages the participation of women and young people in science and technology through participation in groups and seedbeds [28].

2.3 Findings

2.2.1 Data analysis techniques

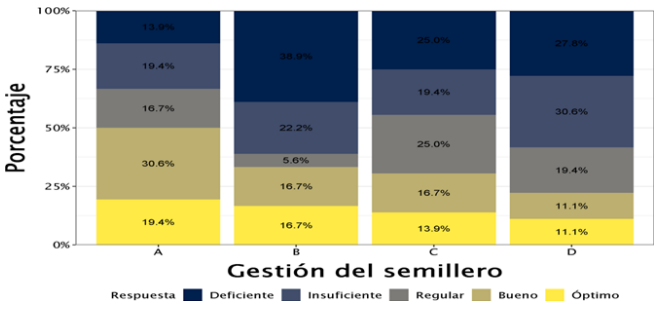
64 Kruskal-Wallis H tests were applied using the R statistical package. These tests were used to establish associations between the survey statements and the descriptive variables of the sample. Kruskal-Wallis tests were used due to the non-parametric nature of the data and allowed significant differences between groups to be identified. Post hoc Dunn's multiple comparison analyzes were also performed using the FSA package. These comparisons allowed us to identify specific differences between the groups in the Kruskal-Wallis tests.

Finally, the survey data are represented in an absolute frequency matrix to perform a simple correspondence analysis (CA) based on the X2 distances (Euclidean distances) between the counts. In this matrix, the rows contain the response categories (5), while the columns house the 16 statements, questions. The AC results are described and analyzed based on contributions per column (variance/columns=20) and row (variance/rows=6.25). This analysis provides information about the relationships between response categories and statements, questions.

- **Seedbed Management (1)**

On the other hand, the perception of Seedbed Management (1) shows a more equitable distribution between the "Good" and "Fair" classifications. Finally, the categories Teacher Role (3) and S&T Competencies (4) present a greater proportion of opinions classified as "Good" and "Fair", respectively. Unfavorable opinions, that is, "Deficient and Insufficient", only exceeded 50% in the S&T Talent Development category.

Figure 2. Frequency distribution of the seedbed management category



Source: own

- **Development of Scientific and Technological Talent**

Figure 3. Frequency distribution of the category development of scientific and technological talent
Source: self made

As can be seen in Figure 3, in relation to the Development of Scientific and Technological Talent, the perceptions indicate shortcomings, which is why the teachers agreed that there is little support for the development of inter-institutional and interdisciplinary processes; This aspect is in a

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"Deficient" margin, training in talent development is required, the few resources of the institutions are tried to be used for the development of learning processes but the gaps in knowledge of strategies for S&T talent with students They are vital and would help to carry out the characterization necessary for this purpose.

From the above, the perception is regular with 38.89%. This fact is also related by teachers to the need to know mechanisms for monitoring students and strategies to obtain better support from parents, since problems are evident in relation to difficulties in fluid communication oriented to achieving objectives. of the project with parents.

- **Role of the teacher (3)**

Figure 3. Frequency distribution of the category development of scientific and technological talent

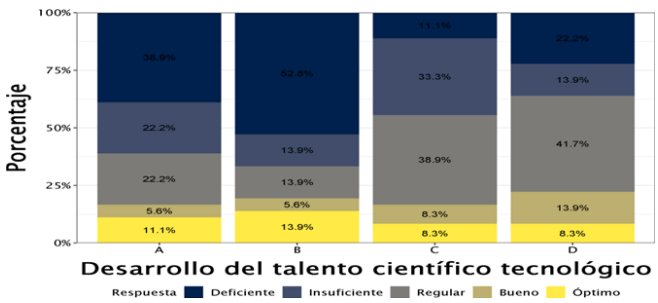

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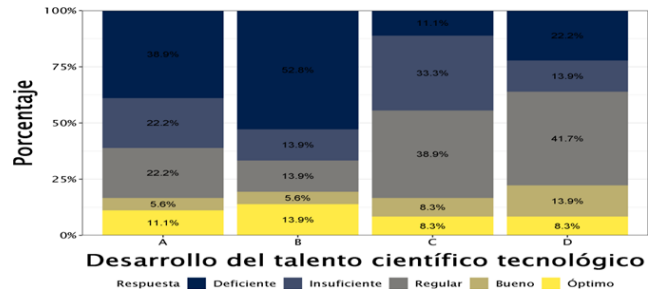
Figure 4. Frequency distribution of the teacher role category



Source: own

As can be seen in Figure 3, in relation to the Development of Scientific and Technological Talent, the perceptions indicate shortcomings, which is why the teachers agreed that there is little support for the development of inter-institutional and interdisciplinary processes; This aspect is in a "Deficient" margin, training in talent development is required, the few resources of the institutions are tried to be used for the development of learning processes but the gaps in knowledge of strategies for S&T talent with students They are vital and would help to carry out the characterization necessary for this purpose.

From the above, the perception is regular with 38.89%. This fact is also related by teachers to the need to know mechanisms for monitoring students and strategies to obtain better support from parents, since problems are evident in relation to difficulties in fluid communication oriented to achieving objectives. of the project with parents.

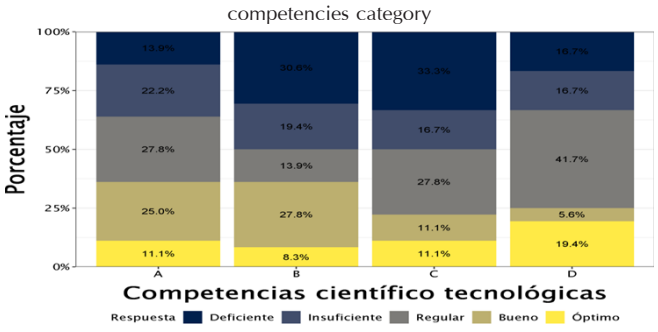
- **Role of the teacher (3)**

As recorded in the previous figure, in relation to the Role of Research Teacher, the perception is varied, from 25% it is observed that training and training is good but sporadic to the extent that it is the teacher himself who is strengthened. in the themes of the project and with this seeks better forms and strategies of organization with its students; However, this perception is not sufficient due to the limited time available to teachers; The pedagogical and administrative management of the academic assignment sporadically allows them to have time to dedicate themselves to training for this area.

30.6% evaluate this perception as deficient. In summary, the leading teacher or leading teachers have few defined strategies for the communication of results and development of learning activities, which is why S&T products are not considered visibility focused on the social appropriation of knowledge, said production is perceived as 33.33% regular.

- **Scientific Technological Competencies.**

Figure 5. Frequency distribution of the scientific and technological competencies category



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As seen in the following figure 5, the general perception for this category ranged between "Regular and Deficient", as the majority agreed that the projects are organized and articulated in a weak way with the context, and little needs of this context are addressed. , which hinders S&T development in students; Like training in S&T disciplines, there is little proximity and methodological development with the use of ICT instruments and students' capabilities for the use and administration of web content systems, virtual training platforms and/or software are not deeply developed. , management of tools for searching and confronting and validating information.

In the best of cases, students are consumers of information and not prosumers, groups that have few communication mechanisms for the development of their respective efforts that show improvement in S&T competencies, the lack of support is emphasized; a perception of regular 41.67% is highlighted.

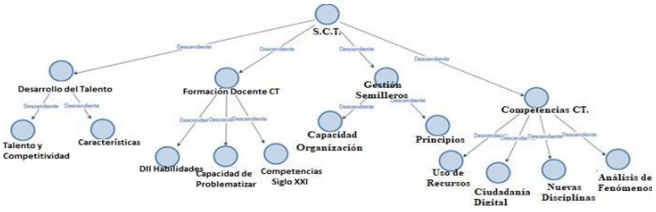
Finally, a synthesis of the main elements addressed in the proposal on strengthening and management of seedbeds is presented.

	Seedbeds Research Department of Meta	

- **Stage I. Preliminaries**

he pedagogical proposal towards the strengthening of S&T research seedbeds constitutes one of the main pedagogical strategies of the educational institutions of the department of Meta, created for research teachers to promote the development of the research culture1, in order to know, understand and transform the development of their environment, both social and academic, in the Region and the country. Therefore, to address this proposal from a methodological point of view, the categories on which said proposal or project is structured were established, in this case they are organized into: Scientific Technological Talent (S&T), Teacher Training for Science and Technology, The Management of School Seedbeds and Scientific-Technological Competencies, as seen in the following illustration.

Categorization of School Research Seedbeds



Source: Nvivo 12 Software development.

Operating model of the S&T research hotbeds

López (2015) states that the concepts of both CdeA and Dialogical Learning have been investigated by CREA through numerous studies based on educational theories and practices; these investigations are based on participatory methodologies in which research seedbeds are given special importance in their S&T practice [31].

Está sustentado en el concepto de las Actuaciones Educativas de Éxito (AEE). Se entiende por AEE aquellas acciones exitosas que se orientan para estimular el aprendizaje y el desarrollo de habilidades y que además contribuyen a la transformación social y la superación del fracaso escolar en las instituciones educativas que gestionan semilleros de investigación a partir del proyecto de CdeA. Es así como el proyecto de investigación incluD-eD (estrategias para la inclusión y la cohesión social en Europa desde la educación, 2006-2011), logró identificar algunas acciones concretas que contribuyan a superar las desigualdades y fomentar la cohesión social, tal como se aprecia en la siguiente ilustración.

Successful Educational Actions



Source: [31]

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The EEE, at the same time, are grouped into two large blocks: inclusive actions and participation of families and the community and are determined by the following subcategories:

Dialogical teacher training: whose purpose is aimed at the training and updating of managers and teachers in the most relevant educational theories and research in the international scientific community, therefore the success of this activity lies in the apprehension of knowledge generation to provide S&T rigor to the educational practices of the teacher in his pedagogical work, in such a way that he manages to generate significant learning in his students (previous knowledge plus new knowledge).

- **Stage II. Manual for strengthening Seedbeds in S&T**

Title of the Proposal

	Manual for strengthening Seedbeds in S&T	

Strengthening the Scientific and Technological Seedbeds of basic and secondary education schools in the department of Meta.

Justification of the Proposal

Colombia has been described as one of the countries with the greatest inequalities on the continent and in the entire world. To try to mitigate and reduce these levels of social inequality, many strategies can be developed, one of them is education with high levels of quality, since by giving young people the possibility of having teachers sufficiently prepared to welcome students of different cultures, capacities and social contexts, it is possible to have keys to advance towards more just, democratic and cohesive societies (UNESCO, 2022).



Teleological Elements

- **Mission**

Semillero Meta seeks to promote the investigative spirit of its members, who are part of the official educational institutions of the Department of Meta. In this way, it seeks to generate in them a process that seeks to develop research skills that enable the production of knowledge in the disciplinary field of Science and Technology (S&T), under the precept of Social Responsibility and articulated to the Communities Project. of Learning and Science, Technology andSociety (STS).

	Aspects to strengthen in the various S&T research variables	

- **Vission**

Semillero plans to achieve recognition at the regional, national and international level, through the design, development and execution of scientific research projects based on the disciplinary field of Science and Technology (S&T), under the precept of Social Responsibility and articulated to the Learning Communities and Science, Technology and Society (CTS) Project, under the institutional vocation of training comprehensive professionals with critical, analytical, ethical, creative and innovative thinking.

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General Objective of the Proposal



Offer strategies that strengthen the Scientific and Technological Field seedbeds in basic and secondary education schools in the Department of Meta, articulating curricular, pedagogical and didactic aspects in the institutions with the groups based on the strengths and needs of the contexts.

Specifics:
Raise awareness in the I.E of the need to apply curricular development strategies, resignification of the PEI, and Didactic Strengthening and S&T.
Develop training processes in curricular and pedagogical aspects, based on the execution of a Diploma in S&T Development.
Generate sustainability plans and articulation with the territorial vocations of institutions and communities that guarantee the institutionalization of projects.

Roles establecidos

- Advisory professor/researcher

He is a full-time teacher (if possible) of the public I.E of the Department of Meta, in charge of accompanying and guiding students in their projects and research activities, and of representing the seedbed before the representative bodies in matters that the student coordinator cannot assume.

- Student Researcher/Coordinator

Its main function is to maintain contact between the seedbed and the representative bodies of the University's seedbeds, attending scheduled meetings and disseminating information of general interest to the seedbed that is made known from these bodies. Likewise, he is in charge of delivering the information that they need.

- Student Researcher/Members

They are the students who are carrying out projects or other research activities within the seedbed and there must be at least four for the seedbed to be taken as such. Each seedbed can have the number of members it considers necessary to develop its activities and is free to make calls for the selection of new participants. The student coordinator also enjoys the status of member of the seedbed.

- Coordinating committee.

The Coordinating Committee operates as a body delegated by the General Assembly of Coordinators, whose powers, among others, are to promote the programs that are generated within the seedbeds in each of the public
I.E of the department of Meta and represent the themselves in the investigative events and processes that are underway or potentially to be implemented and must provide a work plan with emphasis on S&T and with social impact.

Tactical objectives of the Seedbed

In relevance to the institutional vocation, strengthen the structure of the research system with emphasis on S&T by promoting the creation of seedbeds and strengthening them.
Promote formative research and research itself among students of any of the I.E. of the Meta department.
Facilitate collaborative work in all active members of the group through spaces inside and outside the classroom that contribute to the development of a learning culture through dialogic practices typical of Learning Communities.
Consolidate the academy-research-State-business relationship, promoting multidisciplinary interaction of students, professors, researchers and businessmen.
Promote a research culture in each I.E. of the public sector through the creation of spaces that bring students closer to research with an emphasis on S&T, not only with purely academic objectives but as an alternative for employment-generating entrepreneurship

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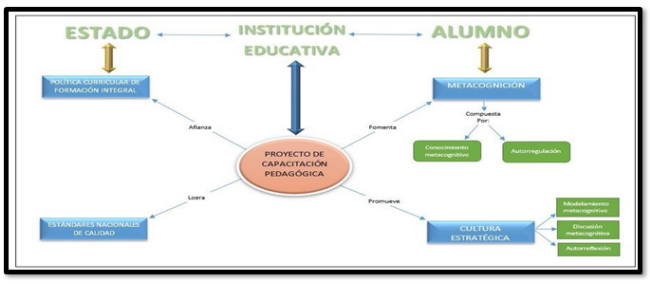
- **Variable II. Teacher's Role**

In this sense, reference is made to the knowledge society and its management, since the production of knowledge and pedagogical knowledge, according to research by Colombian university professors, largely supports the design of curricular plans which demand a management in its transversality and coherent with the competency training of teachers; In other words, the production of knowledge is put at the service of training, both undergraduate and postgraduate. A second aspect to strengthen lies in the solid formation and adequate training in the curricular, pedagogical, didactic and disciplinary of the S&T field, this will allow them to guide students in their learning processes, providing the necessary guidance so that they develop their skills and competencies in this area. Consequently, the basic concepts for the training proposal are presented below.

- **In-service and/or continuous training.**

Situated training refers to the training of teachers in the context of their own teaching practices. This training is carried out in a realistic environment and through observation, reflection and interaction with students, allowing teachers to recognize their own practices and improve them to achieve better results (MEN, 2011), therefore, the Colombian State includes, within its educational guidelines, a curricular policy where the comprehensive training of the student is the main objective of any educational process (MEN 1994), which is corroborated with the new Skills Training policy inspired since 2006 by the MEN.

CEM pedagogical training project



Source: [32]

The strengthening of S&T Talent must begin with the ability to detect talent. This requires being able to recognize the set of skills and competencies that make people creative, innovative and efficient. These characteristics can be observed from an early age. , so it is important to detect and strengthen it in basic and secondary education. In this sense, clear and profound guidelines are required on how to determine S&T skills in students. Likewise, for detection, the set of attitudes that students show towards science and technology, as well as S&T thinking, must be analyzed. . The development of S&T talent has several perspectives, one of them is reflected in the result of the students' academic progress; this indicator can have a direct relationship in the areas of science and mathematics. In this line, standardized tests and extracurricular activities are recommended for measuring S&T talent; such as science and technology clubs, science fairs and camps in this discipline. For the above, it is vital that teachers not only know in depth the theories of talent development, the skills and competencies necessary to guide students in their learning of science and technology. Teachers can participate in S&T education and training programs.

- **Variable IV. Scientific-Technological-S&T Competencies**

In science and technology research hotbeds for the development of scientific-technological competencies, mechanisms are required that lead to the development of scientific skills in students to participate in relevant research projects and contribute to the development of S&T knowledge. These competencies are The teacher's aim is focused on the design of environments for the recognition of technological, communicative, digital, investigative and informational skills, so that said training allows motivating students to develop research and projects based on new scientific and technological disciplines [33].

Krishnaratne et al. (2013) and Glewwe et al. (2011) discover that the actions that most impact the performance of young people in school tend to be those that tend to improve infrastructure and resources in educational materials and those that seek to improve teaching quality through in-service teacher training. and pedagogical support.

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Now, in order to stimulate the generation and strengthening of S&T Research Seedbeds, the Department of Meta, in association with the Institutions of the official sector and other interest groups, establish the following stimuli.

	Stimuli to the I.E. Seedbeds, Department of Meta	

- **Aim**

Strengthen, consolidate and promote the academic quality of research hotbeds through a system of incentives and recognition for the students and professors who participate in them and for their groups.

- **Types of recognition**

to. Financing for small research projects
b. Annual Research Award. participation in interdisciplinary research networks in relation to the development of the project
c. Support for the dissemination of research results derived from the work of the seedbeds and. Scholarship for research excellence Annual mention for outstanding seedbed
d. Training and assistance to graduates.

Possible topics for Semilleros "Meta" training

- Strengthen, consolidate and promote the academic quality of research hotbeds through a system of incentives and recognition for the students and professors who participate in them and for their groups.
- Artificial intelligence
- Dynamics of technological transfer in I.E.
- Linking practices A Biotechnology process: case studies
- Implementation of Regional Technological Platforms
- strategy for regional cooperation in ST&I
- Science, Technology and Society Project-CTS-
- Foresight as a management tool: its application in various sectors and economic activities
- Software development models and their relationship with innovation: in various sectors and economic activities
- Institutional impact of the new public policy framework for science and technology in Minciencias
- Operationalization of research teaching policies in their beginnings
- How do human resources behave in collective health according to CvLAC and GrupLAC in Colombia?
- Analysis of the dynamics of international mobility of Colombian university graduates.
- Relationship between an expanded conceptual model of innovation and innovation management: local focus and in small MSME companies.
- Creation of Virtual Learning Objects (OVA) in Virtual Learning Environments (VLE)
- Innovative strategies: private benefits and systematic spillovers
- The role of patents for new products in Colombian MSMEs.
- Clean energy project
- Visibility and international impact of Colombian scientific production in biotechnology.
- Emergence and evolution of clusters of technology-based companies in regions of low technological development.
- Institutional development and scientific policy in the agricultural sector.
- Factors that condition the dynamics of interaction of companies with their environment.
- Innovation and territory for development in MSMEs in Latin America
- Cooperation networks for innovation and territorial development.
- Critical contribution to ST&I policies in Colombia.
- Socio-institutional innovations for the territorial planning and development of the department of Meta.
- Strategies for appropriating the results of innovation in public-private knowledge generation schemes-GC-

Given the weaknesses diagnosed in the S&T training processes, and the competencies, as appreciated in terms of the recorded values, a "Regular" perception is observed in the responses, which are consistent in the four Transversal Axes, highlighting that The focus is more on "Insufficient and Deficient", since the majority of responses tended to have a perception of the poor functioning of the seedbed, a fact that can be verified by adding the regular and insufficient observations in the table, which exceed 50 % of negative perceptions. Consequently, the following topics should be included in the training and assistance to diploma courses for students and for those teachers who lack them.

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4. Conclusions

As a conclusion of this research regarding the theoretical references for the management of research hotbeds in the S&T field, the foundations for management theory are recognized, providing general concepts and principles that can be applied to any type of organization, of this type for the improvement of processes and strengthening of efficient systems.

In relation to theories for the cultivation of research and talent, learning methodologies are related and formative research is guided for the development of students' skills. In addition to these references, the present study epistemically relates the theory of scientific knowledge by providing concepts and principles on the S&T knowledge construction process. This theory will help seedbeds understand how this knowledge is generated and how it can be applied to problem solving.

The detailed characterization of research hotbeds in the S&T field provides a clear vision of the strengths, weaknesses, and opportunities for improvement, this in turn is essential to identify critical areas that require attention and development, thus allowing the formulation of specific strategies. that contribute to the strengthening of these training spaces in the I.E. object of study.

The determining factors for the development of the proposal to strengthen the scientific-technological seedbeds allow us to corroborate the relevance and pertinence of the proposed strategies.

Specifically, in response to the formulated objectives, first of all, to raise awareness in the Educational Communities of the Schools that Develop CT-I Projects, the need to apply curricular development strategies, resignification of the PEI, and Didactic Strengthening and Scientific Dissemination to the strengthening of the Scientific-Technological Seedbeds, this was achieved with the different meetings prior to the application of the survey; secondly, about developing training processes in curricular, pedagogical, didactic aspects and relationships with the vocational and territorial context of the institution based on the execution of a Diploma in S&T Development

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