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Evaluation of a Strategy Based on Pedagogical Mediation for the Development of Metacomponential Skills

Evaluación de una Estrategia Basada en la Mediación Pedagógica para el Desarrollo de Habilidades Metacomponenciales

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ABSTRACT

El artículo parte de un estudio cuasiexperimental cuyo objetivo es evaluar los efectos de una estrategia basada en la mediación pedagógica para el desarrollo de la metacognición de los estudiantes. El alcance de los objetivos se apoya en el método cuasiexperimental con observación antes y después de la aplicación de la estrategia. La muestra probabilística está compuesta por 176 estudiantes de educación secundaria dividida en dos grupos: grupo experimental (88 sujetos) y grupo de control (88 sujetos). Se lleva a cabo el diagnóstico previo con la aplicación del Inventario de Habilidades Metacognitivas y la Batería Aurora. Para el procesamiento de datos se aplica la Estadística Radial y la Prueba t de Student para muestras independientes y muestras emparejadas. La estrategia de intervención se desarrolla durante cuatro meses en dos sesiones de aplicación de la estrategia por semana. Los resultados que arroja la observación antes (OA) indican la no existencia de diferencias significativas entre el Grupo de Control y el Grupo Experimental. Ambos grupos arrojan resultados similares. Una vez aplicado el Inventario de Habilidades Metacognitivas, los resultados evidencian diferencias significativas entre el grupo experimental y el de control; en consecuencia, se acepta la hipótesis alternativa y se rechaza la hipótesis nula. Se concluye la efectividad de la estrategia de intervención basada en la pedagogía de la mediación en el despliegue de las habilidades metacognitivas que son fundamentales en la resolución de los problemas académicos, teniendo en cuenta que la mediación se presenta como pedagogía emergente y fundamental en el aprendizaje y desarrollo cognitivo de los estudiantes.

RESUMEN

Palabras clave:

The article is based on a quasi-experimental study that aims to evaluate the effects of a strategy based on pedagogical mediation for the development of students' metacognition. The scope of the objectives is based on the quasi-experimental method with observation before and

habilidad metacomponencial y metacognitiva, inteligencia analítica, inteligencia práctica.	after the application of the strategy. The probabilistic sample is composed of 176 secondary school students divided into two groups: experimental group (88 subjects) and control group (88 subjects). Pre-diagnosis was carried out with the application of the Metacognitive Skills Inventory and the Aurora Battery. For data processing, the Radial Statistics and Student's t-test for independent samples and for paired samples are applied. The intervention strategy is developed during four months based on two sessions of strategy application per week. The results of the observation before (OA) indicate no significant differences between the Control Group and the Experimental Group. Both groups show similar results. However, once the Metacognitive Skills Inventory is applied, the results show significant differences between the experimental and control groups; consequently, the alternative hypothesis is accepted and the null hypothesis is rejected.

Introduction

Colombian students have difficulties at the level of reading comprehension, in understanding mathematics and science mostly, which suggests that students present difficulties in developing linguistic and cognitive skills that are required to advance in the cognitive processing of learning objects; in the capacity of analysis, in the resolution of tasks as well as in the organization of information, since metacognitive skills are not adequately applied in the processing of tasks and academic work. Therefore, learning goals are not achieved, (Garcia, 2018). This problem is related to the persistence in the application of traditional pedagogical models that do not stimulate the deployment of cognitive processes that lead to the consolidation of meaningful and autonomous learning, which are fundamental in the resolution of academic problems. The viable and adaptive construction of academic content is not carried out with the ideal pedagogical processing; a process that makes it difficult for students to achieve their learning goals (Puma, 2020).

In the district of Barranquilla, the geographical area where the research was carried out, a modernization of schools has taken place, characterized by the construction of mega schools and the academic organization of intelligent schools. However, difficulties persist in the pedagogical aspect, since teachers maintain the traditional approach to education, are not updated in the application of pedagogical models, nor in the design of strategies that favor the development of critical thinking in students. All this is due to the absence of interactive and didactic processes that are motivating, questioning and dialogic, so necessary for the development of students' cognitive skills and abilities.

Theoretical references

The theoretical references in this research are based on three major blocks, which are: the neurobiological theory of brain plasticity, the theory of successful intelligence and the theory of mediation in education. In the first block, concepts, principles and theorizations related to neuronal plasticity are established, taking into account its importance for the evolutionary modifiability that leads to the development of new cognitive skills and abilities, within the ontic chronology of the learning subjects. Brain plasticity turns out to be highly dynamic during childhood and adolescence since it especially affects memory and learning processes. This indicates that, trainings or strategies oriented to the mediation of the development of metacomponential skills, are pedagogically relevant at these evolutionary ages to achieve highly functional cognitive processes during schooling, (Sierra & León, 2019).

The second theoretical block, referring to the theory and practice of successful intelligence, is based on Sternberg, who sustains the evolutionary and functional importance of analytical intelligence and practical intelligence. Both intelligences are functionally supported by the metacomponential or metacognitive processes of individuals. The concept of metacognition was originally conceived by Flavell as the ability to reflect on one's own learning processes, and also refers to the deployment and development of skills, control knowledge and self-regulation of cognitive and mental processes that significantly manage learning (Benavides 2020).

The third theoretical block supports the importance of pedagogical mediation, taking into account that it constitutes a pedagogical and sociocultural event, which allows the teacher to apply his pedagogical competence to favor in students the deployment of skills, abilities and processes that functionally represent advances in their human and intellectual development. Mediation is theoretically supported by Vygotsky's proposed constructivism, Louis Not's dialogical pedagogy and Feuerstein's theory of structural cognitive modifiability, (Garcia, 2018).

Pedagogical Mediation

The objective of mediation is oriented to deploy human development, so that the subject in the learning process reaches not only the levels of knowledge construction, but also the deployment of skills, abilities and competencies of the art under study. For this reason, didactics is directed to the achievement of the socio-cognitive domains of the learning process. In the same way, it is necessary to understand that the mediated learning experience is structured from the didactic interactivity that constitutes an intentional, socio-cognitive and organized dialogic relationship, allowing the student to build knowledge from socialized learning experiences and the deployment of potentialities.

Pedagogical mediation is based on the theoretical assumptions of Vygotsky (1978), from his concept of the zone of proximal development, which is conceptualized as the evolutionary distance that exists in the cognitive performance of the learner and is determined by his chronological age and performance achieved with the mediation of a competent interlocutor. Mediation favors the deployment of the subject's human development during the learning process, so that he/she achieves the levels of knowledge construction and deployment of abilities, skills and competencies of the art under study, as well as the socio-cognitive mastery of his/her learning process.

The process takes place because mediation builds a pedagogical competence that leads to the deployment of complex functional processes that generate an operative framework of higher psychological processes. In reference to this, Vygotsky, (1978), states that "The metacognitive or metacomponential functioning is the manifestation of intelligence achieved from the transformation of the operational processes of thought; in such a way that the student reaches functional levels of organization, planning, evaluation and metacognition that is transferred in the adoption of heuristic processes and the resolution of processes" pg. 95.

Language represents the ideal cultural tool to shape the possibility of understanding and discernment so that the different frames of reference encoded from immediate everyday knowledge can be reinterpreted and recoded for their operative modification and give rise to new learning. Language and thinking are functionally integrated by traversing the hard core of hypotheses and theories legitimized by the student who recodes and constructs new knowledge and deploys new skills to process knowledge, (Parra, 2014), (Sierra & León, 2019). Mediation is not limited to the construction of knowledge; it is transferred to the cognitive sphere so that students reach the development of metacomponents that allow them to become aware and intentional about their learning processes.

The discursive and pedagogical approach to mediation shapes a symbolic interactionism between teacher and student where their metacognitive components and metacomponents, their analytical intelligence and practical intelligence, are deployed towards the evolutionary and academic scope of the students, (León & Zúñiga, 2019).

Method

The methodological design is a quantitative study defined from the empirical-analytical research paradigm. Quantitative studies derive from the natural and exact sciences such as chemistry and physics. Epistemologically, they are based on the Galilean tradition of science and the positivism of Augusto Conte. This paradigm determines measurement, empirical testing and verification as criteria of validity, reliability and scientificity of research data (Mardones, 2000), Hernandez (2015), epistemological coherence between paradigm and design is therefore conceived. Quantitative research favors positive knowledge, which is measurable, quantifiable and proven in the research results.

To develop the empirical process of the research, a quasi-experimental design is proposed, with a longitudinal approach, with observation before (OA) and observation after

(OD), having developed an intervention strategy for the training of metacomponential (metacognitive) processes in high school students, specifically in the ninth and tenth grades of the Colombian regulation of the Ministry of Education.

Quasi-experimental designs have their origin in the analytical empirical paradigm of research, as they maintain similar characteristics to experiments. They are applied in social situations where the researcher cannot present the values of the independent variable at will, nor can the experimental groups be presented randomly. But it does allow the application of procedures similar to experimental design for data collection.

The quasi-experimental design leads to establishing causal relationships between the Dependent Variable (assessment of metacognitive or metacomponential skills) OA and the Independent Variable, (testing of an intervention strategy, based on mediation for the development of metacognition and modification of cognitive structures).

For OA, the questionnaire "Inventario de habilidades metacognitivas, developed and validated for the Colombian context by researchers Huertas, Vesga, & Galindo, (2014) and the Aurora Battery are applied. After evaluating the results of the OA, the intervention strategy oriented to the development of metacomponential or metacognitive skills in high school students is implemented. The OA has a diagnostic purpose, which allows to evaluate the functional state of the metacognitive skills of the participant sample in both groups: the control and the experimental group. Subsequently, the application of the intervention strategy is carried out to potentiate and strengthen the development of metacognition.

Research Hypothesis

The following hypotheses are defined within the study:

Null Hypothesis: In both the Experimental Group and the Control Group, there are no differences in the mediation-based assessment of the deployment of metacognitive skills applied in high school students.

Alternative Hypothesis: There are differences in the evaluation of the effects of the mediation-based strategy for the deployment of metacognitive skills applied in high school students.

Population and Sample

The starting point was a population of 1395 students belonging to three schools. The formula for calculating the sample of finite populations was applied, a procedure that yielded a sample of 178 students to form 89 students for the control group and 89 students for the experimental group. The formula applied was as follows:

$n= N\times Z^2\ p\times q\ /\ d^2\times(N-1)\ +Z^2\times p\times q$

$n= 1395\times (1,96)^{\ 2}\times (0.05)\times (0,95)\ /\ (0,03)^{\ 2}\ (1395-1)\ +\ (1,96)^{\ 2}\times (0,05)\ (0,95)$

$n= 1395\times 3,8416\times 0,05\times 0,95/\ (0,0009)\ (1394)\ +\ (3,8416)\times (0,05)\ (0,95)$

$n= 254,55/1,2546+0,182476$

$n= 254,55/1,437076= 177,13 =178$ —> $n=178$

Variables

Dependent Variable

Assessment of metacognitive or metacomponential skills.

Independent Variable

Testing the effects of a mediation-based intervention strategy for the development of metacognition and modification of metacognitive structures.

Conceptual Definition of Variables

Conceptual Definition of the Dependent Variable

Metacognitive skills can be conceptualized as a process of self-monitoring, control and supervision of thinking, which allows the subject to think about thinking; in such a way that

he/she can retrospectively analyze the course of his/her thinking in order to differentiate and select the most effective thinking strategies for problem solving. In this sense the subject, with the use of metacognition, can configure and deploy analytical intelligence and practical intelligence because he can predict and construct new ways of thinking by redescribing and monitoring the use of his skills to achieve success in solving problems inside and outside the classroom. Metacognition is the self-knowledge that people construct about the functioning of their own thinking. They essentially constitute processes of supervision and regulation that people carry out on their own cognitive attitude that is applied in the resolution of the problem and tasks favoring the evaluative success of the same, (Mera, 2022).

Conceptual Definition of the Independent Variable

Testing the effects of a mediation-based strategy. Conceptually, the strategy designed in this research is pedagogical and is based on the approach of mediation as a constructivist concept, which rethinks the teacher's pedagogical praxis. The purpose is to guide dialogical and questioning pedagogical processes, which conflictualize the students' thinking and whose final goal is to be able to configure in their thinking, abilities, skills and complex thinking strategies that develop the students' intellect in an evolutionary way. The mediating pedagogical strategy is structured as a tutorial scaffolding based on Vygotsky's zone of proximal development. It is a constructivist concept that privileges the stimulation of a dialogical approach and is characterized by symbolic interactionism oriented to the student discovering and using his cognitive capacities in the construction of expected learning and adaptive intelligence (Ramírez & Chávez, 2012).

In this sense, the interactive sociolinguistic activity allows establishing learning agreements between teachers and students, formulating activities, contents and evaluation criteria so that students understand and achieve metacognition and mental agility, developing synthesis capacity and planning work and tasks (Romero, 2015).

Mediated learning is a constructivist construct where the teacher is presented as an organizer and mediator who facilitates the modification of the student's mental structures and their cognitive transformation while making modifying interventions on the student's mental operations. The mediator acts as a support to develop the thinking system by facilitating in the student the application of new intellectual tools (Parra, 2014).

Operational Definition of Variables

Operational Definition of the Dependent Variable

In order to carry out the diagnosis of the state of development of the students' metacognitive or metacomponential skills, we started with the application of the Metacognitive Skills Questionnaire and the Aurora Battery in the Control and Experimental groups that were part of the study sample.

Operational Definition of the Independent Variable

In the operationalization of the Independent Variable, the researcher designs a pedagogical strategy based on mediation that is applied in phases in the Experimental Group during a period of four months, a process during which the students develop exercises oriented to the deployment of metacognitive skills and abilities. At the end of the training, the effects of the strategy are measured by applying the Metacognitive Abilities Questionnaire and the Aurora Battery. The statistical process is performed with the application of Radial Statistics and Student's t-test for independent samples and paired samples.

Research Instruments

For the empirical execution of the research, the following instruments are applied:

1. Inventory of Metacognitive Skills, developed by Huertas, Vesga, & Galindo, (2014) for students in the Colombian context. The instrument evaluates the application of metacognitive and/or metacomponential skills in problem solving and academic tasks, self-regulation, monitoring and control. It is considered relevant within the framework of this research because of its validation for the Colombian context. It is a highly reliable instrument with a Crombach's alpha of 94 making the instrument valid and reliable. Assesses students' metacognitive awareness. The instrument was created by Schraw and Denninson (1994) to identify metacognitive skills. It is made up of 52 items distributed in 8 categories as follows:

Declarative knowledge, made up of items 5, 10, 12, 16, 17, 20, 32 and 46.

Procedural knowledge, consisting of items 3, 14, 27 and 33.

Conditional knowledge, comprising items 15, 18, 20, 20, 29 and 35.

In the regulation of cognition the questionnaire assesses the categories presented below:

Planning, items 4, 6, 8, 22, 23, 42 and 45.

Organization, items 9, 13, 30, 31, 37, 39, 39, 41, 43, 47 and 48.

Monitoring, items 1, 2, 11, 21, 28, 34 and 49.

Debugging, items 25, 40, 44, 51 and 52.

Evaluation, items 7, 19, 24, 36, 38 and 50.

This intervention strategy, based on mediation for the development of metacomponential and/or metacognitive skills, is developed in four phases of exercises: metacognition, executive control, self-regulation and monitoring. Each phase has an intensity of eight hours for a total of 32 hours of intervention. Mediation is the constructivist and tutorially scaffolded intervention strategy defined for it. This skill constitutes a psychological competence oriented to potentiate the development of students' metacognitive abilities.

2. The Aurora Battery, to evaluate analytical capacity. It is an instrument designed to evaluate the analytical, practical and synthetic skills of the subjects. It was created by researcher Sternberg, (2006) and validated for the context of Spanish-speaking countries by researcher Llor, (2014). In the present research, the factors related to analytical intelligence and practical intelligence are applied. The Aurora Battery allows determining the successful intelligence of individuals and is related to the academic performance of individuals (Prieto, Ferrándiz, Ferrando, & Bermejo, 2015). It was initially created to evaluate the performance of

students with high abilities, but it is currently used to respond to diversity, since it is based on the principle that people have the ability to achieve their goals and objectives within the context that circumscribes them. However, to this end, people must enhance their strongest abilities and compensate for their weaker ones in order to achieve an adaptive intelligence to interact with the surrounding environment as a successful individual.

- Analytical Intelligence comprises six types of exercises such as: homophonic words, limited metaphors, math flashcards, algebra, Tangrams and connected ships.
- In the Limited Metaphor Exercises, the student must identify words that present an apparent relationship between unrelated elements.
- In Tangrams the student must complete figures from a set of pieces. The exercise assesses spatial skills, analytical skills, synthesis, logical processes and problem-solving strategies.
- The Algebra Exercises require the resolution of basic operations and the understanding of certain complex language.
- Floating Ships assesses the ability to discover complex spatial relationships that individuals can perform.

At the Practical Intelligence level, the test comprises the following exercises:

- The Money Exchange program evaluates situations and problems that arise in daily life.
- Logistics Maps that evaluate the capacity to plan.
- Shades of Toys that exercise in individuals the ability to determine the spatial movement of bodies.
- Paper Cuts, which exercises spatial relationships.

Procedure and Data Analysis

To carry out the research, meetings were held with the school principals to obtain permission and informed consent from the parents. As well as for the granting of the endorsement in order for their sons and daughters to participate in the research. Meetings are held with teachers and students to inform them of the process of empirical execution of the research.

Cooperation agreements were signed with the rectors to inform them of the objectives of the research and the contributions of the intervention strategy in terms of academic, cognitive and personal development for the students and were organized into Control Group and Experimental Group. For OA the groups were assessed with the Metacognitive Skills Inventory and with Ala Batería Aurora to determine their metacognitive functioning. Radial Statistics was used to analyze the data from the instruments applied. Later, Student's T-test for paired samples was used to define the observation before the experiment. Having carried out the observation procedure before, the intervention strategy for the deployment of metacognitive or metacomponential skills is developed. The strategy was carried out in four phases of execution, the first one oriented to the training of metacognitive skills, practical intelligence and analytical intelligence. The second for self-regulation with exercises for the management of declarative knowledge, procedural knowledge and conditional knowledge. The third is for the executive control of thinking with planning and organization exercises, and the fourth is determined by the management of monitoring, debugging and evaluation.

The strategy was executed for 16 weeks. It should be clarified that the Control Group did not participate in the execution of the program. Once the intervention was over, the Metacognitive Skills Inventory was applied again in the Experimental Group and also in the Control Group, as well as the Student's t-test for independent samples.

Statistical analysis determines mean scores, standard deviation and error of means in OA. The significance level of the Student's t-test is 0.05 to define the hypothesis test of equality of means analyzed.

The proposed design determines the application of guidelines oriented to the treatment of the variables, which are functionally manipulated as elements linked to the causes in order to measure the effect, which in turn will be related to another variable. The experimental procedure defines the measurements that need to be made and the number of times they must be performed with a statistically defined degree of confidence. The relationship is of the cause-effect type. In the present investigation the quasi-experimental design presents the following phases of the procedure:

Phase I: Evaluation in a sample of 178 subjects, OA: The metocomponential or metacognitive variable of the students was measured based on their performance with assessment tests such as the Metacognitive Skills Test and the Aurora Battery. Data were also analyzed with the support of Radial Statistics and the Student's t-test for paired samples.

Phase II: Implementation of the mediation-based strategy: Application of the mediation intervention strategy for the development of metacomponential or metacognitive skills in order to determine its efficiency in the development of executive thought processes that are fundamental for academic and learning performance. The strategy was applied to strengthen higher thought processes. In this phase, which lasts sixteen weeks, students were expected to achieve the developments that consolidate the functional mastery of metacomponential processes. In the first stage of the intervention strategy, students carried out analytical, procedural and declarative thinking processes, as well as conditional processes. In a second stage of the intervention strategy, the semiotic analysis of linguistic structures was carried out; for this purpose, the organization of thought, planning, self-regulation and monitoring of thought were worked on, since the subjects of the Experimental Group are confronted with the resolution of neurolinguistic exercises that strengthen the executive control of thought. In the third stage, students were confronted with hypothetical dilemmas and case studies in order to manage hypotheses, establish theorizations and propose solutions to the problems presented in the case studies and hypothetical dilemmas. The process aims at intellectual training, the deployment of metacognitive skills and abilities and, therefore, the intellectual development of thought

Phase III: Measuring metacognitive skills, OD: In this phase, the sample was evaluated with the aforementioned instruments. The data were analyzed with Student's t-test. The statistic was used to determine the significant difference between the experimental and control group means. Thus, the higher the value of t, the greater the evidence against the null hypothesis. The procedure allowed verifying that the applied strategy contributes to the functional deployment of students' metacomponential skills in problem solving. Data were analyzed with the Radial Statistics and Student's t-test for independent samples and for paired samples to determine the acceptance or rejection of the hypothesis.

Phase IV: Discussion of research results, conclusions and recommendations. Presentation of the impact of the intervention strategy at the level of human development and the deployment of students' metacomponential skills.

Results

The OA establishes the statistical analysis of the instruments applied, such as: The Metacognitive Skills Inventory and the Aurora Battery were processed with Radial Statistics to analyze the performance of the participant samples against the indicators of each

instrument and the Student's t-test to find the difference in means between the experimental group and the control group.

Description of Statistical Results Metacognitive Abilities Inventory

The following table expresses the averages of Experimental Group and Control Group yielded by the Radial Statistics in both groups for the indicators: declarative knowledge, procedural knowledge, conditional knowledge, planning, organization, monitoring, debugging and evaluation regarding the Metacognitive Skills Inventory.

Table 1

T-Student OA Test

AVERAGE EXPERIMENTAL GROUP	AVERAGE CONTROL GROUP
135,8	144,8
84,2	86,4
62,4	70,4
175	183,4
79,4	66,6
106,4	103
121,2	123,2
115,8	121,2

Observing the results obtained in Table 1 regarding the Metacognitive Skills Inventory for the Experimental Group and the Control Group, it is shown that the indicators: declarative knowledge (135.8 and 144.8), planning (175 and 183), organization (79.4 and 66.6) and monitoring (121.2 and 123.2) respectively are those that show the highest acceptance in the evaluated subjects of the Experimental Group and the Control Group and Control Group. The results of the Student's t-test are presented in Table 2.

Table 2

T-Student Test results of the control group and experimental group

AVERAGE EXPERIMENTAL GROUP		AVERAGE CONTROL GROUP
Media	110,025	112,375
Variance	1275,776429	1558,690714
Remarks	8	8
Pearson correlation coefficient	0,985528524	
Hypothetical difference of means	0	
Degrees of freedom	7	
Statistic t	-0,896511016	
P(T<=t) one tail	0,199879992	

Critical value of t (one-tailed)	1,894578605
P(T<=t) two-tailed	0,399759984
Critical value of t (two-tailed)	2,364624252

Therefore, the Student's T-test analysis shows that the critical value of T (1.894578605) is higher than the value of T (-0.896511016), which indicates that there are no differences in the results of both groups for the mentioned indicators.

Description of Statistical Results of the Aurora Battery. Student's t-test

The Aurora Battery focuses on two higher cognitive processes: analytical intelligence and practical intelligence. Analytical intelligence suggests the application of heuristic pathways involving organization, planning, declarative, conditional and procedural knowledge, present in the cognitive processes of problem solving. Practical intelligence is articulated around procedural knowledge and the organization of thought, applying the strategies previously designed and transferred to a new resolution process.

The statistical results of the Aurora Battery are shown in Table 3 for Analytical Intelligence and Table 4 for Practical Intelligence for both the Experimental and Control Groups.

Table 3

Analytical intelligence statistics of the experimental group and the control group

Average experimental group (IA)	**3 2,33**	**3 0,33**	**1 7,00**	**6 ,83**	**1 ,50**
Average control group (IA)	25 ,67	51 ,83	4, 67	5 ,83	0 ,00

T-TEST FOR PAIRED TWO-SAMPLE MEANS

	Average experimental group (IA)	*Average control group (IA)*
Media	17,6	17,6
Variance	188,68	463,12
Remarks	5	5
Pearson correlation coefficient	0,82	
Hypothetical difference of means	0	
Degrees of freedom	4	
Statistic t	-0,00000000000000012	
P(T<=t) one tail	0,5	
Critical value of t (one-tailed)	2,13	
P(T<=t) two-tailed	1	
Critical value of t (two-tailed)	2,78	

Table 4

Practical intelligence statistics of the experimental and control groups

Average experimental group (IP)	**13,00**	**44,60**	**30,40**
Average control group (IP)	15,60	26,60	45,80

T-TEST FOR PAIRED TWO-SAMPLE MEANS		
	Average experimental group (IP)	*Average control group (IP)*
Media	29,33	29,33
Variance	250,49	233,61
Remarks	3	3
Pearson correlation coefficient	0,41	
Hypothetical difference of means	0	
Degrees of freedom	2	
Statistic t	0,00000000000000006	
P(T<=t) one tail	0,5	
Critical value of t (one-tailed)	2,92	
P(T<=t) two-tailed	1	
Critical value of t (two-tailed)	4,30	

According to the mean differences analyzed with the Student's t-test presented in tables 3 and 4 respectively, the Aurora Battery shows the following: In the Analytical Intelligence test (Table 3), the critical value (2.13) is higher than the T value (0.00000000000000012). Therefore, there are no significant differences between the Experimental Group and the Control Group in terms of cognitive performance in this type of intelligence. In relation to the Practical Intelligence test (Table 4), the critical value (2.92) is higher than the T value (0.00000000000000006) this shows that there are no significant differences in the performance of this type of intelligence between the Experimental Group and the Control Group.

Results OD

The OD in the present research is carried out with the analysis of the Radial Statistics that determines the performance of the Experimental Group after having carried out four months of intervention with the mediation-based strategy. In this second evaluation moment, the results of the Radial Statistics of the Experimental Group are compared with the results of the same group in the OA and with the results of the Control Group, with the application of the Student's T-test for paired samples and independent samples. It is necessary to clarify that the Experimental Group was composed of high school students with academic difficulties, while the Control Group was composed of high school students without academic difficulties. The results are presented in Tables 5 (Experimental Group) and 6 (Experimental Group and Control Group) respectively.

Table 5

Experimental group (OD-Radial)

	EXPERIMENTAL GROUP (O.D)					
	ANSWER OPTIONS					
INDICATORS	1	2	3	4	5	TOTALS
Declarative knowledge	5 1	5 5	1 26	1 92	2 88	7 12
Conditional knowledge	2 8	4 4	9 1	1 19	1 69	4 51
Procedural knowledge	3 0	3 2	8 8	8 8	1 18	3 56
Organization	6 9	9 6	1 28	2 44	3 53	8 90
Debugging	1 7	3 2	7 9	1 34	1 83	4 45
Evaluation	4 5	4 6	8 6	1 50	2 07	5 34
Planning	4 5	6 1	1 24	1 69	2 24	6 23
Monitoring	4 5	6 4	1 13	1 74	2 27	6 23
TOTALS	3 30	4 30	8 35	1 270	1 769	4 634

When observing the results obtained from the metacognitive skills within the Experimental Group, it is evident that the indicators: organization, declarative knowledge, planning and monitoring, according to the order described, are the indicators with the highest acceptance by the evaluated subjects.

Table 6

T-test for paired two-sample means experimental group

	AVERAGE EXPERIMENTAL GROUP (O.A)	*AVERAGE EXPERIMENTAL GROUP (O.D)*
Media	110,025	115,85
Variance	1275,776429	1167,86
Remarks	8	8
Pearson correlation coefficient	0,996536529	
Hypothetical difference of means	0	
Degrees of freedom	7	
Statistic t	-5,004268359	
P(T<=t) one tail	0,000778886	
Critical value of t (one-tailed)	1,894578605	
P(T<=t) two-tailed	0,001557773	
Critical value of t (two-tailed)	2,364624252	

The means of two paired samples obey the calculated value in standard error units. Table 6 shows that the absolute value of the T-value (-5.004268359) is greater than the critical value (1.894578605) (as is the case), the null hypothesis is rejected, which means that there are differences between the averages of the Experimental Group (before) with respect to the Experimental Group (after).

Table 7

T-test for two independent samples experimental group and control group

	AVERAGE CONTROL GROUP (O.A)	*AVERAGE EXPERIMENTAL GROUP (O.D)*
Media	112,375	115,85
Variance	1558,69071	1167,86
Remarks	8	8
Clustered variance	1363,27536	
Hypothetical difference of means	0	
Degrees of freedom	14	
Statistic t	-0,18823181	
P(T<=t) one tail	0,42669804	
Critical value of t (one-tailed)	1,76131014	
P(T<=t) two-tailed	0,85339607	
Critical value of t (two-tailed)	2,14478669	

If the absolute value of the t-value (-0.18823181) is less than the critical value (2.14478669) (as is the case), the null hypothesis is accepted. This means that there are no significant differences between the averages of the Control group with respect to the Experimental group during the DO.

Discussion and conclusions

Finally, the conclusions of the article will be presented in a last section, followed by the main conclusions. Where appropriate, limitations and proposals for continuity will be included. The data yielded by the OD test the alternative hypothesis for the Experimental Group, taking into account that this is the group that receives the mediation-based strategy training. The group in question is composed of students who present difficulties in academic performance and in processes related to text comprehension and analysis. Therefore, the mediation theory states that students' previous learning experience allows them to build knowledge that leads to the deployment of metacognitive skills, therefore, mediated learning experiences allow them to generate an intentional awareness regarding the relevance, effectiveness and successful function of their cognitive development (De la Portilla, Duque, Landínez, Montoya & Gutiérrez, 2022, p.149). It also corroborates the student's capacity to acquire expertise while they carry out the elaboration of their learning, since they apply their skills to face the problematizing situations and, thus, achieve metacognitive expertise. (Dussan Ruiz and Montoya 2021).

In this order of ideas, the application of the intervention strategy allowed the students of the Experimental Group to advance in the mastery of the exercises, resulting in a high performance in these indicators that are demonstrated in the data obtained from the Student's t-test. In this order of ideas, the importance of the dialogic interaction of mediation that gives rise to an intermediation between the interacting subjects is corroborated. These rely on open

dialogue, argumentation and language to meaningfully learn schooled scientific content, (Montoya, Dussan, Taborda, & Nieto, 2018).

It is concluded that intellectual training demonstrates that the exercise of higher order skills leads to the development of metacognition. It can be understood that cognitive transformations operate from the neurobiological and social structural order, since mediation stimulates the cognitive action of the learning subjects, who operate, mobilize and dynamize cognitive and intellectual processes that transform their thinking. The pedagogy of mediation, due to its dialogic character that implies the management of communicative competencies, is presented as a strategy of a dialogic maieutics that problematizes the student's thinking in its evolution.

The students participating in the research have different years of academic experience, so in the OA the Control Group and the Experimental Group presented similar results. However, after four months of application of the intervention strategy, the statistical analysis of the OD reveals significant differences in the results of the Experimental Group, with respect to those obtained by this group in the OA. All this proves that the exercise that these people carried out during the four months of application of the strategy offers palpable results in terms of progress in their performance. All this allows us to infer the cognitive evolution of the subjects. The null hypothesis is rejected and the alternative hypothesis confirming the positive effect of the strategy on the deployment of students' metacognitive skills is accepted.

The OD reveals no differences between the Control Group and the Experimental Group. The Control group was composed of students with high academic performance while the Experimental group was composed of students who present academic difficulties. The first group did not receive the application of the mediation-based strategy; however, their academic experience, characterized by good performance, is what allowed establishing the non-variability of this group compared to the Experimental Group. The application of the mediation-based intervention strategy allows students to manage better performances in thought control, self-monitoring and monitoring of cognitive processes needed in the effective resolution of academic tasks and assignments. This process is manifested in a significant improvement in the academic performance of the students in the Experimental Group.

Throughout the research, certain limitations were found regarding the timetable for the application of the exercises, since they were rescheduled within the same months of application. Similarly, there were limitations related to the paradigmatic disposition of some teachers who needed to rethink their pedagogical paradigms in order to update their teaching practice. This reality raises questions regarding the approach to the students' learning process and invites further research on the advancement of pedagogy.

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