IMPROVING TEXT COMPREHENSION, LOGICAL REASONING, AND PROBLEM-SOLVING SKILLS: AN EMPIRICAL STUDY IN PRIMARY EDUCATION

MIGLIORARE LA COMPRENSIONE DEL TESTO, IL RAGIONAMENTO LOGICO E LE CAPACITA' DI RISOLUZIONE DEI PROBLEMI: UNO STUDIO EMPIRICO NELLA SCUOLA PRIMARIA

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ABSTRACT
The research shows the results from the analysis of quantitative tests and classroom observations, on Cognitive Training CLPS combined with CAE at the Primary School. The sample is made of 82 children, 16 with Special Learning Needs. Cognitive training consists of 132 activities of increasing difficulty, based on texts with optimal challenges and questions for metacognitive development. It facilitates educational planning based on thought processes, allowing the connection between cognitive enhancement and school curriculum.

La ricerca mostra i risultati dell'analisi dei test quantitativi e delle osservazioni in classe, sul Training Cognitivo CLPS nella scuola primaria. Il campione è composto da 82 bambini, 16 con bisogni educativi speciali. Il training cognitivo consiste in 132 attività di difficoltà crescente, basate su consegne che riguardano la comprensione, la logica, la risoluzione di problemi, il pensiero metacognitivo a partire da testi narrativi, descrittivi, regolativi. Il training è pensato per stimolare l'esercizio di una pluralità di processi di pensiero su contenuti tipici della programmazione scolastica.

KEYWORDS
Cognitive enhancement, problem solving, innovative teaching, text comprehension, logical skills.

Potenziamento cognitivo, problem solving, didattica innovativa, comprensione del testo, abilità logiche.

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Introduction

The integration of cognitive intervention strategies in classroom settings represents a significant opportunity to enhance student learning outcomes across various educational contexts. By focusing on developing cognitive potential rather than merely delivering content, educators can foster deeper learning, improved retention, and the development of higher-order thinking skills in their students.
Cognitive learning strategies are techniques that enhance how learners process, retain, and apply information across different situations, resulting in more durable and effective learning experiences. These approaches engage students in active thinking processes and metacognitive reflection about their learning material and problem-solving methods. Research strongly demonstrates that the consistent integration of cognitive strategies with daily active learning practices significantly improves both the depth and longevity of learning outcomes.
This metacognitive approach helps students develop self-regulation skills essential for independent learning. Incorporating age-appropriate challenges into lesson plans stimulates critical thinking and problem-solving skills across diverse subject areas. These challenges should be designed to target specific cognitive skills while remaining accessible to students at their developmental stage. Feuerstein's Instrumental Enrichment Programme (Feuerstein, 2008) and Trinchero's Cognitive Training in Comprehension, Logic and Problem Solving (CLPS Training, Trinchero, Piacenza, 2020) represent two structured approaches that enable the creation of a learning environment in which every student can fully develop their cognitive potential, learning not only ‘what’ to study, but ‘how’ to learn to face future challenges.

1. Unlocking Learning Potential in Schools: applying Feuerstein’s Theory

The educational system frequently encounters dilemmas arising from a range of equally important needs, creating conflicts regarding which factors should inform decision-making. In early childhood education, a central question is: "What should be the primary goal of education?" Addressing this issue is highly complex. Piaget’s theory of genetic epistemology stands in contrast to approaches that advocate for systematic intervention. According to him, the development of intelligence progresses through distinct stages, primarily determined by biological maturation-

specifically, the development of the brain and nervous system-alongside the child's environmental experiences He argued that intensive intervention is unnecessary, as it does not fundamentally alter the natural sequence of cognitive development, which he regarded as largely predetermined by genetic and developmental factors. His theory clearly asserts that, for optimal development, individuals must be provided with opportunities to actively engage with and explore their environment. He viewed learning as an active process where children construct Knowledge through assimilation (integrating new experiences) and accommodation (modifying existing schemas). Development is constrained by stage-specific readiness, limiting the efficacy of teaching abstract concepts to younger children. He elaborated the direct approach: the individual learner (O) interacts directly with the stimuli (S) of the surrounding world and responds (R). In this kind of interaction with the environment, learning is incidental, it takes place as a direct result of such experiences, but it is not enough to ensure that effective learning takes place.

Reuven Feuerstein, an internationally renowned Israeli psychologist, devolves Piaget's formula (S-O-R). He introduced the figure of the human mediator, a teacher or in general an educator, who interposed between the learning organism and the world of stimuli to interpret, guide and give meaning to the stimuli. In this kind of interaction learning is intentional: he believed that the mediated learning, allowed a child to be more receptive to direct exposure and benefit more from it. He conceptualized learning as an active process in which children construct Knowledge through assimilation integrating new experience and accommodation, modifying existing schemas (Boninelli, 2022).

Development, according to this view, is constrained by specific stage readiness, which limits the effectiveness of teaching abstract concepts to younger children. He elaborated the direct approach, in which the individual learner (O) interacts directly with the stimuli (S) of the surrounding environment and responds (R). In this form of interaction, learning is incidental; it occurs as a direct result of such experiences, but this alone is insufficient to ensure effective learning. For this reason, he proposed the role of the human mediator, such as a teacher or educator, who intervenes between the learner and the world of stimuli to interpret, guide and assign meaning to these stimuli.

Mediation is considered a form of interaction that fosters the development of fundamental attitudes and competencies necessary for self-directed learning. Through his work with individuals who are low-functioning and disadvantaged, Feuerstein developed innovative methods for both assessment and learning. He

rejected the notion that intelligence is an innate, fixed attribute, instead proposing that learning is a dynamic process occurring through continuous social interaction. Feuerstein, it is these interactions that facilitate cognitive change and modifiability. Central to this theory is the concept of the Mediated Learning Experience (MLE). Through guided interaction, the learner acquires effective thinking skills, referred to as cognitive function (Boninelli, 2023).

The goal of Feuerstein's approach is to facilitate autonomous and independent learning. This goal can be achieved, by using two different theories: structural cognitive modifiability, the mediated learning experience. His approach is not aimed at trying to overcome a particular difficulty or teach a specific skill. Rather, it is aimed at teaching learners how to learn in order to adapt their learning for different situations.

1.1. Feuerstein's Instrumental Enrichment: a training programme for developing problem Solving, comprehension, and logical reasoning skills

Feuerstein developed his theory around his learning interaction that he called mediated learning experience (MLE): the learner develops efficient thinking skills that he described as the cognitive functions. MLE is the vehicle through which cognitive modifiability is achieved. It requires skilled mediators, and can be applied to all areas of practice-including occupational therapy, speech and language therapy, academic skill teaching.

Through his work with individuals who are low functioning and disadvantaged, he developed innovative methods of testing and teaching. He rejected the notion that people are born with a certain intelligence that remains fixed and static throughout life. He proposed that learning occurs through ongoing interactions with others within a social context and that is this interface that facilitates changes and modifiability in our cognitive processes.

Feuerstein Instrumental Enrichment (FIE) method, can be considered a pioneering approach designed to enhance reading comprehension, logical reasoning and problem solving skills through structured cognitive intervention. FIE employs paper and pencil tasks and interactive exercises to target specific cognitive functions:

a. *Comprehension*: tasks focus on decoding information, vocabulary building and interpreting relationships. Several instruments within the Feuerstein Instrumental Enrichment (FIE) programs, both Basic and Standard, are

specifically designed to develop comprehension skills. These instruments target the ability to understand, interpret, and make sense of information, narratives, and instructions. For the development of comprehension we can use the following instruments: Comparisons and Categorization. Using these instruments during the teaching practice, learners identify similarities and differences, which is fundamental to understanding relationships and drawing logical conclusions from information. They involve finding similarities and differences between items according to relevant and appropriate criteria. When students compare, they identify what is the same and what is different between things, using specific characteristics. These two instruments represent the building block of all relational thinking, understanding how things relate to each other. This involves determining how objects, events, stimuli are similar and/or different from each other according to different criteria. Using these instruments during the didactic experience at school could be useful to identify pros and cons of an activity such as taking notes in class (mapping versus taking notes in linear style). With Analytic Perception and Instructions the development of careful observation and the ability to analyse details, both essential for accurate comprehension. They focus on the ability to accurately receive, interpret and follow verbal or written interaction, directly supporting comprehension skills. Analysis and synthesis involves the skill of breaking the whole into its parts (analysis) and putting the parts together to make the whole (synthesis). Analysis involves breaking up an organized entity so that the sections stand out and are separable from each other, for example identifying the nouns and verbs in a sentence, cutting out the parts of a dress, or laying out the pieces of a puzzle. Synthesis involves organizing the parts into a meaningful whole or restructuring them into a new and original whole, for example in making a sentence. Both are involved, alternately, in all aspects of cognition. This can be linked to the Piagetian concepts of assimilation, taking on board new “bits” or pieces of information and knowledge, and accommodation, integrating the new bits a new understanding of how the parts interact and links with each other to form a whole. Why is the thinking skill of Analysis and Synthesis important? There are numerous reasons why we use analysis and synthesis. Complex problems are more easily solved by breaking them up and solving them one step at a time. For example a story problem in mathematics needs to be decoded into the sub steps before it can be solved.

b. *Reasoning*: Syllogism trains deductive thinking and hypothesis testing. Syllogisms are a form of reasoning based on an analysis of the relationships between sets and the members of sets. It is an important tool to understand and critically interpret statements made about the relationships between things in everyday life and to detect incorrect conclusions based on untrue statements. There are many contexts and situations where syllogism is needed in class. For example, to interpret the rules and regulations at school and in the community. Analysing literature in terms of mutually exclusive sets according to the style or period in which the selection was written. Use premises to create the set or appraise the language of logic and statement of premises used in various forms of literature and philosophy.

c. *Problem solving:* activities such as Numerical Progression and Transitive Relations develop strategic planning and adaptive thinking. The Numerical Progressions tool helps students to look for deduced and induced relationships between different objects or events. As the tool enhances students' ability to compare, infer and reason deductively and inductively, students draw accurate conclusions about the rules and formulas of progressions. In determining a general rule for a progression, this tool conveys precision, discrimination and a willingness to defer judgement until all elements have been worked out. Transitive relation is one of the core instruments in FIE, designed to develop and enhance specific cognitive functions related to logical and relational thinking. It requires students to work with relationships that exist in ordered sets, such as those described by “greater than”, “ less than” and “equal to”. The instrument focuses on the ability to transfer information from two pairs of items to a third pair, fostering skills in inferential and relational thinking. It is designed to help students engage in both deductive and inductive reasoning, essential for mathematical thinking, scientific reasoning and everyday problem solving.

By working, in a mediated way, through these structured tasks, learners develop the ability to make logical inferences and to generalize rules from specific cases, supporting broader cognitive flexibility and critical thinking.

2. Innovating teaching: theories, strategies and tools for cognitive enhancement and text comprehension

Several researches in the field of neuroscience and cognitive psychology (Nouchi & Kawashima, 2014; Thomas, 2012) have shown that the brain has considerable plasticity, that is, the ability to change and adapt in response to environmental stimuli and educational interventions. Previously, Reuven Feuerstein, with the Theory of Structural Cognitive Modifiability, supported the possibility of modifying the cognitive structures of individuals subjected to appropriate interventions (Feuerstein, Rand & Rynders, 1995) and Carl Haywood, assuming the value of Feuerstein's intuition, continued theorizing on the topic, defining the transactional nature of intelligence and its development. He also focuses on the functional modifiability of cognition and draws a distinction between intelligence, cognition and motivation (Haywood, 2010). It makes sense to direct educational efforts towards cognition and motivation (Piacenza & Mignone, 2024). Cognitive enhancement and cognitive modifiability are thus the outcome of the conscious and controlled guidance of educational figures and the preparation of a facilitating context. Depending on the theoretical framework of reference, mediators affect the recovery of cognitive functions (if cognitive rehabilitation) or the activation of cognitive operations (if cognitive enhancement), which in the model presented here are represented by the exercise of cognitive processes on certain learning contents. The reference is to the *Impregnation Theory* (Calonghi & Coggi, 1993), according to which the teacher enhances thought processes while teaching school contents, leading students to develop methods for understanding, using and transferring contents, appropriate attitudes towards tasks, awareness of the nature of situations and of their own potential and limits.

High-level thought processes are based on executive functions located in the frontal lobes of the brain, which allow conscious control of thought and behaviour, allowing the individual to respond in a flexible way to environmental stimuli, plan goal-oriented actions, and adapt to new situations never faced before in that form (Trinchero, 2022; Cantagallo, Spintoni & Antonucci, 2010).

The success of this internalization process depends on emotional factors, socialization, perception of competence and motivation (Cornoldi & al., 2018). Pekrun's (2006) control-value theory highlights how self-control and the value attributed to the task influence the emotions experienced in training contexts and the learning that is achieved. Both Haywood and Paour underline the importance

of social and cognitive self-regulation, to control behaviour through focused attention on the problem-situation, manage impulsiveness in providing impulsive responses and plan actions (Haywood, Brooks & Burns, 1992; Paour, 2012).
Feuerstein also includes the “feeling” of competence among the key principles of mediation (Minuto & Ravizza, 2008).
In the 90s, the exclusive centrality of knowledge was overcome in favour of skills, which means developing students' ability to apply knowledge to new problems in new and changing contexts (Trinchero, 2018). The European Parliament (Recommendation of 18th December 2006, 2006/962/EC) highlights the importance of skills such as learning to learn, communication in the mother tongue, mathematical competence and basic competence in science and technology, and social and civic skills. Closely linked to these and relevant, the problem of text comprehension emerges, to be considered as a basic skill for the exercise of citizenship and for success in school learning. Possessing adequate linguistic skills is a prerequisite for access to knowledge, communication and for the structuring of thought, as highlighted by the National Guidelines for the curriculum of nursery school and the first cycle of education (MIUR, 2012). Italian adolescents demonstrate lower levels of text comprehension in tests on average compared to other European countries, according to data from the OECD-PISA surveys (OECD, 2019). Significant gaps in competence are also found between the south and the north of the country. Often, teachers' teaching interventions do not adopt effective strategies to solve the problem. Similarly, textbooks do not offer effective tools for working on comprehension, limiting themselves to proposing exercises with questions in which the student is asked to find explicit information present in the text and not to make inferences starting from the information given and the student's background knowledge (De Beni, Cornoldi, Carretti & Meneghetti, 2003; Rizzo, Traversetti & Pellegrini, 2023; Bertè 2014). Teachers often have difficulty in "understanding the different cognitive nature of the contents and thought processes that their teaching activity is able to mobilize" (Calvani, 2023, p.15); this makes it necessary to implement training courses that allow them to recognize the fundamental cognitive processes (Calvani, 2023). INVALSI data also show considerable heterogeneity between geographical areas of the country and in general the Italian population shows a percentage of readers, identified through ISTAT surveys (2015, 2017), among the lowest in Europe (Cardarello & Pintus, 2019).

Text comprehension, understood as "reading to understand", goes beyond the acquisition of instrumental skills of decoding and encoding characters and requires, in addition to the acquisition of reading fluency, the expansion of the vocabulary and the exercise of cognitive skills and metacognitive strategies (among these, the ability to make inferences is fundamental) (Rizzo, Traversetti & Pellegrini, 2023). In fact, several studies mention the inferential components (which allow to obtain implicit information in the text) and the metacognitive ones as aspects lacking in subjects who have difficulties in understanding the text (Oakhill & Cain, 2007).

Specific difficulties in inferential areas can be diagnosed and remedied through dynamic assessment tools (Piacenza, 2023). Memory, inferences and metacognition are fundamental for text comprehension (Tzeng, Van Den Broek, Kendeou & Lee, 2005) as well as the ability to solve problems (Trinchero & Piacenza, 2020). In the treatment of difficulties related to text comprehension, training courses for learning based on metacognitive strategies are used, which work on the student's awareness, focusing on the analysis of a task; in this way the student develops the mental habit of questioning, planning and finding resolution procedures.

In the experiment, CLPS Training was used to enhance the thought processes defined by the RIZA model (Trinchero, 2018) which allows the operationalization of the competent action of the student in new problem-situations through four components: Resources (knowledge, skills, personal, social and methodological abilities, attitudes, values), Interpretation structures (correctly assign meaning to the situation and choose appropriate strategies to deal with it), Action structures (activate operational strategies to achieve the goal), Self-regulation structures (analyze and review one's own assignments of meaning and actions). These thought structures are nothing other than the exercise of specific cognitive processes that have a specific role in assigning meaning, acting and reflecting.

The CLPS training works both on the thought processes defined by the RIZA model and on the development of attitudes towards the task, socio-emotional and relational skills (Trinchero & Piacenza, 2020).

The objective of the training path defined by the CLPS training (11 batteries of 12 activities, from 3 to 14 years) is to lead the student to develop effective strategies to extract information and meanings from texts, draw conclusions, analyse problems and identify the knowledge necessary for resolution. This is achieved by proposing the reading of narrative, descriptive, regulatory and argumentative texts and asking students, organized in moderately heterogeneous pairs, to answer

questions that stimulate the thought processes described. The conduct of any Training activity uses the Experiential Learning Cycle - C.A.E. (Trinchero, 2022) includes the following phases:

1. Problem solving in heterogeneous pairs.
2. Explanation of the solutions forced by the pairs (speaker).
3. Analysis of the solutions (good/questionable, teacher with students).
4. Presentation of the optimal solution.
5. Application of the principles exposed to the next problem situation.

Overall, the teaching action based on tools graduated by complexity and on mediation within the C.A.E., facilitates the development of the students' proximal development area.

3. The starting point of the research

The research carried out by applying the Cognitive Training of Reading Comprehension, Logic and Problem Solving (CLPS), involving four groups of the primary schools of the I.C. Perugia 7. The sample consisted of 82 children. The analysis also considered the actual data for SEN students with a sample of 16 children. The starting point of this experimental research is the analysis of the standarlized test of Invalsi, referring to the school year 2022/2023 in the 2nd class (currently third) of primary school where it emerges the following data: for Italian language the experimental class reports a higher score (73.3) than the control class (69.1).

The INVALSI mathematics test referring to 2022/2023 shows:

The trial class scored lower (70.5) than the trial class (77.2). (The school's RAV for Perugia for the year 2023).

From the results of the INVALSI tests of the Italian carried out in the second (currently fourth) experimental and counter-class, referring to 2021/2022, it emerges:

- The experimental class achieved a higher score (71.8) than the control ones (64.4)
- The INVALSI mathematics test referring to 2021/2022 shows
- The experimental class achieved a higher score (62.4) than the control class (49.8) (The school's RAV for Perugia for the year 2022).

3.1. The research project

This project focused on the ability to actively participate in discussions, mathematical problem solving and text comprehension through cognitive interaction with classmates and teachers. The cognitive activation of the students (bringing out and working on their current knowledge, skills and competences) was the main goal.

The cognitive training involved students and teachers of the primary school. The activities proposed to teachers aimed to produce an immediate impact on the teaching action. The teachers were followed *in itinere* via online for two hours each for five meetings. During these meetings, the trainer guided the teachers in the use of CLPS Training. The activities were improved in the classroom by the trainees for a total of 12 weekly meetings. The trial period began in February 2024 and ended June 2024 for approximately two and a half hours per activity.

The trainer and the teachers met regularly, every 4 sessions, to monitor the progress of the experiment and to adapt the subsequent lessons. The effectiveness of the training and its impact on the pupils was assessed by means of pre-post test, which were also given to the control groups. Specifically, there were two third classes (experimental and control) and two fourth classes (experimental and control). The teachers submitted a 'pre-test' (initial test, before the intervention) and a 'post-test' (final test, after the intervention).

The pre-test allowed us to check the level of the students in relation to the expected objectives, before starting the training and teaching activities. The post-test verified the acquisitions resulting from these actions in relation to the objectives. The tests showed increases for each student through the statistical test of differences (which determines the likelihood that a significant number of students have improved) and “Student T-test for paired samples” (which determines the likelihood that, for each student, there have been significant increases between the results of the pre and post-test).

3.2. Tools used for initial assessment

In order to obtain a clear and scientifically accurate picture for the initial analysis of student data, the following standardised operational tools were used:

1. The SPM test (Lucangeli, Tressoldi & Cendron, 2013) is a standardized test that allows assessment of the learning level of calculation and the problem-solving capability.
2. The LCT (Trinchero, 2018) evaluates the students' understanding of texts.
3. The LPC (Trinchero, 2018) assesses students' competence in mathematics.

The assessment were collectively administered to the entire class during the morning instructional period, with each test conducted in immediate succession.
The findings enabled the identification of the educational levels represented in the sample population. The questionnaire, which was developed in accordance with Moreno's sociogram, was also administered to students in the experimental group. Students pairs were then formed based on specific criteria, using the performance outcomes from the initial assessments and the analysis derived from the sociogram:

- Low test results (SPM, LCT and LPC)
- High test results (SPM, LCT and LPC)
- High popularity in sociograms
- Low popularity in the sociogram (isolation)

The students who reported a low performance on the SPM, LCT and LPC tests or low relation through Moreno's sociogram were matched with classmates who reported higher results, to form balanced and heterogeneous pairs.
In each pair, a speaker was chosen: the role was entrusted to the student who presented greater difficulties with the aim of making them more involved in the learning process and to make it more visible in case of isolation.
The results allowed us to obtain information about the level of the two classes. The tests that were used were administered to the class as a whole, during morning lessons.

3.3. Results of the experimentation

The results of the experimentation, produced by the analysis of the quantitative data, emerging from the initial and final tests (SPM, LCT and LPC) for both classes are presented below. A bivariate analysis, with the technique of differences between variables pre−post was chosen, by using the statistical package JsStat analysis were obtained. Results are highlighted based on: − Repeated results (paired samples) − Difference test − WIlcoxon t-test − Student's t-test − Cohen's d-index − the Bi−Serious point correlation coefficient − identified Effect Size.

The variables taken into consideration are the incoming results (initial test) and the output results (final test) developed by the two groups, then the incoming and outgoing results were analyzed considering the population of SEN students in both cities.

Class	Teachers meetings with trainer	Training with the class	Improved	Worsened	Stable	Significance	Starting level	Increment	Standard deviation	Significance	ES (Cohen D)
Ciari 3rd experiment	5 10hrs	12 30hrs	17	2	0	0.001	36.37 over 19	+7.5	5.17	0	0.9
Ciari 4th experiment	5 10hrs	12 30hrs	14	8	0	0.286	52,41 over 22	+3.5	8.17	0.055	0.3
Ciari 3rd SEN	5 10hrs	12 30hrs	3	1	0	0.625	26.5 over 4	+5.2	5.54	0.154	0.85
Ciari 4th SEN	5 10hrs	12 30hrs	5	3	0	0.727	41.63 over 8	+0.9	9.99	0.19	0.75
Green 3rd control	-	-	17	3	0	0.003	36.6 over 20	+6.5	6.73	0	0.9
Green 4th control	-	-	17	3	1	0.007	44.67 over 21	+9	7.38	0	0.87
Green 3°SEN	-	-	-	-	-	-	-	-	-	-	-
Green 4°SEN	-	-	3	1	0	0.625	43.75 over 4	+8,5	8.99	0.155	0.64

Table 1. Results of SPM Test referred to the 3rd and 4th classes

The results of the pre−post SPM tests (Table 1) show a statistically significant improvement for both groups involved, with a positive increase of 7.5 for the third class and 3.5 for the fourth class compared to the initial tests.

The positive increase is also found in the sample of SEN pupils with a higher value in the third class than in the fourth class, where the composition of the SEN pupil is largely heterogeneous.

In the experimental fourth-class, 14 students improved, while 8 worsened. The teachers reported that they submitted the final tests in the second part of the morning, while the initial tests were submitted in the early morning, this may have affected the students' performance (greater stress and less concentration). The improvement also occurred in the control classes, also for the SEN students, the control classes carried out the tests started under the same conditions (first part of the morning). The other element to be taken into account is the number of hours

per week of school attendance, the experimental classes attend a moderate time (27 hours), the control classes attend full-time (40 hours).

Class	Teachers meetings with trainer	Training with the class	Improved	Worsened	Stable	Significance	Starting level	Increment	Standard deviation	Significance	ES (Cohen D)
Ciari 3rd experiment	5 10hrs	12 30hrs	15	4	0	0.019	5.84 over 19	+1.9	2.47	0.004	0.7
Ciari 4th experiment	5 10hrs	12 30hrs	9	8	5	0.523	7.68 over 22	+0.04	2.48	0.932	0.01
Ciari 3rd SEN	5 10hrs	12 30hrs	3	1	0	0.625	3.75 over 4	+1.5	2.18	0.262	0.68
Ciari 4th SEN	5 10hrs	12 30hrs	3	4	1	0.727	5.25 over 8	−0.9	3.1	0.451	−0.43
Green 3rd control	-	-	11	9	0	0.824	4.95 over 20	+0.2	2.62	0.736	0.08
Green 4th control	-	-	7	10	4	0.189	6.43 over 21	−0.4	2.06	0.406	−0.13
Green 3°SEN	-	-	-	-	-	-	-	-	-	-	-
Green 4°SEN	-	-	1	3	0	0.625	7 over 4	−0.8	3.63	0.707	−0.22

Table 2. Results of LCT tests referred for the 3rd and 4th classes

The results of the pre−post LCT tests (Table 2) showed a positive increase for both experimental classes, also in this case in the experimental fourth class there were 8 worsened students and 5 stables, compared to 9 improved; there was a decrease referred to the SEN group of the fourth class. Teachers reported that the composition of the fourth class in the experimental group is very heterogeneous and that there are 8 SEN pupils with different diagnoses and with the presence of comorbidities, compared to half the number of SEN pupils in the fourth class in the control group; taking this into account, the decrease for the SEN population in the two groups (experimental -0.9, control -0.8) differs by 0.1.

The data for the control group show a decrease for the fourth class (-0.4) compared to a slight increase for the experimental class (+0.004). The third experimental class showed an increase of +1.9 compared to +0.2 for the control class. The data for the SEN pupils of the third experimental class showed an increase of +1.5, while for the third control class they are not relevant as there are no certificates.

Class	Teachers meetings with trainer	Training with the class	Improved	Worsened	Stable	Significance	Starting level	Increment	Standard deviation	Significance	ES (Cohen D)
Ciari 3rd experiment	5 10hrs	12 30hrs	12	3	4	0.359	3.37 over 19	+1	1.51	0.003	0.87
Ciari 4th experiment	5 10hrs	12 30hrs	16	5	1	0.052	3.73 over 22	+1.7	2.38	0.003	0.76
Ciari 3rd SEN	5 10hrs	12 30hrs	2	2	0	1	3,5 over 4	+0.2	1.3	0.726	0.22
Ciari 4th SEN	5 10hrs	12 30hrs	5	3	0	0.727	2.88 over 8	+0.7	2.33	0.393	0.51
Green 3rd control	-	-	10	5	5	1	2.7 over 20	+0.5	1.83	0.195	0.33
Green 4th control	-	-	12	4	5	0.664	2.95 over 21	+0.5	2.17	0.377	0.25
Green 3°SEN	-	-	-	-	-	-	-	-	-	-	-
Green 4°SEN	-	-	3	0	1	0.625	1.75 over 4	+0.7	0.43	0.041	1.39

Table 3. Results of LPC tests for 3rd and 4th classes

The results of the pre−post LPC tests (Table 3) showed a positive increase in all the classes, both experimental and control, and in the groups of SEN students, which reported the same increase (+0.7). It should be noted that the increase is greater for the experimental classes (third: +1, fourth: +1.7) than for the control classes (third: +0.5, fourth: +0.5). This last data could refer to a greater decrease in attention in the execution of the LPC test by the control classes, submitted as third and last test, while the experimental classes maintained their attention towards the task for a longer time, this element is also confirmed by the observations made by the teachers**.**

3.4 **Analysis of logbooks**

During the experimental phase, teachers conducted direct observations of the development of the 12 cognitive training activities, traditional teaching methods, and student-produced work. In order to obtain a clear and scientifically accurate picture for the initial analysis of student data, the following standardised operational tools were used. The most important observations in the logbooks, made by the teachers of the experimental units for each classroom work session, are summarized below (Table 4).

Class	Analysis Of Logbooks/Students Papers
3rd Class Primary School Bruno Ciari	The following observations can be deduced from the logbooks: the majority of students have increased their participation during the meetings, which have recurred. In May, during the development of the final three meetings, greater difficulty was encountered in maintaining the attention level of the working pairs. The teachers argued that this was due to the approach of the end of the school year, which led to increased difficulties in working together. An analysis of the workpapers indicates a consistent utilisation of strategies from the first meeting to the tenth, including the verification of text and answers, the formulation of numerous inquiries, the highlighting of salient information, the inscription of the question reference number, the employment of diverse colouring, the formulation of concise responses to optimise time management, the allocation of tasks, the utilisation of illustrations and diagrams, and the adoption of a nonchalant disposition in the experience phase to engage the least proficient partner. As the tests were being developed, the teachers noted an enhancement in the manner in which the tests were being executed. The students appeared to be more focused and exhibited reduced levels of stress in comparison to the initial tests.

Class 4th Primary School Bruno Ciari	The analysis of the logbooks reveals the challenges encountered by some pairs in interpreting the texts. It was evident during the course of the activities that a number of the students were exerting considerable pressure on their classmates experiencing difficulties. However, this was perceived by some of them as an overly arduous task. An analysis of the workpapers reveals a greater utilisation of strategies from the initial meeting. These strategies encompass collaborative efforts, highlighting and circling key data points, reading questions first followed by the text, answering known questions first, creating simple and clear diagrams or drawings with captions, formulating concise answers to optimise time management, assigning tasks, employing double-entry tables, referencing the text, utilising different colours, facilitating mutual control and comparison, and engaging all participants. It has been demonstrated that gaps in attention become more prevalent in circumstances where the complexity of the activity is elevated.

Table 4. Analysis of logbooks and students papers

The teachers assigned a positive judgment. This was with respect to the interventions carried out in the classroom. These were carried out with the use of CLPS Training. The interventions led to an improvement which was in a part of the students' ability to argue their own ideas. It also improved their aptitude to interact with their classmates reporting that students were able to be more concentrate on the tasks.

3.5 Observation of the work sessions

The following tables (*tables n° 5 e n°6*) report the attitudes observed during the work sessions by both experimental classes and the feedback emerged during the activity and from the analysis of pairs paperwork.

Attitudes Observed	Description	Feedback/outcomes during activities
Collaboration between students in the pair	The students of the couple discuss and find solutions in agreement.	PT1: Children report that this way of working allows them to get to know their peers better, learning their strengths and weaknesses. PT3: there is serenity and there is a commitment from everyone to make their own contribution. PT4: increase in participation, especially of children who only tend to be pulled by others.
Self-esteem	Pupils increase confidence in themselves by being able to contribute to the resolution of problems and by arguing the solutions.	PT3: Students are satisfied with the work they have done. Progress is evident in all pairs. PT4: Couples report greater ease in answering questions and feel more confident in facing the tasks proposed. PT7: Students show a more confident attitude towards their ability to resolve.
Perseverance on the objective	Students maintain the needed concentration to develop the entire activity, finishing the workpaper by producing coherent and contextual answers.	PT3: Almost all the couples completed the questionnaire with coherent answers and in line with the questions.
Better time management during the activity	The students in the couples find strategies in order to respond to increased number of questions and complete the given tasks	PT3: Progress in time management, thanks to the implementation of strategies such as: division of tasks and formulating shorter answers

Table 5. The 3rd Class, Bruno Ciari, Primary School, Perugia 7

Attitudes Observed	Description	Feedback/outcomes during activities
Generation of strategies	Students apply the strategies learned in different areas/outside the work developed during the training.	PQ6: The pairs state that they paid more attention during the reading of the text, than before and that they use some of the strategies that emerged during homework development (solving mathematical problems). A little girl says she applies the strategies in other contexts and expects a reduction in execution time. Teachers realized an increase in children's vocabulary. PQ11: Before starting, the teacher discussed the experience of the "Rally Transalpino" mathematics competition, and the students state that they have worked using some of the strategies emerged during cognitive training.
Self-esteem	Students increased confidence in themselves by being able to contribute to the resolution of problems and to argue the solutions.	PQ3: The pairs reported a greater simplicity in the execution of the test and some of them realized to be improved. PQ7: Teachers find greater serenity in the development of activities, a little girl reported that after understanding the mechanism behind the first question, it is possible to answer the subsequent ones with less difficulties. PQ8: Many couples said they faced the test easier than the previous one.
Perseverance on the objective	The students maintained the necessary concentration to develop the entire activity, completing the task and producing coherent and contextualized responses.	PQ4: Teachers reported an increase in concentration on the pairs during the experience phase, discussing possible answers among themselves. The teachers reported a constantly high level of attention and motivation throughout the entire cycle. PQ5: Teachers reported a setback for some couples due to difficulties in the comprehension of the text. Anyhow, teachers reported an

		increase in the use of helpful strategies that allow the work to continue. PQ6: Following a motivational intervention (teachers encourage some couples to continue to find solutions), themselves can answer all ten questions.
Greater time management during the development of the activity	The students of the pairs found strategies to be able to answer the greatest number of questions and complete the assigned tasks.	PQ6: Couples report greater ease in dealing with the situation, find information in the text more easily, answer more questions in less time and better remember information taken from the text.
Collaboration between the students of the couple	The students of the couple discuss and find solutions in agreement.	PQ1: the members of the pairs shared the work and respected the different execution times, underlining the importance of sharing. At the time of communication and generalization. Everyone participated actively during communication

Table 6. The 4th Class, "Bruno Ciari", Primary School, Perugia 7

Conclusions

To summarize, the data collected show that the use of CLPS Training has led to significant improvement in the learning of experimental groups, with differences between the experimental call and the group of control.

Another aspect to be taken into consideration is heterogeneous composition of the experimental classes compared to the control classes. The final tests for the experimental class were submitted under a different and unfavourable condition than those which began (late morning), while the tests for the experimental class were submitted under the same conditions (early morning). The cognitive training tool is, however, able to promote an increase of attention during the development of the task and the ability to collaborate among peers, manage time and use probing strategies. The study took into consideration a small sample, it would be interesting to perform the same research on a larger population. Another limit of

this research is the time school of the classes taken in consideration. The experimental group attend 27 hours for week compared to the two groups of control which attend 40 hour for week. Finally the submission of the tests under different conditions could be relevant for the analysis of the results. In future research these elements should be taken into account.

Author contributions

The contribution is the result of a joint work of the authors; however, Maria Luisa Boninelli has elaborated the introduction, §§1, 1.1; 3.1, 3.4 Susanna Piacenza has elaborated, §§ 2, 3.2 and the conclusion; Norma Lamberti has elaborated §§ 3, 3.3 and 3.5.

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