

## Effects of an Instruction Method in Thinking Skills with Students from Compulsory Secondary Education

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The purpose of this study was to assess the effects caused by the instruction method “Think actively in academic contexts, TAAC”, an adaptation of Wallace and Adams’ (1993) method of thinking skills, creativity, self-regulation, and academic learning, with students from the second grade of Compulsory Secondary Education (CSE). We used a pretest-intervention-posttest design with control group. The sample was made up of 110 participants, aged between 13 and 15 years, 58 of them in the experimental group and 52 in the control group. Six assessment instruments were administered before and after applying the method in order to measure the dependent variables. The method, divided into eight stages, was used in all the didactic units of the syllabus content of Natural Sciences, Social Sciences, and Language, during one academic course, and allowed the conjoint teaching of thinking skills and the syllabus content. The results of the analyses of variance indicate positive impact of the intervention, as the experimental subjects improved significantly in thinking skills and academic achievement. Some interesting reflections for research and education are derived from this study.

*Keywords: thinking skills, TAAC method, creativity, transfer, and academic achievement.*

El estudio que presentamos tuvo como objetivo evaluar los efectos originados por el método de instrucción “Pensar activamente en entornos académicos, PAEC”, una adaptación del método de Wallace and Adams (1993), en las habilidades del pensamiento, la creatividad, la autorregulación y el aprendizaje académico con alumnos de segundo curso de Educación Secundaria Obligatoria (ESO). Se utilizó un diseño pretest-intervención-postest con grupo control. La muestra estuvo formada por 110 sujetos entre 13 y 15 años, 58 de ellos pertenecientes al grupo experimental y 52, al grupo control. Antes y después de aplicar el método se administraron seis instrumentos de evaluación para medir las variables dependientes. El método, dividido en ocho fases, se utilizó en todas las unidades didácticas de los contenidos de ciencias naturales, ciencias sociales y lengua durante un curso académico, y permitió la enseñanza conjunta de las habilidades del pensamiento y de los contenidos curriculares. Los resultados de los análisis de varianza sugieren un impacto positivo de la intervención, ya que los sujetos experimentales mejoraron significativamente en habilidades del pensamiento y en rendimiento académico. Se derivan de este estudio interesantes reflexiones para la investigación y la educación.

*Palabras clave: habilidades del pensamiento, método PAEA, creatividad, transferencia, rendimiento académico.*

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Learning to think skillfully is an efficient way to achieve many goals, but it is also an end in itself, the main goal of education (Csapó, 1997). However, this great challenge is not achieved spontaneously, but instead requires programmed, continuous, and assessable interventions, which are still far removed from the regular classroom environment. Therefore, it is important to investigate which methods may be effective to help students at a certain educational stage to think more and better when learning (Perkins & Grotzer, 1997).

Students need to use *reflective thinking skills* to achieve meaningful learning of the academic contents that they must select and understand; *creative thinking skills* to generate new ideas, inquire about, identify and solve problems, and create an optimistic view of their personal and social future, and *critical thinking skills* to appraise the information they receive, persuade others of its value, and apply it in many situations. These statements are based on achievements in theoretical research on the nature and functioning of thought, but also in applied research on whether the capacity to think can be trained and how to achieve this (Costa, 2001; Halpern, 2003; Sternberg, Kaufman, & Grigorenko, 2008; Swartz & Parks, 1994).

But students who are committed to the practice of thinking skills must know how their minds work, what their essential cognitive processes are, and how to regulate the learning process during its important stages: before the task, to plan; during the task, to monitor their performance, their behavioral reactions, and distribution of time and mental effort; and after the task, to assess what they have done. This facilitates making temporal and comparative judgments, examining readiness for more or different activities, and controlling one's interpretations, perceptions, decisions, and behaviors. Many studies have shown that metacognition and self-regulation are relevant to think well, to know what we know and what we don't know, to transfer what we learn, and that both variables can be taught and learned (Cohen, Freeman, & Wolf, 1996; Flavell, 1979; Nelson, 1996; Perkins & Salomon, 1992a; Pintrich, 2004; Rosário et al., 2007; Segal, Chipman, & Glaser, 1985).

An additional goal of any psychological intervention to improve thinking should be to achieve transfer of the training, that is, that the individuals who are the target of the intervention know how to use the skills taught in a variety of settings and contents. Brainerd (1975) classified transfer according to a three-level proximity criterion: near-near, when the intervention tasks and the posttest tasks are almost identical; near-far, when the intervention tasks require similar processes to the posttest tasks, but with different stimuli, and far-far, when the intervention tasks and the posttest tasks are very different in materials and cognitive processes. The last two levels are considered the appropriate ones to recognize a change in an individual's cognitive functioning (Ritchhart & Perkins, 2005; Tomic

& Kingma, 1998). According to Perkins and Salomón (1992b), another relevant aspect with regard to transfer is to decide what one wishes to transfer, for example, as in the present study, skills, knowledge and behaviors.

We are evaluating—at all levels of the Spanish educational system—the effects of the method “Think actively in social contexts” of Wallace and Adams (1993), with some different nuances. This method has the following goals: (a) to stimulate thinking skills and self-concept so that students will perceive themselves as being capable of achieving realistic goals through their own effort; (b) to facilitate the teachers' effective organization of the instruction, and the students' learning, mainly through group activities, and (c) to provide meaningful learning experiences that will help acquire the syllabus contents. As stated by Wallace and Adams, the method is based on a holistic theoretical perspective. In this sense, it proposes social interaction, intentional mediation, going step-by-step in the learning process so that the current level of performance can change dynamically to a higher one (Vygostky, 1978); it proposes activities that demand reflection, creativity, and common sense from students and teachers (Sternberg, 1985); it assumes that learning is the result of the interaction of context, behavior, and thinking processes (Bandura, 1986); it facilitates improvement of multiple intelligences (Gardner, 1983); it obliges students to be capable of regulating and judging their own behavior and making decisions to change it (Brown, 1987), and it considers essential for students to transfer the learning acquired in one context or with certain materials to their performance in another context or with other related materials (Perkins & Salomón, 1992b). This eclectic approach incorporated and synthesized of the most successful elements of the range of thinking skills projects Wallace and Adams had evaluated. Gradually, a pragmatic working model emerged for the teaching and learning of thinking and problem-solving skills and the seeds of TASC grew and blossomed.

The method has eight stages: (1) seeking information about the topic; (2) defining the learning goals (in terms of skills and contents); (3) generating new ideas about the goals; (4) deciding which ideas are more relevant to study the topic; (5) verifying the learning; (6) assessing the way the skills were practiced and the topic was studied in more depth (individually and in groups); (7) presenting to the group the achievements attained and the difficulties encountered, and (8) learning from the experience. In Table 1 is displayed a synthesis of the activities carried out in each of the stages.

The differences between Wallace and Adams' proposal and our way of interpreting it can be observed in the following aspects: (a) we called the method “Pensar activamente en entornos académicos, PAEA” (in English: “Thinking actively in academic contexts, TAAC”) because, while not neglecting cooperative learning, we

Table 1  
*Guideline of activities to carry out in each stage and didactic unit*

Stages	Activities
Organize the information about the topic	Relate to prior knowledge and personal experiences. Specify the terminology known about the topic to be studied. Seek relevant information about the content. Establish comparisons among this information. Formulate questions about the content.
Define the goals to be achieved	Describe what should be learned. Specify the goal of the thinking skill and of the contents. Consider the importance of the didactic unit from a personal viewpoint. Select the appropriate strategy to learn. Specify the evaluation criterion that will be used at the end of the unit.
Generate the largest possible number of ideas about the topic	Create many new ideas about the study content. Analyze the content from different points of view. Consult with experts on the topic. Make graphic, figurative, or numerical representations of the content. Foresee difficulties or problems with the content.
Decide which is the best idea of the topic	Arrange the ideas discussed by their importance. Select the best. Examine the consequences of the decisions made. Plan the time intervals to be devoted to the work to be carried out.
Verify the essential work of the unit	Make sure that the work is correct and the plan is being followed. Make sure the assigned time intervals are met. Maintain interest during the entire process. Ask if one is committing errors. Observe progress in studying.
Evaluate task performance	Appraise whether the goals of the skill and the contents were achieved. Detect whether errors were committed. Ask if one could improve in future activities. Evaluate personal participation in the group task.
Communicate to classmates what was learned	Present the individual work to the class group. Justify one's own ideas in front of the classmates. Contrast one's individual work with that of other groups. Compare works with the criteria formulated at the beginning of the unit.
Learning from experience	Summarize personally what was learned. Compare what is known at the end of the unit with initial knowledge. Transfer what was learned to other situations. Identify the thinking skills that were practiced during the didactic unit.

emphasize the importance of the fact that students should think about the academic contents in the language of the topic, for example, a student who is learning history should use a historical theoretical framework to interpret past and present events; (b) we introduce the strategy of simultaneously and explicitly teaching thinking skills and syllabus contents; in this sense, we clearly explain the steps to be followed mentally when performing a certain skill; (c) we integrate metacognition and self-regulation in the eight stages of the method, emphasizing the stages that prepare for or plan learning, those that verify it, and those that assess it, and (d) we promote creativity, not only in

the third stage of the method—idea generation—, but also in all the others, which develops students' expectations of self-efficacy.

In a recent investigation, we compared the effects of the PAEA method with those of the Instrumental Enrichment Program (IEP) of Feuerstein, Rand, Hoffman, and Miller (1980), with the same variables as in the present study. The results revealed that the PAEA method seems more effective than the IEP in the improvement of verbal and numerical reasoning, creativity, and academic achievement, and that both intervention strategies are satisfactory to stimulate intelligence, abstract and deductive reasoning, and self-

regulation, and that the changes achieved with the PAEA were not only maintained one year after the intervention but that, in general, they increased, an aspect that was not observed in the improvements achieved with the IEP (Sanz de Acedo Lizarraga, Sanz de Acedo Baquedano, Goicoa Mangado, & Cardelle-Elawar, 2009).

The method facilitates learning thinking skills and syllabus content simultaneously and it is based on the idea that academic study offers many chances to practice mental operations; thus, study plans can become the ideal strategy to develop cognitive skills and achieve meaningful learning (Perkins, Goodrich, Tishman, & Mirman-Owen, 1994; Swartz & Parks, 1994; Tishman, Perkins, & Jay, 1995).

### *Purpose of the study*

The main purpose of this study was to assess the effects produced by the instruction method “Think actively in academic contexts, TAAC” on the stimulation of thinking skills, self-regulation, and academic learning through the syllabus contents of Natural Sciences, Social Sciences, and Language. The general hypothesis was that, in comparison to the students from the control group (CG), the students from the experimental group (EG) who received the proposed method would obtain higher scores in the instruments used to measure intelligence, reasoning, creativity, self-regulation, and academic achievement.

## Method

### *Participants*

The sample comprised 110 participants, (57 female and 53 male, mean age 13.11 years, standard deviation .59), from second grade of Compulsory Secondary Education (CSE) from two public centers randomly selected from a total of six centers that were available to the investigators at that time. The centers were also assigned randomly, one to the EG ( $n = 58$ ) and the other to the CG ( $n = 52$ ). In the opinion of the teachers, the students’ general academic achievement was low and the parents’ socioeconomic level was medium-low, taking into account the location of the centers and other family data, although this variable was not quantified. The head of the educational center of the control group reported that some students had language problems, perhaps because they frequently spoke both Spanish and Euskera (the Basque language), two languages whose linguistic structures are different in some aspects. None of the subjects refused to participate and there were no dropouts.

### *Assessment Instruments*

*Cattell Intelligence Test, Scale 2* (Cattell & Cattell, 1973). This test evaluates general mental capacity in

subjects between 8 and 15 years old. It has 46 items that require performing the processes of comparison, analysis, synthesis, classification, and seriation. We selected this test because the above processes would be the subject of our investigation and because in opinion of others researchers is a good instrument to measure inductive reasoning (Büchel & Scharnhorst, 1993). In our study, the test had a reliability index of  $\alpha = .76$  (Cronbach’s alpha).

*Differential Aptitudes Test, DAT-5 Level 1* (Bennett, Seahore, & Wesman (1992). Only two tests from this battery were used: Verbal Reasoning (VR) and Abstract Reasoning (AR). Each one of these tests has 40 items. The VR test evaluates the capacity to apply the inductive reasoning processes of analogy, comparison, discrimination, similarity, complementing, analysis, and synthesis to verbally formulated questions, and the AR test evaluates these same processes with figures. In our study, we obtained reliability indexes of, respectively, .82, and .79 (Cronbach’s alpha) for these tests. These tests were administered because their performance also requires the activation of the processes that are taught and practiced in the intervention.

*Psychopedagogical Battery “Evaluate-8”* (García Vidal, González Manjón, & García Pérez, 2002). This battery comprises cognitive tests (inductive, deductive, and spatial reasoning), and instrumental, affective, and behavioral tests. In this study, only the Inductive (50 items) and Deductive Reasoning (23 items) tests were employed. The former evaluates the capacity to identify categories, solve verbal and figurative analogies, and discover laws that organize series. The latter evaluates the capacity to analyze deductive propositions. In our study, we obtained reliability indexes (Cronbach’s alpha) of .78 and .77, respectively, for inductive and deductive reasoning. Inductive reasoning test was selected because it objective coincides with the intervention and deductive reasoning test because its results would be interpreted as the level of transfer achieved.

*Creative Intelligence Test - CREA* (Corbalán Berná et al., 2003). This test is a cognitive measurement of creativity by means of the respondent’s generation of questions about some graphic material. The test provides a global score and has high correlations with other creativity tests such as, for example, the Guilford Creative Battery ( $\alpha = .78$ ). In our study, we obtained a Cronbach’s alpha value of  $\alpha = .76$ . This test was administered because: (a) it provides a single cognitive score of creativity, considered response fluidity, a variable that is stimulated in the intervention; and (b) the test has ecological validity for the present study because it is validated in a Spanish sample.

*Learning Strategies Scales - ACRA (Subscale IV)*. This subscale assesses the use that students make of metacognitive strategies (Román & Gallego, 1994). It contains 35 items about metacognitive knowledge and about self-regulation strategies—planning, control, and evaluation—that facilitate and support comprehension



and processing of information. Responses are rated on a 5-point Likert-type scale ranging from 1 (*never or seldom*) to 5 (*always or almost always*). Two sample items of this scale are: (a) "I mentally plan the strategies that I think will be efficient to 'learn' every kind of subject I have to study", and (b) "At the end of a test, I check whether the strategies I used were suitable to remember the acquired information." The reliability index of the scale in our sample was .74 (Cronbach's alpha). This subscale was chosen because it has been validated in Spanish population.

*Academic Achievement Tests (A and B).* These tests measure students' basic knowledge in the areas of Sciences, Language, and Social Sciences. Each test had 30 items, 10 for each subject matter. Test A (pretest) was created according to the currently established Spanish norms to measure students' academic achievement upon completion of the first course of CSE. Test B (posttest) had the same number of items and structure as Test A, but it covered the contents of the second course of CSE. Both tests were created by the teachers of the CG: the teachers proposed the items related to their subject and afterwards, they analyzed the items together to reach a final consensus about the content of tests A and B, thus guaranteeing content validity. These tests were also used by the teachers of the EG. The obtained reliability indexes (Cronbach's alpha) were .75 and .77, respectively, for Test A and Test B.

Except for the achievement tests, none of the items of the above mentioned tests was the target of specific training. This should allow us to evaluate the level of transfer achieved in thinking skills, as defended by Tomic and Klauer (1996).

### *Instruction Materials*

The instruction materials were in the form of a theoretical/practical booklet for teachers and students. The booklet presented the following contents related to the intervention: (a) operational definition and graphic organizer of each skill to be taught (see Swartz & Parks, 1994); (b) information about the activities to be carried out in the eight stages of the method: organize, identify, generate, decide, verify, assess, communicate, and learn (Wallace & Adams, 1993; Sanz de Acedo Lizarraga & Sanz de Acedo Baquedano, 2007) (see Table 1), and (c) a table of the skills to be practiced in each didactic unit (contents related to a specific topic of the syllabus content), according to the textbooks: Sciences (Barrio, Bermúdez, Faure, & Gómez, 2003), Language (Castán, Fernández, & Laborda, 2003), and Social Sciences (Sada et al., 2003).

### *Design*

The work plan we followed corresponds to a quasi-experimental design with two measures: pre- and posttest. The independent variable was the infusion method

administered to the EG and the dependent variables were: intelligence as measured by the Cattell test; verbal and abstract reasoning as measured by the DAT-5 Level 1; inductive and deductive reasoning as measured by the Evaluate-8 battery; creativity as measured by the CREA; self-regulation as measured by the Subscale IV (ACRA test), and academic achievement as measured by tests A and B.

The instruments were administered by the investigators, except for the academic achievement tests, which were administered by the teachers.

### *Procedure*

*Contacting the Centers.* The first step was to contact the directors and teachers of the school centers. They were informed about the goal of the investigation, its structure and content, and the training required for the teachers. The parents were also informed that a new teaching method would be employed with their children and that, as it was a different method from that used in previous academic courses, the children would be evaluated at the beginning and at the end of the course, in order to appraise its effects.

*Training the Teachers.* At the end of the academic course prior to the intervention, the three teachers of the EG (with between 10 and 16 years of professional experience) participated in a 30-hour training seminar in which we explained: (a) thinking, creativity, and self-regulation skills and the possibility of improving them; (b) the new instruction method and the activities to carry out at each stage; (c) integration of the thinking skills and the syllabus contents, and (d) transfer of what was learned. The CG teachers (with between 6 and 12 years of professional experience) participated in a 10-hour seminar in which they explained their habitual teaching methods and how they prepared academic achievement tests. The hours the teachers spent in the seminars were acknowledged by the educational centers as part of their permanent training time.

The teachers of both study groups, EG and CG, were not the object of special selection. The investigators had access to the centers and there was no problem for the teachers of Natural Sciences, Social Sciences, and Language to participate in the investigation. In the training seminars they received, they learned to be effective facilitators of the learning process.

### *Student Participation*

*Pretest.* At this stage, all the participants were evaluated in the target variables by means of collective administration of the following instruments, in three sessions: (a) Cattell, CREA, Evaluate-8, and VR; (b) ACRA and AR, and (c) the Academic Achievement test A.

*Intervention.* The intervention consisted of the use of the infusion method in the EG and the conventional method in the CG for one academic course (September to June).

On the first day of class, the teachers informed the students that: (a) in the subjects of Natural Sciences, Social Sciences, and Language, they would be using a new method that would help them to think better about the study content; (b) the purpose of the course was two-fold: particularly, to improve their thinking skills and academic achievement; (c) to achieve these goals, they should work responsibly, both individually and as a group; and (d) the method would be used in each didactic unit and the duration would be approximately three weeks (four hours per week).

At the beginning of each didactic unit, the teachers focused on the skill, self-regulation, creativity, and transfer. They explained the *skill* that would be practiced, analyzing the steps to be taken mentally to practice it. For example, analysis and synthesis require the following steps: (a) what things or parts make up the whole, a story? The characters, time and place, plot, conflict, narrative point of view, main idea, etc.; (b) what would it happen if one of these parts were missing, for instance, time and place? The reader would not know where or when the story takes place or who were the characters; (c) what is the function of each part? The characters are the actors in the story, time and place provide the story a basis for the action and dialogue that occur, the plot makes the reader want to read on to see what happens next, conflict gives the character something to overcome, etc., and (d) how do the parts act together to make the whole or how does it work? What is the relationship between the parts and the whole? As the characters become involved in the plot, which is based on the time and place the story occurs, they solve some kind of conflict. All of this is told through the narrator's point of view. In the story, the elements interact with the main idea.

The teachers stimulated *self-regulation* by grouping the eight stages of the method into three phases: before learning (organizing, identifying, generating, and deciding), while learning (verifying), and after learning (assessing, communicating, and learning from the experience), showing how the important each one of these moments is, teaching how to select the skills needed to solve a problem or acquire a certain content, and inviting the students to constantly inquire why they are performing a certain task and how effective their performance is.

Also, in each didactic unit the teachers encouraged to students to produce and combine new and different ideas, ask profound questions, respond unusually to ideas, questions, tasks or problems, shift from "what is" to "what might be," challenge conventions and assumptions and think independently, in all stages of the method, mainly in the third phase of the method, generating ideas. Students should attempt to list many possibilities about the topic, decision and solution alternatives, and diverse viewpoints, which Chappell, Craft, Burnad, and Cremin (2008) call "possibility thinking," a conceptualization of creativity as a

common core across domains of activity, and which Costa (2006) calls an approach to critical thinking in creativity.

And, lastly, the teachers improved *transfer* by: (a) teaching the steps of the skill in the diverse curricular contents; (b) applying the skill within and outside of the educational environment; (c) inviting the students at the end of each didactic unit to answer several questions, such as: on what aspects did I work well during this unit? Which aspects were more difficult? What should I do to improve in the next unit? How could I use what I learned in this unit in other situations?; (d) building bridges from the context of learning to other contexts of potential application, and (e) asking students to brainstorm about how whatever they learned from the unit might be applied elsewhere, to establish a mindset for transfer. That is, one of the specific tasks of the last stage of the method, learning from experience, is to propose situations in which what was learned can be used.

The CG students were taught as is customary in the Spanish educational system. This system focuses mainly on teaching the syllabus contents: the teachers explain the lessons, propose an example and assign tasks related to the knowledge they want the students to acquire, and the students study at home or carry out the prescribed tasks, hardly participating in group activities because these take up too much time. The teachers subsequently evaluate the students' academic achievement, usually requesting the mere repetition of whatever was taught. Such learning is achieved with minimum and shallow comprehension, and as a rule requires the students to memorize or retain facts (simple recall). We asked the head of the educational center of the control group whether they were using any educational innovation with their students. The answer was that they followed the curricular contents proposed by the Ministry of Education. This way of teaching, which we call "conventional method," does not take into account the thinking skills needed to achieve meaningful and profound learning of the curricular content, nor does it assess the cognitive processes that are activated during learning.

During the intervention, the investigators visited the experimental group once a week as observers and, at the end of each school term, they met with the teachers to analyze certain aspects of the intervention process. The teachers' attitude was positive from the start and when they were informed about the goal of the study, they agreed to participate actively. Both the EG and the CG used the same textbooks and studied the same didactic units (see Annex 1).

*Posttest.* In order to determine the effects of the intervention, upon completing it at the end of the academic course (in June), the students from both groups were evaluated by administering the same tests (except for Academic Achievement Test B, which substituted Academic Achievement Test A) and in the same order as at pretest.

Table 2

Means, standard deviations, ANOVAs of the EG and the CG at pretest and posttest, and pretest-posttest ANCOVAs

Performance Indicators	Pretest			Posttest			ANCOVA Pre-Posttest <i>F</i> Eta ( $\eta^2$ )
	EG <i>n</i> = 58	CG <i>n</i> = 52	ANOVA <i>F</i> Eta ( $\eta^2$ )	EG <i>n</i> = 58	CG <i>n</i> = 52	ANOVA <i>F</i> Eta ( $\eta^2$ )	
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )		<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )		
Intelligence	23.59 (3.65)	23.83 (3.12)	.14 --	26.52 (2.72)	25.02 (2.79)	8.13** .07	14.55*** .13
Verbal R <sup>1</sup>	20.53 (2.19)	19.67 (2.08)	4.45* .04	21.55 (1.91)	19.94 (1.87)	19.81*** .16	43.30*** .30
Abstract R <sup>1</sup>	21.88 (2.71)	22.15 (2.77)	.11 --	24.69 (2.39)	22.42 (2.71)	21.76*** .17	116.77*** .54
Inductive R <sup>1</sup>	27.74 (3.08)	27.63 (3.76)	.28 --	29.66 (2.70)	27.83 (3.59)	9.23*** .08	90.40*** .48
Deductive R <sup>1</sup>	13.28 (1.76)	13.35 (1.68)	.05 --	14.71 (2.09)	13.54 (1.58)	10.73*** .09	65.58*** .40
Creativity	12.62 (2.02)	12.71 (1.32)	.08 --	14.45 (2.20)	12.81 (1.24)	23.49*** .19	55.08*** .36
Self/regulation	94.97 (3.53)	95.19 (4.06)	.10 --	97.84 (3.29)	95.13 (4.13)	14.66*** .12	101.33*** .51
Academic A <sup>2</sup>	5.55 (.68)	5.58 (.56)	.05 --	6.24 (.80)	5.69 (.51)	17.96*** .14	21.90*** .18

$p > .05$ ; \*\*  $p > .01$ ; \*\*\*  $p > .001$

R<sup>1</sup> = Reasoning; A<sup>2</sup> = Achievement

## Results

The results of the MANOVA carried out on the set of variables revealed that, before the intervention, there were statistically significant group differences, Wilks' Lambda = .79,  $F(9, 100) = 2.91$ ,  $p = .004$ ,  $\eta^2 = .21$ ; the ANOVAs only yielded significant differences in the variable verbal reasoning,  $F(1, 108) = 4.45$ ,  $p = .037$ ,  $\eta^2 = .04$ , in which the performance of the EG was superior ( $M = 20.53$ ) to that of the CG ( $M = 19.67$ ). Therefore, at the start of the investigation, the two groups were relatively homogeneous in the criterion variables to be trained (Table 2). This EG superiority in verbal reasoning might be due to the mutual interference of Spanish and Euskera.

The MANOVA carried out on the posttest scores revealed statistically significant group differences in all the variables after the intervention, Wilks' Lambda = .663,  $F(9, 100) = 5.65$ ,  $p < .000$ ,  $\eta^2 = .34$ ; the respective ANOVAs ratified these differences with effect sizes or proportion of explained variance for each variable with values that

ranged between lowest ( $\eta^2 = .07$ , in intelligence) and low ( $\eta^2 = .19$ , in creativity), according to the criterion proposed by Cohen (1988), who defined effect size as small ( $d = .2$ ), medium ( $d = .5$ ), and large ( $d = .8$ ).

To better control the regression towards the mean of the data and to eliminate the effects of the pretest scores on the posttest score (Bonate, 2000), we carried out a pretest-posttest MANCOVA, using the pretest scores as covariates, obtaining significant differences in the students' performance, Wilks' Lambda = .204,  $F(9, 91) = 39.56$ ,  $p < .000$ ,  $\eta^2 = .80$ . The ANCOVAs confirmed these significant differences, reaching effect sizes that ranged between low ( $\eta^2 = .13$ , in intelligence) and medium ( $\eta^2 = .54$ , in numerical reasoning). The increase in the posttest measures compared to the pretest ones was significant for the EG but not for the CG (Table 2).

Therefore, the EG students benefited more from the instruction method, as their performance was superior to that of the CG in all the dependent variables. They improved significantly in thinking skills, creativity,

self-regulation, and academic achievement and they showed a high degree of transfer of what they had learned to the reasoning and intelligence tests.

### Discussion

This study has shown that the method “Think actively in academic contexts” stimulates cognitive functioning, verbal reasoning, abstract reasoning, inductive and deductive reasoning, creativity, self-regulation, and academic achievement in second-grade students of CSE. Thus, this method has been validated, as it was more effective than the conventional instruction method. It could be said that the students who participated in the investigation used comprehensive thinking skills (comparison, classification, analysis, synthesis, and seriation), creative thinking skills (generation of ideas) and critical thinking skills (causal analysis and prediction of effects and analogical reasoning) when they studied and regulated the stages (before, during, and after) of the teaching-learning process, which verifies the general work hypothesis.

The investigation we present corroborates many other results that have suggested the possibility of improving thinking skills, as well as creativity, self-regulation of behavior and learning, and transfer of learning (Amabile, 1996; Baron & Sternberg, 1987; Boekaerts, 1997; Cropley & Urban, 2000; Halpern, 2003; Klauer, 1998; Nickerson, 1989; Perkins & Grotzer, 1997; Pintrich, 2004; Pressley & Woloshyn, 1995; Richards, 2007; Rosário *et al.*, 2007; Runco & Sakamoto, 1999; Sanz de Acedo Lizarraga *et al.*, 2009; Sanz de Acedo Lizarraga, Ugarte, M. D., Iriarte, M. D., & Sanz de Acedo Baquedano, 2003; Schunk & Zimmerman, 1998; Sternberg *et al.*, 2008; Swartz & Parks, 1994; Tomic & Klauer, 1996).

In this study, we reached, at least, the second level of transfer—the near-far level—in Brainerd’s (1975) categorization; that is, the skills practiced during the intervention were generalized to the problems posed in the intelligence and reasoning tests used, which were not the target of treatment. Also, the fact that the EG achieved improvement in academic achievement indicates that the treatment provided learning strategies that were transferred to real study situations. It has always been stated that thinking skills facilitate comprehension and acquisition of syllabus content (Perkins & Salomon, 1989).

In general, the data could indicate that thinking skills, creativity, and self-regulation are not learned unless the school emphasizes their importance, teaches them explicitly, and uses them continuously, and unless content is not considered an end in itself but a vehicle that activates and engages the inquiring mind.

Despite the achievements, this study also has some limitations, some of which are: (a) we assessed the effects of the method only with standardized tests and we did not

take into account other more procedural measures; (b) as in other interventions, the teachers and students may have been particularly interested in the new method; if this is the partial or entire cause of the higher gains of the EG, we gladly accept this limitation, and (c) we did not include follow-up measures to assess the permanence of the changes over time. Also, we had some difficulties related to the method, for example: the restrictiveness of content dominated formal curricula; the suddenness of the increased emphasis on a skills-based approach; the need to successfully train the teachers in thinking skills; the lack of experience on the part of pupils to cope with increased cognitive demands, and initial problems experienced by pupils who are unused to co-operative learning procedures and techniques.

Summing up, it is evident that thinking skills can notably enrich the quality of the results of the educational system; therefore, researchers should continue to work to make the stimulation of such skills a common educational goal in schools. This investigation contributed a new style of teaching and learning that seems effective in CSE, where an absence of this kind of initiative in the educational method is observed.

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## APPENDIX 1

### DIDACTIC UNITS THAT WERE STUDIED DURING THE INVESTIGATION

Natural Sciences	Social Sciences	Language
Material and energy.	Population: evolution and emigration.	Functions of language. Emphasizing words. Literary genres.
Forces and their effects.	Economic, social, and culture society.	Speech and its classifications. Narrative genre.
Heat and temperature.	States and international organizations.	Plot. Syntagma. Novel: its history.
Sound and light.	Africa and Asia: population and economy.	Variations in language. Tales and stories.
Chemical changes in material.	America and Europe: population and economy.	Work techniques. Verb complements. Narration.
External geological agents.	Medieval history: German, Byzantine, and Islamic power.	Preparation and presentation of works. Verb complements.
Earth-external energy.	Birth of Europe.	Simple sentence. Dramatic genre.
Earth-internal energy.	Feudal society.	Explanatory text. Lyrical poetry.
Functions of living beings.	Emergence of cities and European kingdoms.	Letter, note, and notification. Parts of a text. Verse measurements.
Material and energy in ecosystems.	The Iberian Peninsula between the 11 <sup>th</sup> and 15 <sup>th</sup> centuries: politics, arte, and religion.	Verbal and nonverbal communication. Capital letters and punctuation marks.