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INTERACTION AND COGNITIVE DEVELOPMENT: COGNITIVE MOBILIZING PATTERNS (CMP)

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The data presented here was obtained within the context of a broader study related to the thinking skills programme "Comprehending and Transforming (C&T)" (Mora, 1991, 1995, 1997). The sample was made up of three groups of schoolchildren that participated in this programme with differing pretest-posttest gains. We hypothesized that it is teachers' different interaction styles in the classroom that explains the different results of each group. In order to confirm this, an observation instrument was developed and 26 programme videotaped sessions were analyzed. Results support the idea that certain aspects of interaction (which we call "Cognitive Mobilizing Patterns") are relevant for the stimulation of thinking skills. Conclusions point to the need to incorporate these patterns into the training of those responsible for implementing C&T.

Este trabajo se ha realizado en el contexto de otra investigación más amplia en torno al programa de estimulación de habilidades de pensamiento "Comprender y Transformar (CyT)" (Mora, 1991, 1995, 1997). Hemos partido de tres grupos de escolares que han seguido el citado programa con ganancias distintas en un estudio pretest-postest. Tomamos dichos grupos como sujetos de nuestra investigación y propusimos la hipótesis de que es el distinto estilo de interacción en el aula que mantiene cada aplicador el que explica la diferencia de resultados. Con objeto de comprobarla procedimos a la construcción de instrumentos de observación y al análisis de 26 sesiones de aplicación del citado programa grabadas en vídeo. Los resultados confirman la hipótesis destacando algunos aspectos de la interacción (a los que denominamos "Patrones de Movilización Cognitiva") como relevantes para la estimulación del pensamiento. Como consecuencia, la formación de los aplicadores de CyT debe incorporar el entrenamiento para la activación de dichas pautas de interacción.

This work was carried out within a research line on cognitive facilitation programmes, also called *programmes for improving intelligence* or for *teaching thinking*. Specifically, it is related to the programme for stimulating thinking skills called Comprehending and Transforming (C&T) (Mora, 1991, 1995, 1997).

C&T is a metacognitive guidance programme aimed at school pupils with special educational needs of sociocultural and organic etiology, designed so as to be applied by teachers themselves within the school context. Assessment of its impact has indicated its effectiveness for producing significant and relevant cognitive improvement as measured by means of a criterion battery (with measures of fluid and crystallized intelligence) according to a pretest-posttest design in which each experimental group had its corresponding control group. Other qualitative data contributed by teachers applying the programme and by external observers confirm the psychometric results, as well as showing other effects, such as attitudinal improvements and progress in psychosocial and self-regulation skills, which are in fact, according to the teachers, even stronger than the purely cognitive ones (Mora, 1991, 1995).

However, it is one thing to show that C&T has led to improvements in thinking skills; it is quite another to analyze the mechanisms through which it operated. It seems obvious that the type of objectives pursued with C&T, the activities involved, the materials it provides, the methodology it recommends and the intervention scheme that guides it are far from irrelevant elements, but it is also quite clear that not all experimental groups have progressed in the same way. We therefore believe that empirical assessment of the programmes should not be restricted to identifying the direct or indirect effects; rather, it is necessary to look into the mechanisms that give rise to change, with the aim of improving them (Alonso Tapia, 1987).

One way of responding to the problem raised is to turn to the programme's theory, which provides a theoretical-explanatory framework that allows researchers to interpret and make sense of what is observed. Kemmis

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(1993) refers to "practical theory", which would permit us to understand and guide action. Elsewhere (Mora, 1995), we have presented the C&T theory indicating which elements produced cognitive improvement and in what conditions.

In the present work we aim to analyze from an empirical perspective the causal mechanisms of the change observed in pupils to whom the C&T programme was applied. The assessment strategy is based on the fact that the level of improvement achieved differed across the groups. Given that there is concordance between the gradation of the progress found in the psychometric results and in the qualitative assessments made by the appliers and external observers, we can put the groups in order according to their greater or lesser improvement. From that point on, it is a question of identifying the differences in the treatment received by each one in order to try ad recognize the elements that lead to success.

On the basis of the preliminary information available, we proposed the hypothesis that it is the different interaction style used in the classroom by each applier of the C&T tasks that explains the different results obtained in the assessment of the programme's impact. Should this hypothesis be confirmed, the training of appliers in the interaction style shown to be especially advantageous would be a key variable to take into account for optimizing results.

METHOD

Participants

The participants in this study were three groups of pupils of both sexes from three schools in Seville (Spain) who took part in a C&T cognitive enrichment programme with differing results as regards gains in the measures of cognitive development. One of them was made up of pupils from three classes in a special education centre that joined together for the application of the programme. The other two corresponded to groups from two different centres for special educational attention. Henceforth we shall refer to them in the following way: group A denotes the group with the best results (that is, with high gains after application of the programme), group M denotes the group with intermediate results and group B refers to the group with null progress and irregular application of C&T.

Instruments

We had access to 18 hours of video recordings corresponding to 26 sessions of application of C&T (although the initial sample was of 30 sessions, we had to eliminate four because of technical problems that made it difficult to hear the recording). Of these, 13 sessions corresponded to group A, 7 to group M and 6 to group B. The recordings were obtained over different periods of time, with intervals of months in some cases; thus, with this type of sampling we were able to discover features of teaching behaviour that were persistent over time, at the same time as avoiding biases due to the content of the unit being developed.

Following the procedure described below, we designed a system of observation categories and a registration sheet on which we noted the results of our observations.

Procedure

From the set of sessions we selected a sample made up of recordings of each one of the groups formed in accordance with their different cognitive improvement (groups A, M and B). We thus obtained an initial set of behavioural features representative of the teaching skills considered as stimulating improvement, following the criterion that such features appeared habitually in the group with the highest gains and were practically nonexistent in the lowest gains group, and that there were theoretical arguments supporting the enriching nature of such teaching behaviour (Mora and Aguilera, 1992).

Subsequently, the same sample was analyzed separately by three groups of independent observers: teachers that applied C&T, people that had acted as external observers during the development of the programme, and colleagues of the present authors from the Department of Developmental and Educational Psychology at the University of Seville. In each case the instructions given were that each observer was to describe what he or she had seen, noting down everything that seemed relevant, that was repeated over the course of the session, that appeared positive or negative, or simply that caught their attention. The aim was to do what, according to Erikson (1977), qualitative research does best, that is, to relate key incidents in functionally relevant descriptive terms and relate them in some way to the wider social context.

At a subsequent meeting, the notes made were analyzed and discussed in relation to the behavioural features initially established, points of view were exchanged with regard to substantial differences found between the three groups and a consensus was reached on the indicators through which these differences should be analyzed. In this way it was possible to define a series of behavioural features that included the crucial aspects of the intervention, that is, the behaviours considered especially stimulating for the cognitive process. We refer to these features as *Cognitive Mobilizing Patterns* (CMPs) (see Table 1; Appendix 1 offers a summarized description of each pattern).

At a later stage their presence in the recordings made was analyzed quantitatively and qualitatively. Two types of registration were made on the data sheet, to which we refer as *Register of occurrences* and *Overall appreciation scale*, respectively.

The first of these consists of a graph, with the defined categories on the y-axis and the time periods on the x-axis. The observation was made by playing the video for periods of one minute so that, in each period, observers noted the presence or absence of the features when they appeared as a consequence of the teacher's activity. In this type of register we considered only the first 13 CMPs of those listed in Table 1, since they are those that can be identified on the basis of specific actions representative of them. The remaining 7 CMPs refer to aspects that can be discerned in a more general way over the course of the session, so that they are assessed in an overall manner in the second type of register.

Table 1
List of Cognitive Mobilizing Patterns

Cognitive Mobilizing Patterns
1. Activity oriented towards processes.
2. Reinforcement of cognitive behaviour of a level higher than the baseline behaviour.
3. Stimulation of pupils' self-concept.
4. Raising of arousing cognitive conflicts.
5. Alternative thinking.
6. Explanatory thinking.
7. Stimulation of interaction between pupils.
8. Personal attention.
9. Slowing of the dynamic.
10. Centring-focusing.
11. Teacher adopts a role of "active partner".
12. Teacher provides models of thinking aloud.
13. Increase of input.
14. Active-participative atmosphere.
15. Fun atmosphere.
16. Structuring of the situation.
17. Flexibility in following the work schedule.
18. Shaping.
19. Introducing problems for another day.
20. Encouraging personal expression.

Table 2
Number and duration of sessions of the groups with high gains (A), intermediate gains (M) and low gains (B) after application of the Comprehending and Transforming programme, expressed in minutes.

Session/Group	B	M	A
1st	20 min.	39 min.	45 min.
2nd	29 min.	52 min.	41 min.
3rd	42 min.	41 min.	51 min.
4th	30 min.	50 min.	36 min.
5th	19 min.	28 min.	51 min.
6th	40 min.	33 min.	47 min.
7th	-	35 min.	50 min.
8th	-	-	36 min.
9th	-	-	50 min.
10th	-	-	41 min.
11th	-	-	45 min.
12th	-	-	54 min.
13th	-	-	32 min.
N∞ sessions	6	7	13
Total m.	180 min.	278 min.	579 min.
Mean	30 min.	39,71 min.	44,54 min.
S.D.	9,65 min.	8,79 min.	6,88 min.

The aim of the Overall appreciation scale was to confirm and complement the data from the Register of occurrences considering the 20 CMPs. This scale was filled in after viewing each session, and the presence of each pattern was assessed by means of a 5-point scale on which the values signified as follows: (1) Feature absent or not achieved at all, (2) Feature present, but in an insufficient or irrelevant way, (3) Feature present but with doubts over its significance or relevance, (4) Feature present with clear significance or relevance, aspect achieved, and (5) Feature or aspect achieved to maximum extent, paradigmatic performance in this aspect.

In order to facilitate categorization we drew up a summary of the categories defined so that we could refer to it continually (Appendix 1). This summary was consulted periodically, and whenever it was thought advisable due to doubts or any other specific circumstance.

We carried out a pilot observation in order to establish optima with respect to duration of each observation period, format of the registration sheet, codification system, and other aspects related to the observation technique. Another consequence of this pilot observation was a more precise redefinition of the content of some categories.

Results

Results from the Register of occurrences

Time differences

Among the initial data provided by the Register of occurrences is that which refers to the duration of each session and how this differs between the three groups (see Table 2).

As it can be seen, the group B sessions last between 19 and 42 minutes, with a total of 180 minutes, and mean session duration is 30 minutes. Group M sessions range from 28 to 52 minutes, summing 278 minutes, and mean duration is around 40 minutes. For group A, the shortest session lasts 32 minutes and the longest, 54 minutes; total time is 579 minutes and mean session duration is around 45 minutes. We carried out an analysis of variance on these data (Kruskal-Wallis rank clas-

sification) (Siegel, 1986), the results of which permit us to state, with a significance level of $p<0.05$, that the groups differ with regard to the duration of their sessions. Figure 1 shows the direction of these differences in session duration from one group to another, as well as the greater or lesser spread of all of them in each group.

Presence/absence of crucial aspects (CMPs)

In this section we consider the frequencies of appearance of the different CMPs from the Register of occurrences, across all the sessions, for each one of the three groups (see Table 3).

Each raw score indicates the number of times the corresponding behavioural pattern appears in the set of sessions of each group. Figure 2 provides a graphical representation of the data from Table 3 corresponding to the percentages of appearance of the different patterns in each group.

A visual analysis of this figure reveals clear differences between group A and the other two, especially with regard to *activity oriented towards processes*, *reinforcement of cognitive behaviour*, *stimulation of self-concept* and *increase of input*, though there are also differences in *stimulation of interaction*, *personal attention*, *slowing of the dynamic*, *activities to focus the topic*, *attitude of active partner* and *presentation of models of cognitive functioning*. In this second group of CMPs, although the differences are smaller, the lines corresponding to groups M and B are notably closer to the x-axis.

There is an area of confusion with regard to the patterns of behaviour referred to as *raising of conflicts*, *stimulation of alternative thinking* and *stimulation of explanatory thinking*, with a notable difference in scores between groups M and B in *raising of conflicts*.

If we consider the set of teaching skills proposed as an overall variable, it can be seen (Figure 3) that the group of pupils with greatest stimulation (highest percentage of periods in which some of the skills appear) coincides with that which made the most improvement, and that the stimulation in the remaining groups is also proportional to the gains.

The total percentage accounted for by these features is itself fairly indicative. If we consider as effective time the period during which any of them is present, and with the simple calculation of a coefficient between this effective time (ET) and real time (RT), we can affirm that the enriching time was lowest in group B, where ET/RT = 0.5667, as against a value of ET/RT = 0.769 for group M and ET/RT = 0.8739 for group A (in Table 4 this data appears in the last three cells of the final column). It should be borne in mind that a value of

Figure 1
Application time. Duration in minutes of the 13 sessions of the high gains group (A), the 7 sessions of the intermediate gains group (M) and the 6 sessions of the low gains group (B) after application of the Comprehending and Transforming programme

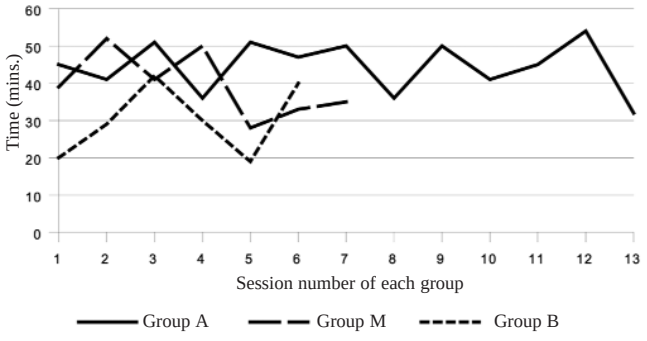


Figure 2
Relative presence of each cognitive mobilization pattern in the total of sessions of each one of the three groups (A, high gains, M, intermediate gains, and B, low gains after application of the Comprehending and Transforming programme)

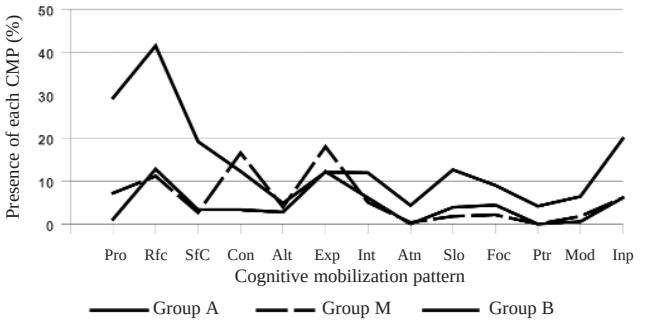


Table 3
Number of occasions that each CMP appears in the total sessions of the groups with high gains (A), intermediate gains (M) and low gains (B) after application of the Comprehending and Transforming programme

	Group B		Group M		Group A	
FEATURES	Freq.	%	Freq	%	Freq.	%
Activity oriented towards processes	2	1.11	20	7.19	170	29.36
Reinforcement of higher-level behaviour	23	12.8	31	11.2	240	41.45
Stimulation of positive self-concept	6	3.33	8	2.68	111	19.17
Raising cognitive conflicts	6	3.33	46	16.6	71	12.26
Stimulation of alternative thinking	5	2.78	11	3.96	28	4.84
Stimulation of explanatory thinking	22	12.2	50	18	70	12.09
Stimulation of interaction between pupils	11	6.11	14	5.04	69	11.92
Personal attention to demands	0	0	1	0.36	25	4.32
Slowing the dynamic of the session	7	3.89	5	1.8	73	12.61
Centring and focusing attention	8	4.44	6	2.16	52	8.98
Playing the role of active partner	0	0	0	0	24	4.15
Presenting models of thinking	1	0.56	5	1.8	37	6.39
Increase of input	11	6.11	17	6.12	115	19.86
TOTAL	**102**	**56.7**	**214**	**77**	**1085**	**187.4**

ET/RT = 1 would indicate that effective time was equal to real time, a value of ET/RT < 1 would show that effective time was less than real time, and ET/RT > 1 would indicate that the number of features registered is greater than the number of minutes in the session (a teacher's performance could be registered in more than one behavioural feature if it presented the stimulation value indicated in each one – for example, thinking aloud and pausing as part of the process of elaborating that thinking could allow registration in both *presentation of models* and *slowing of the dynamic* at the same time). Thus, whilst group A, which shows the greatest improvement, receives almost two of the stimulating behaviours per minute, group B, that of the least progress, receives approximately one every two minutes; the proportion of stimulating behaviours in group M, that which presents intermediate gains, is also intermediate with respect to the other two.

Figure 3
Quantity of total stimulation in each group (percentage which, in accordance with the 1-minute periods observed, represents the sum of stimulating features corresponding to all the CMP, present in the total of sessions of each group, A (high gains), M (intermediate gains) and B (low gains)

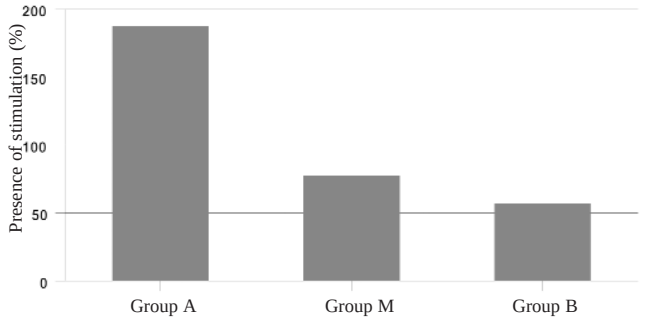


Table 4
Number of stimulating behaviours, duration in minutes and effective time coefficients for each one of the sessions and groups (sessions ranked from highest to lowest effective time coefficient)

Rank	Group	Session nº	Frequency of CMP	Duration (min.)	Effective time coefficient
1st	A	3	117	41	2.85
2nd	A	2	129	51	2.53
3rd	A	6	112	47	2.38
4th	A	13	67	32	2.09
5th	A	12	107	54	1.98
6th	A	7	96	50	1.92
7th	A	9	85	50	1.70
8th	A	1	70	45	1.56
9th	A	4	56	36	1.56
10th	A	11	69	45	1.53
11th	A	10	58	41	1.41
12th	A	8	49	36	1.36
13th	M	5	38	28	1.36
14th	A	5	60	51	1.18
15th	M	2	55	52	1.06
16th	M	7	30	35	0.86
17th	B	2	24	29	0.83
18th	B	4	21	30	0.70
19th	M	4	34	50	0.68
20th	B	5	12	19	0.63
21st	M	3	25	41	0.61
22nd	M	6	20	33	0.61
23rd	B	3	20	42	0.48
24th	B	6	19	40	0.48
25th	M	1	12	39	0.31
26th	B	1	6	20	0.30
1st	A	All	1085	579	1.87
2nd	M	All	214	278	0.77
3rd	B	All	102	180	0.57

If we consider the effectiveness coefficients (ET/RT) session by session and put them in order from highest to lowest, we find once again that the results are favourable to group A, which has the highest gains. This ranking is shown in Table 4, in which it can be seen how all the group A sessions present effectiveness coefficients higher than 1, the group M sessions present coefficients that vary from 0.31 to 0.36 (only two of this group's sessions present values higher than 1) and all the group B coefficients are under 1.

It can also be seen that the 13 group A sessions are among the first 14 in the ranking by effectiveness coefficients shown in Table 4, whilst the group M and group B sessions fall into the remaining ranks in an alternating pattern.

Results from the Overall appreciation scale

The purpose of the Overall appreciation scale is to evaluate the 20 CMPs. The results of this evaluation for the total of sessions of each group are shown in Table 5.

The data shown for each behavioural feature are the mean and standard deviation of the scores (between 1 and 5) obtained in each session.

Figure 4 provides a graphical representation of the mean scores corresponding to each crucial aspect of behaviour for each group, while Figure 5 shows the mean scores corresponding to each session and each group. In all cases the number assigned to each CMP corresponds to that provided in Table 1.

The above data and a visual analysis of the figures indicate once more that it is the highest gains group that obtains the best results. Thus, the following data can be appreciated:

1) The superiority of group A in mean scores for all the behavioural aspects registered. The superiority of group A is also clear in all the mean scores corresponding to each session.
2) There is near-superposition of the lines of groups M and B in Figure 4. The differences are greatest in *sti-*

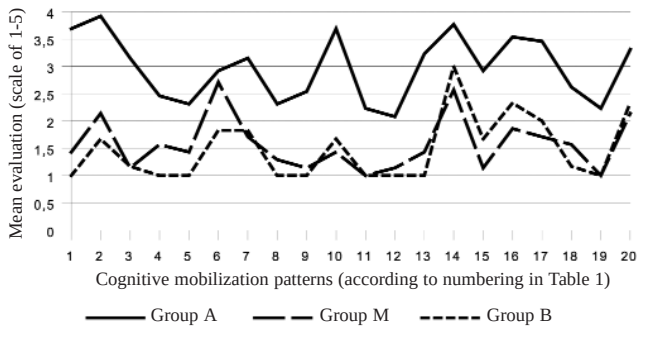
mulation of explanatory thinking and *raising of cognitive conflicts*. There is a degree of parallelism with the group A line.

3) The same superposition of the group M and group B lines appears in Figure 5.
4) In Figure 4 it is interesting to note the following differences in score in favour of the first-mentioned group:
   a) Between groups A and B in *activity oriented towards processes*, *reinforcement*, *increase of input*, *centring-focusing*, *stimulation of self-concept* and *slowing of the dynamic*.
   b) Between groups A and M in *activity oriented towards processes*, *centring-focusing*, *stimulation of self-concept*, *increase of input*, *fun atmosphere*, *reinforcement*, *flexibility in following the work schedule* and *structuring of the situation*.
   c) Between groups M and B in *explanatory thinking* and *raising of cognitive conflicts*.
5) Figure 5 again shows the superiority of group A over the other two in all the sessions.

In sum, as was the case for the Register of occurrences, in the Overall appreciation scale we again find an evaluation proportional to the cognitive improvement achieved by the groups. Rounding up to the nearest whole, the means of groups B, M and A are, respectively, 1, 2 and 3. The mean scores of the group showing most progress (A) are always higher than those of the other two. In this group, all the aspects studied present a mean evaluation of between 2 and 4, whilst the lowest-gains group (B) presents scores between 1 and 3, with nine aspects scoring 1 and just one CMP obtaining a score of 3. The intermediate-gains group (M) shows a similar range to that of group B, but only obtains the minimum score in two features.

In order to test the significance of the differences found, we carried out an analysis of variance using the *Statmode l* program. From its results (F = 44.48, p = 0.0000) it is deduced that we must reject the hypothesis that the three groups belong to the same population.

Figure 4
Mean score for the total of sessions of each group (A, high gains, M, intermediate gains and B, low gains) for each one of the 20 CMPs of the Overall Appreciation Scale (score from 1-5)



Reliability of the observations

Inter-observer reliability

In order to determine the reliability between observers, two psychologists (different from those who carried out the initial assessment) were trained with materials and criteria identical to those employed by the first evaluator. We then chose at random four fragments from the recordings, one from group B, one from group M and

Figure 5
Mean score for the total set of CMPs during each session (group A:13; group B: 7) on the Overall appreciation scale (score from 1-5)

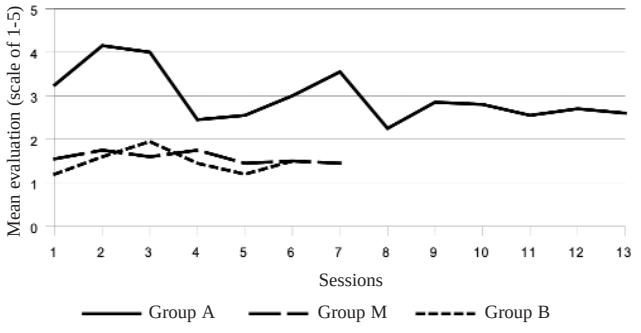


Table 5
Mean evaluation given to each CMP in the three groups

	Group B		Group M		Group A	
FEATURES	M	S.D.	M	S.D.	M	S.D.
Activity oriented towards processes	1.00	0.00	1.43	0.53	3.69	0.75
Reinforcement of higher-level behaviour	1.67	0.52	2.14	0.69	3.92	0.76
Stimulation of positive self-concept	1.17	0.41	1.14	0.38	3.15	0.90
Raising cognitive conflicts	1.00	0.00	1.57	0.53	2.46	0.98
Stimulation of alternative thinking	1.00	0.00	1.43	0.53	2.31	0.95
Stimulation of explanatory thinking	1.83	0.41	2.71	1.11	2.92	0.95
Stimulation of interaction between pupils	1.83	0.75	1.71	0.49	3.15	0.69
Personal attention to demands	1.00	0.00	1.29	0.49	2.31	1.18
Slowing the dynamic of the session	1.00	0.00	1.14	0.38	2.54	0.78
Centring and focusing attention	1.67	0.52	1.43	0.53	3.69	0.63
Playing the role of active partner	1.00	0.00	1.00	0.00	2.23	1.24
Presenting models of thinking	1.00	0.00	1.14	0.38	2.08	1.04
Increase of input	1.00	0.00	1.43	0.53	3.23	0.83
Active-participative atmosphere	3.00	1.21	2.57	0.79	3.77	0.72
Fun atmosphere	1.67	1.21	1.14	0.38	2.92	1.19
Structuring of the situation	2.33	0.82	1.86	1.07	3.54	0.78
Flexibility in following the work schedule	2.00	0.89	1.71	0.76	3.46	1.39
Shaping	1.17	0.41	1.57	0.79	2.62	1.26
Introducing problems for another day	1.00	0.00	1.00	0.00	2.23	1.92
Encouraging personal expression	2.33	1.03	2.14	1.22	3.31	0.75
MEAN	1.48		1.58		2.98	
S.D.	0.59		0.49		0.59	

two from group A. The next step was to replicate the observation by the two new psychologists, who worked independently. Not until the work was completed did either of the two new observers have information about the reliability between their evaluations.

For the analysis of the results we calculated the correlation (Anguera, 1983) between the scores given by each of the three observers. This calculation was carried out for each one of the fragments studied, and for all the observations, using the *Statmode l* program. Of 12 correlations studied, 10 are significant, of which 9 can be considered highly significant. The analysis of the two non-significant correlations shows that the differences between observers has a conservative effect, so that if we were to adopt the data of the replication, the differences between groups A, M and B would be even clearer than in the original calculations, and this means that the conclusions we may reach are not endangered. Furthermore, if the correlation session by session is, as we have just indicated, quite appreciable, the correlation for the total of sessions is highly significant in all cases.

Secondly, we carried out a goodness-of-fit test in order to determine whether the skills profile detected by each observer corresponds to that perceived by the others. As in the previous case, and with the same purpose, calculations were made for each one of the sessions and for the total data. The instrument chosen was the two-tailed Kolmogorov-Smirnov test (Siegel, 1986), calculated with the *Statmode 2* program. In no case can the null hypothesis be rejected, and we can thus conclude that all the pairs of observations considered belong to the same population. There are no significant differences between the skills profiles perceived by each observer, and the values calculated show a wide margin of reliability. As in the case of the correlations study, the fit is much better for the total data.

It can be concluded, therefore, that the criteria given for identifying the presence of CMPs are sufficiently clear, and that, through their use, different observers can discriminate easily between teachers who demonstrate these skills and those who do not, as well appreciating the different degrees of ability in a relative way.

Test-retest reliability

The evaluation of all the material was carried out by a single observer, so that we can assume a constancy of criteria throughout. Nevertheless, for greater security, a control of test-retest reliability was applied, with the same observer evaluating a sample of 14 sessions selected at random (5 corresponding to group B, 3 to group M and 6 to group A). The second observations took place at an interval of approximately two months for the sessions of groups M and B, and of four months for the group A sessions.

As in the inter-observer reliability study, the data analysis was carried out by means of Pearson linear correlation (*Statmode 1* program) and the goodness-of-fit analysis by means of the two-tailed Kolmogorov-Smirnov test (*Statmode 2* program). Of the 14 correlations studied, 12 are significant at a level of 0.05, and all are significant at a level of 0.1, with the values obtained improving in the case of considering the correlation in the total set of observations. In the goodness-of-fit study, 12 of the 14 replications confirm the null hypothesis, as is also the case on considering the total set of the data corresponding to the 14 sessions. The results of this study concur with those obtained by means of the analysis of correlations.

In the cases of significant differences between observations, the replication is more favourable on highlights the differences between groups in line with the quality levels established in the psychometric assessment of the gains in the groups, which led us to classify them as high, intermediate and low progress. In view of all of this, we can conclude that the test-retest reliability of the observations should be accepted.

DISCUSSION AND CONCLUSIONS

Our starting hypothesis is that the interactive style in the classroom, different for each of the three groups in the present study, is what will explain the differences in cognitive improvement indicated by assessment of the impact of the C&T programme (Mora, 1991, 1995). With the aim of examining this hypothesis, we set out to identify the elements of the interaction strategy through which the best results were obtained. For this it was necessary to define the interaction strategies employed in each group, establishing the set of behavioural features to be observed (the CMPs), defining the types of observation, constructing the registration sheet and analyzing the interaction styles of each group.

Time differences

A first characteristic that can be perceived as different in the three groups refers to the duration of the session in each one. It is the group showing the most improvement whose sessions were longest and most homogeneous in their duration; it is the group with the poorest results that presented the shortest sessions and most variability in time between one session and another. An intermediate position is occupied by the group with average improvement, both in mean duration and in variance of duration over the sessions.

It would be a mistake to deduce that the longer the time spent, the better the results. The programme recommends a rhythm of application of between three and five 1-hour periods per week, and although it would seem logical to think that it is better to devote five hours a week to it than three, it is also reasonable to suppose that there should be a time limit beyond which the results do not improve. Furthermore, the application time itself will not necessarily lead to improvement regardless of what is done in that time. In this regard it should be pointed out that not only did we find differences in the real application time of C&T across the three groups, but that the effective time also varied.

Effective time was defined as the total of 1-minute periods in which any of the CMPs were recorded. Calculated for the three groups and transformed into a coefficient (dividing by the real time), so as to allow comparison, it was observed that the differences increased, since group B, as well as being that which presents the shortest sessions, is that with the lowest coefficient of effective time, whilst group A, which presents longer sessions, has a total of effective time greater than its real time. This circumstance can be explained by taking into account that many of the interaction sequences in this group were of such characteristics that they merited being noted in the Register of occurrences, in the same minute, in more than one aspect. While we are aware that this system of categorization is not strictly correct, we found it more useful to consider all the information in the recordings than to give an account of mutually exclusive aspects which, in order to be exhaustive, would have needed to be so long and with such atomized aspects that it would have been difficult to handle in a useful way.

If we consider the effectiveness coefficients not by group, but session by session, we see that in all the sessions of group A they have a value greater than 1, that only in two of the seven sessions of group M do they have a value greater than 1, and that in none of the sessions of group B are the values of this coefficient greater than 1.

With this in mind, and without disregarding the importance of the actual time spent on the programme, the effective time coefficient is a better indicator of the quality of the interaction. Thus, the relevance of computing real application time is limited to its value as an indicator of a higher-quality interaction: a longer session suggests higher task motivation on the part of pupils and teacher, a relaxed, stress-free, "fun" classroom atmosphere in which pupils are active and participative, and which has reinforcement value. On the other hand, a session that ends early is indicative of boredom for pupils and teacher, of lack of participation and loss of purpose.

Standard deviation of the time values in each group support our conclusion: greater variability in the duration of the sessions is a sign of more improvisation in the preparation. Thus, its success depends on uncontrolled and random factors. In contrast, low variability is the result of better preparation, or at least of mastery and skill in the use of the programme, so that the session develops more or less according to the guidelines.

Differences in occurrence of the relevant interactive aspects

The information provided by the analysis of the sessions' duration should be completed by identifying the crucial features making up the interactive style characteristic of each classroom.

Considered overall, the fact that the amount of stimulation received is proportional to the gains made by each group permits us to affirm that the CMPs are, on the whole, good predictors of final achievement, and that they can be considered, at least from an exploratory perspective, as responsible for that achievement.

The data obtained tell us that only in three aspects did group A score lower than one of the other two. The differences are greatest in *activity oriented to the process, reinforcement, stimulation of self-concept* and *increase of input*. The differences are somewhat smaller in *stimulation of interaction, personal attention, slowing of the dynamic, centring-focusing, attitude of active partner* and *presentation of cognitive models*. Worthy of note is the low frequency (close to zero) of the crucial aspects in this latter block in groups M and B. The differences are minimal in *stimulation of explanatory thinking, stimulation of alternative thinking* and *raising of cognitive conflicts.*

Differences in the quality of interactions

If we take as an indicator of the quality of the interactions the presence of relevant behaviours in several of the aspects of the Register of occurrences considered as crucial, the coefficients of effective time indicate the superiority of group A in this aspect. Pointing in the same direction are the results of the Overall appreciation scale, where there is a notable superiority of the mean scores of group A, both those for each CMP across all the sessions and those for each session across all the CMPs.

As regards differences between groups related to the seven aspects of classroom atmosphere that did not form part of the Register of occurrences, it must be said that they are not as marked as those related to the crucial aspects of interaction. Even so, there are noteworthy differences in *fun atmosphere, structuring of the situation* and *flexibility in following the work schedule*.

Whilst in the thirteen aspects included in the Register of occurrences the greatest differences are found between groups A and B, in the seven aspects appearing only in the Overall appreciation scale, the greatest differences are found between groups A and M, in either case favouring group A.

What are the critical CMPs?

Not all the categories have the same weight in the results. Although it is not easy to deny the influence of any of the features considered in isolation (given that there are theoretical reasons in support), it is appropriate to identify those teaching skills that are distributed in the groups in a similar way to the gains observed, and that may constitute critical factors of achievement.

Figure 2 shows us that this "critical" quality is possessed by the CMPs *activity oriented towards processes*, *stimulation of alternative thinking*, *personal attention* and *presentation of models of thinking*.

Teacher's attention towards processes is a skill with decisive weight in the results. It is possible that all the change noted in the pretest-posttest assessment of the groups is largely attributable to this variable, since, abstracting all the others, it would be sufficient for explaining the variation between the groups. Even so, the analysis reveals the existence of other teaching skills which, albeit to a lesser extent, also emerge as associated with the final gains. The most important of these is *presentation of cognitive models*, whose relevance has been pointed out in other studies (e.g., Nickerson & cols., 1987). This importance should be considered in relation to the variable *activity oriented towards processes*, since an effective way of focusing pupils' attention on the processes may be the presentation of thinking models. The interaction of the two variables will undoubtedly produce a mutual strengthening.

There are two other CMPs that in the Register of occurrences were distributed among the groups in the same way as the skills we have just considered as critical, though given that the differences in this case are much smaller, we should be more cautious about proposing them as critical without subsequent confirmation. These are *stimulation of alternative thinking*, a cognitive variable, and *personal attention to the thinking processes of each pupil*, which is cognitive-affective in nature.

Consideration of the Overall appreciation scale (Figure 4) permits us to confirm the analysis carried out with the Register of occurrences. The critical CMPs found there are once more present, together with new ones, namely, *reinforcement*, *raising of cognitive conflicts*, *stimulation of explanatory thinking*, *slowing of the dynamic*, *increase of input* and *shaping of the behaviour*.

The fact that new critical CMPs emerge in this analysis suggests that more accurate methodologies might reveal the weight of those behavioural features of the teacher that may in principle appear irrelevant, and leads us to think that rather than *critical features* especially relevant for pupils' cognitive enrichment, we should be talking about skills profiles. In this regard we should conclude that the most stimulating teachers are those who focus their activity on making pupils aware of the cognitive processes they are experiencing, who present them with alternative models of functioning and who encourage the production of other, original models to be critically assessed – and all of this within a pleasant and cooperative atmosphere in which the problems encountered are precisely the basis for constructing the feeling that one is competent for facing up to them and solving them.

Examination of the data group by group may help to put the above comments in context. Thus, the distribution of teaching skills observed in group A shows that the commonest CMPs are *reinforcement* of pupils presenting cognitive processes close to those formulated as objectives of C&T (22% of the total of behaviours registered), *activity oriented towards processes* (16%), *increase of input* (11%) and *stimulation of pupils' self-concept* (10%). Together, these four categories account for 59% of the observed behaviours, which says a great deal about the stimulation profile adopted by the teacher of this group, a profile that can be summarized as "clear concern for orientation towards the processes more than towards the results of the task" (given by the CMPs *orientation towards processes* and *increase of input*, which account for 27% of the total of teaching behaviours recorded), but in an affective atmosphere in which achievements are reinforced and encouraged and a positive image of oneself is stimulated *(reinforcement* and *stimulation of pupils' self-concept*, which account for 32% of the total).

In the intermediate progress group (M), *reinforcement*, *activity oriented towards processes* and *increase of input* are also prominent as teaching behaviours. The highest percentage, however, is for *raising of cognitive conflicts* and *stimulation of explanatory thinking*. Given that, furthermore, the percentage corresponding to *stimulation of self-concept* is low, it can be stated that this is a group with greater orientation towards cognitive aspects than the previous one, and less characterized by the existence of a warm and affectionate atmosphere that strengthens a more adjusted self-image.

In group B, which presents low progress according to the psychometric criterion adopted, we find the same affectively cold cognitive orientation as in group M.

There is *reinforcement* and *active and participative atmosphere*, but *personal attention* is absent, as are the *role of active partner* in the teacher and *stimulation of feeling of self-competence in pupils*. What substantially differentiates this group from the other two (and may be largely responsible for its poor relative results) is the scarce importance given to *orientation towards processes*.

In sum, if Nickerson (1986, 1987) talks about the teacher as a variable in the success of programmes for improving thinking skills, we have been able, through an empirical study, to identify some teaching patterns that appear to be responsible for the changes observed, and which seem useful in that they are more specific than other references from the literature and they are trainable.

Thus, the most effective teachers for achieving the objectives of C&T are those with a combination of the following three qualities: (a) orienting the activity towards processes instead of towards results, frequently presenting models with this characteristic; (b) creating a personalized class atmosphere n which the pupil feels attended to, group dynamics are subordinate to individual growth and the teacher is a *partner* or *colleague* who aids thinking and stimulates self-image; and (c) managing the pace of the activity and the attention to pupils so that the processes can be more clearly perceived and the class atmosphere is pleasant, and never oppressive or boring.

The work in the group presenting maximum progress (group A) is characterized by a slow pace and equal attention to metacognitive orientation and affective interchange, in contrast to the rapid pace and "cold" cognitive orientation of the null progress group (group B). These data are in confirmation of what is well known but has in fact been neglected in the tradition of the improvement of intelligence and thinking, namely, that affective and motivational variables have decisive influence on the way in which people deal with their problems, and thus on the way they think and act intelligently. It seems clear to us that it is high time to put an end to the state of estrangement between stimulation of thinking and attention to the emotions, which should be given equal emphasis in cognitive facilitation programmes.

A final conclusion refers to the training of those who are to use cognitive enrichment programmes in general and the C&T programme in particular: their training and supervision in relation to the indicated CMPs, especially those classed as critical, would appear to be a key variable in the success of the programme. It is therefore appropriate to design specific materials for the initial training of appliers in knowledge and correct use of CMPs, as well as guaranteeing ongoing supervision and support structures; this training and support should be provided by people with sufficient knowledge and experience of the programme.

Furthermore, there remains the possibility of the classroom interaction patterns that facilitate pupils' cognitive development (CMPs) being generalized by appliers to their normal teaching work, so that the interaction style learned for the development of C&T becomes a useful element for maintaining the cognitive gains achieved by pupils, beyond the period of the programme itself. Examination of this possibility should constitute the objective of further research.

REFERENCES

Alonso Tapia, J. (1987). *¿Enseñar a pensar? Una alternativa en Educación Compensatoria*. Madrid: CIDE.

Anguera. M.T. (1983). *Manual de prácticas de observación*. Mexico: Trillas.

Erickson, F. (1977). "Some approaches to injury in school community ethnography". *Anthropology and Education Quarterly, 8,* 58-69.

Kemmis, S. (1993). "Investigación en la acción". In T. Husen & T. Neville Postlethwaite.

Enciclopedia Internacional de Educación. Vol.6, (pp. 3330-3337). Barcelona: Vicens-Vives.

Mora, J. (1991). *Evaluación del programa 'Comprender y Transformar'*. Doctoral dissertation. Universidad de Sevilla.

Mora, J. (1995). *El programa 'Comprender y Transformar': Bases, metodología y evaluación*. Sevilla: Repiso libros.

Mora, J. (1997). Comprehending and Transforming. In J.H.M. Hamers, & M.Th. Overtoom (Eds.) *European Programmes for Teaching Thinking* (pp.105-110). Utrecht: Sardes.

Mora, J. & Aguilera, A. (1992). "Cognitive Activating Patterns: An instrument for the assessment of interactions in the classroom". In T.J. Plomp, J.M. Pieters & A. Feteris (Eds.). *European Conference on Educational Research: Book of Summaries, vol. 2*.
(pp. 911-913). Enschede: University of Twente.

Nickerson, R.S. (1986) "Project Intelligence. An account and some reflections". *Special Services in the Schools, vol 3 (1,2)*, pp. 83-102.

Nickerson, R.S., Perkins, D.N. & Smith, E.E.(1987). *Enseñar a pensar. Aspectos de la aptitud intelectual*. Barcelona: Paidós/MEC (The teaching of thinking. Lawrence Erlbaum Associates, Publishers, New Jersey, 1985).

Siegel, S. (1986). *Estadística no paramétrica aplicada a las ciencias de la conducta*.
Mexico: Trillas (Non-Parametric statistics for the behavioral sciences. New York: McGraw-Book. 1970).

APPENDIX 1

List and brief description of the Cognitive Mobilizing Patterns

1. *Activity oriented towards processes*. The relevance of the activity lies in the analysis of the process followed or the identification of the strategy to follow. It corresponds to the guiding questions: "*How do you do it?*", "*Is that what you have done?*", "*How will you do it?*". Activity oriented towards the process is distinguished from task-oriented activity in that the objective pursued is the clear perception of the cognitive strategy to employ, with mastery of its nuances and generalization of its applicability, success in the task set being secondary. In task-oriented activity the objective is a good result so that there can be eventual analysis of processes, but with an instrumental value.
2. *Reinforcement of cognitive behaviour of a level higher than the baseline behaviour*. All behaviour showing a cognitive level higher than the initial one is reinforced, even when the difference is minimal in absolute terms. Reinforcement must be immediate or very close in time to the reinforced behaviour. This concept of reinforcement is not completely identical to that formulated in the psychology of learning; in this case it also has a triple cognitive function of feedback on the appropriateness of the behaviour, stimulation of pupils' self-concept and creation of an affectively gratifying class atmosphere.
3. *Stimulation of pupils' self-concept*. Activity is oriented towards increasing pupils' positive self-concept and their level of satisfaction with the cognitive experience.
   a) The reinforcement has a "personal" nature and is thus perceived by the receptor. Although it is dispensed in group fashion, the pupil feels it is aimed at him/her.
   b) The pupil judges his/her role and contribution within the group positively, expressing this verbally or through gestures.
   c) The pupil shows signs of knowing his/her present and/or future possibilities for coping with situations similar to the one proposed.
   d) The teacher analyzes with the pupil how "he/she" has been capable of dealing with a situation (it is necessary to distinguish between the analysis of the process oriented to its perception and that which stimulates self-concept, with orientation to the person).
   e) The teacher gives thanks for the contribution, even if it is erroneous, as a way of praising effort and participation.
4. *Raising of arousing cognitive conflicts*. The stimuli proposed are perceived as a problem to be solved, characterized by (a) having a solution, (b) being of interest, and (c) involving contradictory points of view. The conflict originates in differing points of view between: teacher-pupil, pupil-pupil or groups-groups. Counter-suggestions are made to the points of view presented by a subject/group. The group adopts a critical attitude. Contributions are discussed, and not judged as valid until they have been compared with alternative points of view. Contributions are not accepted without analysis, even if it is elementary.
5. *Alternative thinking*. Stimulation of the search for and consideration of diverse solutions. Although a good conclusion may have been formulated, all the alternative arguments are examined and analyzed before deciding on the best conclusion. The teacher asks "*In what other way…?*" and/or asks for examples that do not fit the situation under consideration. The teacher's interventions open up the topic, give it nuances and extend it (increasing the level of complexity and slowing the process), and do not systematically close off discussion.
6. *Explanatory thinking*. Explanation is sought in all reasoning. In the contributions made, the "why" is sought. Interventions are not accepted without a simple explanation.
7. *Stimulation of interaction between pupils*. Encouragement of exchange of contributions among pupils. Problems are raised that must be resolved in teams or through group discussion. Individual contributions are put back to the group to be analyzed, accepted or rejected. There is stimulation of cooperation between group members for resolving problems or carrying out the task.
8. *Personal attention*. Cognitive conflicts are not treated in a depersonalized way. As far as possible, every personal cognitive problem, every point of view is attended to. Even when the dynamic demands agility and only one point of view can be considered, this is done in a personal way (e.g., "Let's think about the problem raised by so-and-so…"). When a pupil or small group is not convinced by the majority opinion, even when it is correct, some time is devoted to analyzing the minority opinion. The teacher makes sure that all the pupils are covering all the stages of the process (with short questions, shows of hands to indicate opinions, etc.).
9. *Slowing of the dynamic*. The dynamic of the class and/or the teacher's activity introduce latencies before the emission of responses, in order to inhibit impulsiveness and improve results. Class atmosphere is one of reflection and contemplation, unhurried and with time made for analysis of the problem, even of trivial aspects if they have aroused the interest of the group.
10. *Centring-focusing*. The group's attention is directed towards pertinent aspects of the discussion or process through the contribution of information (e.g., "*Look at this, it's important…*") or through emphasis on some particular content by means of intonation or with gestures/move-

ments. Even when all the contributions are accepted, there are selective references towards those that maintain the thread of the discussion or offer interesting points of view on the activity or the perception of the processes. The information is reiterated, stressing the relevant aspects. The synthesis made filters the accumulated information, eliminating noise and irrelevant aspects. The teacher makes sure to maintain the thread of the collective discourse. There is no moving on to new aspects without having dealt with the previous problems.

11. *Teacher adopts a role of "active partner"*. The teacher puts him/herself *alongside the pupil* when it comes to solving the problem. The effective attitude is that of *colleague* rather than of director of the dynamic. He/She is also interested in finding the solution to the problem, a solution which it is not clear the teacher already has (even if it is assumed he/she has it). His/Her words and gestures reflect an attitude of quest, as a partner or group member. There are facial expressions that confirm this attitude. The teacher appears not as possessor of the truth (so that when he/she speaks all discussion is over), but as a stimulus so that the truth can be found as a group. When the teacher speaks, topics are not closed, but rather opened up, with their complexity brought out. It is a question of being an *active* partner or colleague, thus making this role compatible with the functions of guidance of the dynamic, making of syntheses, etc.
12. *Teacher provides models of thinking aloud*. In his/her role of active partner, the teacher puts him/herself in the position of the pupil and reflects aloud in order to solve some cognitive conflict raised or to analyze some stage of the process. He/She formulates thoughts that *substitute* deficient or poorly elaborated thoughts, not in the manner of a talk or formal presentation, but as the expression of thinking aloud (supported by the corresponding gestures). The teacher provides a *scaffolding* or cognitive scheme for pupils to develop their own. The teacher *does not teach*, but rather offers cognitive models.
13. *Increase of input*. The formulation of the problem, the information accumulated and the analysis of the process are repeated cyclically. The dynamic becomes slower and more reiterative.
14. *Active-participative atmosphere*. Pupils are in an almost constant climate of activity, discussing, analyzing or reflecting. The majority of them are participating in the activity proposed and/or the reflection raised: talking in groups, asking to speak even if they do not get the chance, maintaining frequent visual contact with the person speaking, participating in shows of hands, etc.
15. *Fun atmosphere*. The atmosphere of the group is fun, pleasant and enjoyable, closer to that of informal extra-curricular activities (leisure-pursuit or expression workshops, sports) than to the more rigid and formalized academic climate. Pupils enjoy the activities proposed, rather than simply accepting them as just another school obligation. In the class atmosphere there is a mixture of interest and relaxation.
16. *Structuring of the situation*. The work, at all times, is geared towards an objective. The intervention follows an established plan. There is unity and a system in the intervention, and its elements are coordinated and organized, related to one another and not simply juxtaposed. The work is not the result of improvisation, nor of random or uncontrolled factors. Pupils are aware of the planned nature of the work. Periodically, the teacher makes explicit the stages covered ("*What have we done?*"), the present objective ("*What are we doing?*") and the anticipation of the coming task ("*What will we have to do?*"). Time is organized with the different tasks in mind. There are moments for informing, for thinking, for discussion, for deciding. There are pauses and changes of pace that facilitate the differentiation of the task. The teacher, by means of words and gestures, provides discriminative stimuli that allow the identification of what is expected of the pupil.
17. *Flexibility in following the work schedule*. The teacher shows flexibility in working on the task set, adapting to the pace of the group. He/She spends the necessary time on each point. He/She does not interrupt discussions "because there is something else to be done". Everything he/she proposes is a consequence of the previous reflection. There is no simple juxtaposition of tasks.
18. *Shaping*. The establishment of a higher cognitive level is achieved by successive approximations.
19. *Introducing problems for another day*. The teacher ends each session by proposing a topic for individual reflection, which will serve as the basis of the subsequent work.
20. *Encouraging personal expression*. All pupils can express themselves: freely, with sufficient time to put their ideas in order, and in the knowledge that their contribution will be accepted, even though it may be challenged or discussed.