Modifying the Regulation Processes of Learning: Two Exploration Training Studies

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Abstract: Self-regulated learning is defined as learning in which a student performs teaching tasks himself. Regulations of learning (e.g.. orientation, planning, testing, monitoring) are thought to be important both in teacher - and self-regulated learning. Furthermore, mind orientation and distractions are expected to harm effective learning. Two studies are reported on individual differences in regulation-processes. Thinking aloud protocols of good and weaker performing subjects were analyzed as to the number of regulations. mind orientations and distractions and related to test scores (impulsivity, intelligence, concentration, motivation, etc.). Furthermore, students were trained to modify their regulation processes. Training programs consisted of a combination of awareness training and regulation training. The subjects were 10 and 6 students from two secondary schools (for special education), respectively. The results showed some relations between process differences on the one hand and performance on the other hand. There were also influences of task difficulty on the process data. Training appeared to be effective for some of the students only. Transfer effects failed to appear,

INTRODUCTION

Self-regulation Versus Teacher Regulation

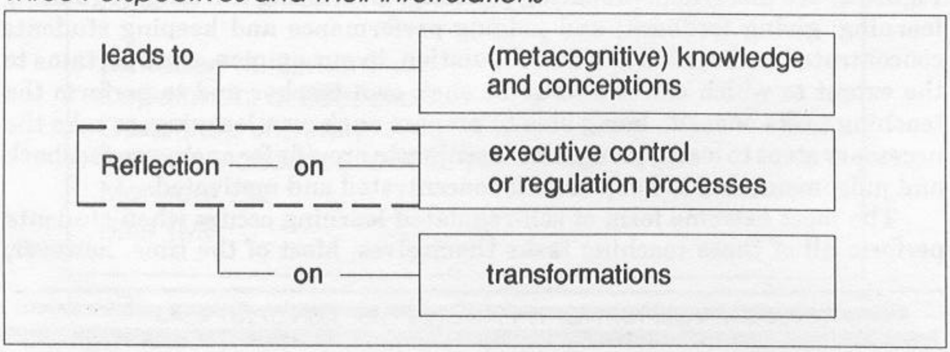
A theoretical framework derived from the theories of Boekaerts (1982), Brown (1980), Gagne (1977), Hettema (1979), Klauer (1985), Kuhl (1983) and Lawson (1984) is the basis of the research reported in this paper. According to this framework, self-regulation of learning is defined as the number and kinds of teaching tasks students perform themselves. Five main teaching tasks (see Figure 2) are discerned: preparing learning; facilitating learning; regulating learning; giving feedback; and judging performance and keeping students concentrated and motivated. Self-regulation, in our opinion, thus pertains to the extent to which one is able to be one's own teacher and to perform the teaching tasks oneself: being able to prepare one's own learning; to take the necessary steps to learn; to regulate learning; to provide for one's own feedback and judgement; and to keep oneself concentrated and motivated.

The most extreme form of self-regulated learning occurs when students perform all of these teaching tasks themselves. Most of the time, however, teachers (or their substitutes, for instance books or computers) take care of at least part of these tasks. In essence, there always seems to be a division of tasks. Extension of the responsibility of students for their own learning may in some cases improve learning. Lodewijks (1981) for instance showed that students learning science concepts in a self-chosen sequence performed better then students learning these concepts in a predetermined sequence. Likewise, Van der Sanden (1986) showed that some students (especially the better ones) performed better on a practical construction task without instructions than with detailed and explicit advice from a teacher.

According to these and other studies, improvement of learning might be reached by giving students more opportunities to regulate their own learning. This, however, is problematical in practice. Apart from the students who might profit from these opportunities, there are also students who will perform worse when teacher advice is absent (Lodewijks, 1981; Van der Sanden, 1986). A differentiated system with opportunities for self-regulation for the better performing students and sound advice for the weaker students, however, encounters many practical disadvantages and problems. As was discussed by Larsson (1983) paradoxes of teaching should also be taken into account. Some teachers would like to give students more freedom to learn but do not believe that students are able to handle this freedom. Some students believe that only the teachers should make decisions on learning and seem to hand over all responsibility to the teachers. In our opinion there is only one way out of these and other paradoxes and circularities and that is by training students in self-regulation. One main goal of training programs should be to convince students that they have a responsibility for their own learning and that they can acquire the skills to regulate their learning.

In our conception (see also Hettema, 1979; Lawson, 1984), three levels or perspectives in respect to the teacher and self-regulation tasks should be discerned (see figure 1): *(metacognitive) knowledge and conception* (for instance knowledge of study strategies; knowing when to use certain strategies; or conceptions of self-regulation); *executive control or regulation processes*

Figure 1.
Three Perspectives and Their Interrelations



(for instance deciding on a plan, attention-maintenance, monitoring, or repair-mechanisms); and *transformations or executive skills* (for instance paraphrasing, underlining, understanding or reading).

In agreement with Lawson (1984) and recent Russian theories (e.g., Zak, 1980) we assume that metacognitive knowledge arises from reflection (being an executive control process itself) on executive control processes transformations.

Subtasks of Self and Teacher Regulation

Some of the teaching and self-regulation tasks discussed above have subtasks (see figure 2 on following page): The first task (preparing learning) has subtasks borrowed from Gagne (1977) and Galperin (1969): orientation, planning, gaining attention, promoting self-confidence, informing on goals, recall or previous learning. The second task (facilitating learning) is formulated in accordance with suggestions by Boekaerts (1982) and Klauer (1985). The subtasks are: facilitation of remembering and comprehension, of integration and of problem solving. For the third teaching task we extrapolated from theories of Brown (1980), Hettema (1979), Lawson (1984) and our own research (see Simons and Lodewijks, 1987): monitoring testing and questioning, revision and evaluation. The fourth task (feedback and judgement) comes from Gagne (1977) and the last one (upholding motivation and concentration) has been formulated in agreement with Kuhl's theory on mind orientation and activity orientation. According to this theory, in ideal mental states (action orientation) attention is divided evenly between a) the beginning state; b) the goal state; c) the discrepancy between the present state and the goal state; and d) the path that leads from a to b. In mind orientation, however, attention fixates on one or two of the four components of a fully developed action structure. Kuhl (1983) discerned four kinds of fixations (or four kinds of mind orientation): goal fixation, planning fixation, failure fixation and success fixation. Teachers should be attentive to these. Moreover, they should try to lead students towards an activity orientation in which the goal state to be reached, the present state, the difference between the goal and the present state and the plan that could be used to change the present state into the goal state each get sufficient attention. One aid teachers might use to help students reach these states is goal setting. In self-regulated learning students should be action oriented instead of mind-oriented.

Previous Studies

In our previous work (see for instance Simons and Lodewijks, 1987) we studied individual differences in the self-regulation of learning, both at the regulation level and at the metacognitive knowledge level of figure 1, emphasizing the preparation and regulation tasks of figure 2 (e.g., orientation, planning, monitoring, testing, revision and evaluation). Furthermore, we tried to change learning performance and processes of students through a relatively short training program. The training was based on the

Figure 2.
A Categorization of Teaching and Self-regulation Tasks

I Preparing learning

* Orientation on goals, strategies, time, etc.
* Planning of learning (time, anticipation of problems, choice of strategies).
* Gaining attention
* Promoting self-confidence
* Informing students on goals
* Stimulating recall of prerequisite learning

II Facilitating learning

* aimed at remembering and comprehension.
* aimed at integration with other information
* aimed at problem solving

III Regulating learning

* Monitoring
* Testing and questioning
  Revision (re-orientation, diagnosing, reflecting, repairing)
* Evaluating learning processes

IV Giving feedback and judging performance

V Upholding concentration and motivation

differences in processes observed during a pretest session. Metacognitive awareness was stressedby letting students reflect on their own way oflearning as well as that of other students. Regulation processes were trained through practice with a set of questions one may ask oneself during learning (e.g., Do I understand this part? What went wrong? Is this in line with the learning goal?) and a set of techniques and skills one may find useful in answering these questions (e.g., paraphrasing, reflection, thinking of new examples, self-testing). For the training program two case histories were written depicting two totally different ways of learning: a passive way and an active way incorporating several self-diagnostic routines and heuristics. Also, a short booklet was written in which the set of questions one may ask oneself during learning was described. Moreover, for each question, suggestions were put forward for possible ways to answer these questions. Finally, a set of practice materials (texts, words and problems) was constructed.

The subjects in the study reported in Simons and Lodewijks (1987) were 14 students from the second year of secondary school. Ages ranged from 13 to 15. Three sets of learning tasks were used, consisting of two parallel texts of 900 words on probability, the one introducing principles, problems and examples of chances with replacement, the other dealing with chances without replacement, two sets of 20 French words and their Dutch translations and two parallel problem solving assignments, in which simple probability principles (introduced in a separate text) had to be applied. Following Olshavsky (1976), red dots were put in places in the texts where verbalization was thought to be crucial.

This study revealed some interesting relations between performance and individual differences in regulation processes. In text processing the tuning of self-diagnostics to the learning goal proved to be the most important aspect. In vocabulary learning, however, the amount of self-testing differentiated between good and weaker performing students. In the problem-solving task monitoring, regulation and orientation processes showed up more frequently with better performing subjects. Thus, individual differences in processes correlating with performance were task-dependent. Training proved to be effective for the text processing only. One important and unique outcome of the study was that there was not only a training effect on learning performance, but also on the frequency of occurrence of some of the regulation processes. Especially the number of task relevant self-testings increased as a result of the training. Though many previous studies succeeded in showing an effect of training on performance (for instance Palincsar and Brown, we did not find any other studies showing an effect of training on regulation

One problem in this study concerned assumptions of cause and effect. The quality of regulation processes could cause the effectiveness of task performance. In the case of the text processing data we have reason to believe that this is what happened. Apart from the correlation between performance and processes, there was also a change in the number of testings on understanding (induced by the training program) coinciding with a change in performance. For the other two tasks, however, the causal relation could also be in the reverse direction. Weak performance (for instance caused by low abilities) might cause the occurrence of particular processes, like noticing negative results or continuing planning. Therefore, a distinction between good and bad regulation processes would be helpful, Kuhl's distinction between mind orientation and activity orientation processes might be a solution. Therefore, we decided to extend our categorization scheme with new categories pertaining to mind orientation and distraction.

The main research questions of the present studies were the same as for the previously described one: a) What individual differences in self-regulation occur and which of these related to performance differences? and b) Is there an effect of training on process and performance variables?

STUDY 1: REGULATION PROCESSES, MIND ORIENTED PROCESSES AND DISTRACTIONS

In this study, an attempt was made to discern good and bad regulating processes, using Kuhl's theory on mind orientation. The categorization scheme was extended with mind oriented processes (directed to failure or success experience, e.g., "I can't do it" and "I succeeded last time," valuations of the task at hand, e.g., "This is too difficult for me" or "I hate these sums," planning fixation, e.g., "How can I solve this" or goal fixation, e.g., "If only I were ready") and task-irrelevant statements (distractions). Moreover, in order to get an impression of the validity of the process measures, relations with impulsivity, concentration ability, verbal intelligence and motivation were studied. Finally, students from special education were the subjects of this study, because we were afraid that we would not get enough statements in our new categories when employing students from a normal school.

METHOD

Subjects

The subjects were 10 boys from a secondary school for special education. They were selected by the school because of their weak concentration abilities. Ages ranged from 12 to 14 years.

Materials

In this study arithmetic word problems formed the main learning materials. Because of the learning disabilities of the subjects, the tasks used in the previous study could not be used. Arithmetic word problems were chosen because of the difficulties they pose for this kind of pupil (according to the teachers). We wanted to restrict the training to one type of task in order to prevent confusion between strategies for different tasks. In total, 11 word problems like the following constituted the training material: "A train departs at 21:47 hours. Travelling time is 3 hours and 36 minutes. At what time will the train arrive?."Another set of 7 of these story problems formed the pre-test and another 7 were the post-test. Also, both at the pretest session and at the post-test session, transfer tasks were administered: 12 fraction problems like 4/– = 6/9 and 2 problem-solving tasks. These tasks consisted of a description and a drawing of a route to be taken, for instance from school to home. On the way some other things had to be done, like visiting a library, shopping, delivering something to a friend. Several time constraints as to how long a certain route takes, how long you need for a task or when something had to be done (e.g., the shop closes at 6 p.m.> form the data to be used. The task of the subject is to find the fastest way home.

The following standardized tests were used: a concentration test (Bourdon-Wiersma), an achievement motivation test (PMT-K), the Matching Familiar Figures Test (MFFT) and the verbal analogies subtest of an intelligence test (Differential Abilities Test).

During training, subjects learned a heuristic self-regulation strategy to be used when solving arithmetic word problems. The following questions were used as examples: ‘What exactly is the question posed?“; “Did I understand everything?“; What calculations are to be made?“; What is the best way to handle this?“; ‘Where can I start?“; “Why don’t I understand this?“; What am I doing?“; “Is this outcome acceptable?“; What mistake did I make?“; “Is there yet another way to solve this problem?“.

Procedure

There were 4 phases in this study In the first individual session (taking 2 hours) the tests were administered. Also, the subjects were trained in thinking aloud, and in using materials comparable to the ones used in later phases.

The second phase consisted of the pretest session (1.5 hours), in which the arithmetic word problems and transfer tasks were administered, subjects thinking aloud all the time.

In the third phase only half of the subjects participated. As a group they were trained during two sessions (4 hours in total). In the first session a group discussion on concentration and self-regulation problems took place (awareness training). Aquestionnaire, measuringreactions to concentration and self-regulation problems, developed in a previous study, was administered individually and the results were discussed in the group. Students were then informed on possible ways to react to concentration and self-regulation problems. Aheuristic self-questioning and answering strategy used in the previous study was then demonstrated by the investigators, solving word problems. During the second session the subjects practiced with this strategy, solving 11 word problems individually. The subjects had to ask themselves the questions they had learned before. Their solution processes were recorded on video. After every word problem the video tape was rewound and the solution processes were shown to the subjects. The investigator and the subject then discussed these in light of the heuristic strategy.

Finally, the individual post-test session took place. All 10 subjects again solved 7 arithmetic word problems and the transfer problems, thinking aloud all the time.

Design

The design was a pretest-post-test-control group design with random assignment to the two conditions.

Data Analysis

For each of the three tasks (word problems, fractions and problem solving) two groups were formed: the subjects performing above and below the median. Processes of these groups were compared, using t-tests for independent samples. Where significant differences in variance appeared, separate variance estimates were used. Four categories of processes were used: ***execution*** (all covert and overt activities transforming states of knowledge or understanding in the direction of the goal states, e.g., reading, writing), ***control*** (all statements that refer to activities regulating the executive actions like orientation, planning, self-testing, monitoring, revision and evaluation, e.g., "Oh yes, I understand," "If I read on I will understand it," Will I be tested?", 'Therefore I must conclude that she must be younger") (see appendix 1), ***mind-orientated*** (all statements pointing to fixations on prior successes or failures, planning or goals, see the introduction for examples) and ***distracted*** (all statements that were judged task irrelevant, reacting to external or internal stimulations, e.g., "There is a pigeon on the roof," "Tomorrow, I am going to play with my computer").

Product moment correlations were determined between process measures themselves and between process measures and test scores. The differences in regulation processes and in performance on the word problem task as well as the two transfer tasks between the trained and the untrained group, were analyzed by way of analysis of covariance.

Results

Table 1 (on the following page) presents the mean differences in processing between subjects scoring above and below the medians of the three performance measures. As to the arithmetic word problems no significant differences appeared (t-values of .60, .08, .94, .56 respectively). There was a tendency for weaker subjects to utter somewhat more mind-oriented and distracted statements. For the fraction, problems differences showed up as to execution ($t=2.69$, $df=8$, $p<.05$) and control ($t=2.05$, $df=8$, $p<.10$). The difference in frequency of mind-orientation and distraction was not significant (t-values of 1.8 and 0.0). For the problem-solving task a similar phenomenon showed up, but now in the reverse direction. Better performing subjects had higher frequencies in execution ($t = -.12$, $Df = 4.6$, $p< .10$) and control processes ($t = 1.0$, $df = 5.1$, $p< .10$) than weaker performing subjects. In all three tasks the mean number of mind-oriented and distracted cognitions was rather low.

Table 2 (on the following page) presents the correlations between the different process categories for the three different tasks. Four of the correlations reached significance, the others were moderately high. The correlations for the mind orientation scores were rather low, possibly because of the low frequencies of occurrence. In Table 3 (see page 38) the correlations are reported between the process measures (word problems only) and the test scores. Significant correlations appeared between mind orientation and intelligence and impulsivity and between distractedness and concentration.

The training program failed to be effective, as can be seen in Tables 4 and 5 (see page 39). None of the analyses of covariance with pretest product and process scores as covariates and post-test product and process scores as dependent variables reached statistical significance. Performance on the word problems did not increase significantly from pre- to post-test, either in the

Table 1
Mean Frequencies of Processes for good and Weak Performing Subjects on the Three Tasks (SD's in brackets)

Processes		Arithmetic Word problems		Fractions		Problem Solving	
		good	weak	good	weak	good	weak
	N	4	4	5	5	5	5
Execution	***M***	20.5	24.0	19.6	39.0**	17.4	5.8*
	SD	(9.8)	(6.4)	(6.3)	(14.9)	(11.7)	(3.3)**
Control	***M***	12.8	13.3	8.6	26.0'	14.6	4.5*
	SD	(11.7)	(5.4)	(7.6)	(17.3)	(10.2)	(3.8)
Mind-oriented	***M***	5.3	8.5	4.4	11.6	1.4	0.2
	SD	(5.1)	(4.7)	(5.6)	(6.9)	(2.5)	(0.5)**
Distracted	***M***	1.8	2.5	3.8	3.8	4.8	0.6
	SD	(1.7)	(2.1)	(4.7)	(4.1)	(6.9)	(0.9)**

* = $.05<p<.10$
** = $P<.05$

Table 2
Correlations Between the Process Measures for the Three Different Tasks (*N*=10)

Processes	Word Problems with Fractions	Word Problems with Problem Solv.	Fractions with Problem Solv.
Execution	.69*	.53	.64*
Control	.52	.67	.53
Mind-oriented	.51	.30	.39
Distracted	.67	.40	.55

* $p<.05$

Table 3
Correlations Between the Process Measures for the Word Problems (N= 10) and Test Scores

Processes	Ach. Mot.	Fear	Intel.	Concen.	Impuls.
Execution	.20	.60	.32	-.48	.58
Control	.10	.53	.33	-.45	.43
Mind-oriented	-.55	.49	.63*	.12	.64*
Distracted	.44	.20	.48	-.64*	-.15

Ach.Mot = Achievement motivation, Fear = Fear of failure
Intel. = Intelligence (verbal analogies), Concentr. = Concentration, Impuls. = Impulsivity.
* p<.05.

training group (t=l.l, df=4, n.s.) or in the control group (t=1.5, df=4, n.s.). Trends in the process data were in an unintended direction. In the trained group a (non-significant) increase, instead of a decrease, in the mean number of mind-oriented and distracted statements appeared. Since there was no effect on the process and performance data of direct dependent variable (the arithmetic word problems), no transfer to the fractions and problem-solving transfer tasks showed up either, as was to be expected.

STUDY 2: MODIFYING PATTERNS OF MIND ORIENTATION

In this study an attempt was made to solve some of the problems encountered in the previous one. One problem was the relatively small number of mind-oriented and distracted statements appearing in the protocols. Therefore mind orientation was operationalized in a different way. Kuhl defined the distinction between mind and activity orientation on a molar level. He defined activity orientation as a state of mind in which both the present state, the goal state, the difference between these two and the possible actions get attention from the subject and mind-orientation as a state of mind in which a fixation on one of these four elements occurs. Perhaps a more holistic approach in analyzing protocols should be taken. Instead of registering single mind-oriented statements, patterns of statements were sought that might be indicative of mind orientation. There was no separate category for mind-oriented verbalizations.

Another problem was the lack of effect of the training program with the

Table 4
Mean Pre-test and Post-test Results on Word Problems in the Trainea and Untrained Groups (SD's in brackets)

		Trained Group pretest	post-test	Control Group pretest	post-test
Variable	N	5	5	5	5
Performance on word problems	M SD	2.0 (1.2)	3.2 (1.3)	1.8 (2.2)	3.0 (2.0)
Execution	M SD	21.0 (8.3)	24.2 (14.1)	25.0 (7.3)	21.6 (5.2)
Control	M SD	12.2 (8.7)	12.6 (14.2)	15.6 (9.1)	13.2 (7.6)
Mind-oriented	M SD	5.4 (4.4)	6.4 (9.0)	9.6 (3.8)	8.0 (2.6)
Distracted	M	3.8 (2.2)	8.8 (6.3)	1.6 (1.1)	3.8 (3.4)

Table 5
Analyses of Coverance on the Product and Process Measures (word problems only)

Dependent Variable	Covariate	***MS*** covar.	***MS*** condition	***MS*** error	***F***	Sig.
word problems	pre-test word problems	1.0	0.8	3.1	.02	n.s.
execution post-test	execution pretest	108.0	46.3	113.1	.41	n.s.
control post-test	control pretest	251.4	6.2	112.0	.79	n.a.
mind-oriented post-test	mind-oriented pre-test	104.2	31.3	35.3	.28	n.s.
distract. pro-test	distracted pretest	6.0	65.9	28.0	.17	

children with concentration problems as opposed to the effects found in our previous work with "normal" children. The training program was changed considerably by incorporating new elements like reciprocal teaching procedures (Palincsar & Brown, 1984), individual learning goals based on protocols collected during a pre-test session and modelling. As a consequence of this, the training took approximately twice as long as in the previous study.

METHOD

Subjects

The subjects were 4 boys and 2 girls from a school of special education, selected out of a group of 45 students on the basis of 6 criteria: weak concentration according to the teacher and the school psychologist; impulsivity (MFFT); age (12 years old); low achievement motivation; hightest-anxiety and, sufficient mathematical ability,

Materials

As in study 1, arithmetic word problems formed the learning task. For the pre-test, 3 word problems were used, the same being done for the post-test. Reading comprehension was used as a transfer measure. Both during the pre-test session and the post-test session the subjects studied a text of3 pages, 1000 words (one text on "old times", the other one on "parents evening") and answered open-ended comprehension questions about its contents.

For all subjects individual learning goals were formulated on the basis of their pre-test thinking aloud-protocols. For each individual training session a script was prepared, concretizing how the individual learning goals could be reached. The elements included in the training were: reciprocal teaching procedures, experimenters and students changingroles, modelling, awareness training, direct instruction on regulation mechanisms, prompting, and feedback on regulation processes. In two group sessions (N=3) students worked together and discussed their regulation processes.

Procedure

The first session was a pre-test session. It started with an exercise in thinking aloud when solving a word problem. Subjects were taught how to think aloud, and received feedback. After that the three word problems were solved thinking aloud. Duringthe second session, the text was read, again with the subjects thinking aloud. Directly afterwards 8 comprehension questions were answered on the content of the text. The third session took place 10 days later and constituted the first individual training session. In between, the thinking-aloud protocols were typed out and analyzed in order to formulate the individual learning goals. This third session was dedicated to awareness training, following the procedure used in study 1. The fourth session (2 days later) was an individual session as well. Now three word problems were solved, following a reciprocal teaching procedure. Two days later a group session (6 students and 2 experimenters) followed. Regulation processes were modelled by the experimenters. Students were stimulated to work together and to be each other's external monitor. Also, important conclusions from the individual sessions were repeated and discussed. The sixth and seventh sessions again were individual training sessions, the procedure being the same as in the fourth session. Different kinds of word problems were used as training materials. The eighth session was another group session (like session 5). Students now learned the differences between five kinds of word problems. Furthermore, they wrote down what they thought they had learned from the training. The final session was the post-test session, and was identical to the first session.

Design and data analysis

The design was a pre-test-post-test design. For the categorization of the thinking-aloud protocols, the same categories were used as in the previous studies. This time, however, a detailed analysis was made of the subcategories of the "control" category used in study 1. These subcategories are defined in appendix 1.

Results

There was a significant increase in scores on the arithmetic word problems from the pretest to the post-test (M pretest = 2.1 (SD=2.2), *M* pos-ttest = 5.5 (SD=2.4); t=2.50, p(one-tailed) <.05). Transfer to the text comprehension performance, however, did not occur (M pre-test=4.9 (SD=4.9), *M* post-testz4.9 (SD=1.7); t=.03, n.s.).

In Table 6 (on the following page) frequencies of the different processes per subject are presented, both for the pre-test and-for the post-test session. Subjects 2 and 5 increased their number of verbalizations in almost all categories. These were also the 2 subjects who profited the most from the training in terms of performance improvement, Subjects 4 and 6 increased their number of execution, regulation and testing statements. Subject 1 increased the number of execution and testing verbalizations and for subject 3 an increase in the number of orientation and regulation statements could be noticedandadecreasein the number of monitoring statements. These changes did not occur as to the verbalizations during text comprehension, as may be seen from Table 7 (on page 43).

In order to find changes in mind and activity orientation, the thinking-aloud protocols were analyzed per word problem and classified according to the 4 kinds of fixations discerned by Kuhl (3 word problems per subject per session). The results are presented in Table 8 (page 44). There was a significant difference in protocol patterns before and after the training (chi-square=6.9, p<.0l). The number ofnegative and positive self-statements was also counted. The number of negative self-statements decreased from pre-test to post-test for 3 subjects during the solution of the word problems and for all subjects during

Table 6
Frequencies of the Different Processes. Before and After Training (arithmetic word problems)

Subject N	1		2		3	
Process	pre-test	post test	pre-test	post test	pre-test	post test
Execution	18	32	25	65	58	57
Orientation	11	11	7	16	8	12
Monitoring	20	20	11	44	31	21
Regulation	13	11	8	30	24	29
Testing	2	8	2	11	5	1
Diagnosing	—	1	1	1	.	.
Evaluation	—	—	1	-	-	-
Distracted	4	2	1	—	—	—

Subject N	4		5		6	
Process	pre-test	post-test	pre-test	post test	pre-test	post test
Execution	7	23	5	230	1	18
Orientation	—	1	—	55	5	2
Monitoring	—	4	4	164	10	7
Regulation	4	14	8	93	2	8
Testing	—	6	—	32	—	2
Diagnosing	—	—	—	7	-	-
Evaluation	—	—	—	2	-	-
Distracted	—	—		5	-	-

Table 7
Frequencies of Different Processes, Before and After Training (text comprehension)

Subject N	1		2		3	
Process	pre-test	post-test	pre-test	post-test	pre-test	post test
Execution	26	33	30	47	34	33
Orientation	5	5	4	6	9	6
Monitoring	7	10	16	22	19	13
Regulation	—	7	10	13	11	5
Testing	1	1	2	6	1	3
Diagnosing	—	1	—	—	1	—
Evaluation	—	—	—	1	—	—
Distracted	3	—	—	2	—	—

Subject N	4		5		6	
Process	pre-test	post-test	pre-test	post-test	pre-test	post test
Execution	24	39	33	30	12	37
Orientation	1	—	4	5	4	8
Monitoring	5	4	23	20	9	11
Regulation	15	15	20	17	5	21
Testing	—	—	—	2	—	1
Diagnosing	—	—	1	—	—	—
Evaluation	—	—	—	2	—	—
Distracted	—	—	—	6	—	—

text comprehension. There were no increases in the number of positive self-statements.

Table 8
Classification of Word Problem Protocols According to Mind and Activity Orientation

Orientation	pre-test		post-test	
Mind Orientation	16		7	
Goal fixation		11		3
Failure fixation		3		3
Planning fixation		2		1
Activity orientation	2		8	
Unclassifiable			3	

GENERAL DISCUSSION

The two studies reported revealed some differences in regulation processes between performing subjects, who have concentration problems. In study 1, differences were found between performing subjects in the number of executions and in various "control" processes. Moreover, significant correlations appeared between the process measures and standardized test scores. The differences in mind orientation and distractibility we had expected, however, were too small to be statistically significant in the first study. The scores for mind orientation and distractibility were rather low. In the second study we therefore decided to use a different way of analyzing the protocols with reference to the mind orientation. This approach succeeded.

The training failed to be effective in the first study. No effects of training on performance or process data were found. This may have been caused by the nature of the students, coming from special education. In the second study we intensified and changed the training procedure. We cannot, however, conclude that the difference between pretest and post-test we obtainedin this study has been caused by the training, since there was no control group. As in our previous work (see the introduction section), we did not confine ourselves to product measures. In our view, process training should lead to changes in processing. The changes we found in the process measures and the patterns of mind orientation therefore give some confidence that the training was successful. Thus it seems that training in self-regulation and concentration may be successful, also with students having severe concentration problems. Transfer to the reading comprehension task, however, failed to appear, indicating that explicit transfer instructions should be built into the training program.

The process measures for the different tasks correlated with each other, indicating that there is at least some individual stability in processes. Although it is reasonable to expect that regulation processes differ for different tasks and task characteristics (difficulty for instance), it is reassuring to note that there is some consistency as well. The correlations between the process measures and standardized test scores can be interpreted as evidence for the validity of the process scores. Specifically, the correlations between mind orientations and impulsivity, fear of failure and achievement motivation, between distraction scores and the standardized concentration test between control and fear of failure and between execution and fear off&lure add to the validity of the measures. Difficult to interpret, however, is the correlation between intelligence and mind orientation.

The process data on the fractions and problem-solving task in study 1 seem to suffer from the cause and effect problem discussed in the introduction. The fractions posed such great problems for some of the subjects that they tried over and over again, noticing negative interim-results and being rather mind-oriented. The problem-solvingtask on the other hand was so difficult for some subjects that they did not do anything at all: processing stopped with hardly any verbalization. It seems, then, that differences in processes depend at least partly on the (subjective) difficulty of the task.

We did not succeed in finding a suitable operationalization for distractibility. Students who were selected because of their concentration problems verbalized only a few task-irrelevant cognitions. This might be an artifact of the thinking-aloud procedure. Probably, the necessity to verbalize keeps students concentrated. In spite of this, a significant correlation with the standardized concentration test was found.

Finally, it should be noted that we do not know which elements of the training were responsible for the obtained effects. Further research is needed to clear this up. In our present studies thinking-aloud protocols are collected with larger **samples,** using training programs of longer duration.

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APPENDIX 1

Definition and Examples of Main Categories of Processing Activities

CATEGORY	DEFINITION	EXAMPLES
1. Execution	all cognitive and overt activities transforming states of knowledge or understanding in the direction of aimed states	· reading · I don't think this is an experiment
2. Monitoring	perceiving, interpreting noticing characteristics of executed actions	-oh yes, I understand -this is very difficult
3. Regulating	choosing activities and objects on which activities should be performed	
3.1. Planning	regulation on a macro-level before text processing	· if I read this very thoroughly I shall understand it
3.2. On-line regulation	regulation during text processing	· I'll just read on, perhaps I shall understand it later
4. Orienting	preparing oneself for the task by inspecting the learning situation, possible activities, goals and own characteristics	-will there be a test? · oh, I'm very good at muitiple choice tests
5. Testing	all activities leading to information about results of learning	· yes, this seems to follow from this table
5.1. Testing on understanding	all activities leading to information on understanding	· paraphrasing
5.2. Testing on knowledge	all activities leading to information on knowledge	· reproduction of fragments without reading

APPENDIX 1 (cont'd.)

CATEGORY	DEFINITION	EXAMPLES
6. Diagnosing	looking back at a preceding learning process in order to discover why resuitsare (not) reached	- I just don't understand how this figure has been constructed, but that is because I am no good at mathematics.
7. Evaluating	judging the total learning process in relation to the goals	- no, I don't understand all of it, but enough to pass the test