

Evaluation of a classroom based training to improve self-regulation in time management tasks during homework activities with fourth graders

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Abstract A study on classroom based training of self-regulated learning was conducted with fourth grade pupils attending German public schools. The participating classes were assigned randomly to either a training group or a control group. The pupils in the training group received 5 weeks of training, as depicted by Zimmerman, Bonner, & Kovach (American Educational Research Journal 31:845-862 1996), during normal classroom instruction and homework activities. Training effects were confirmed for various skills associated with self-regulation, motivation and performance. By reviewing the solution rates to daily assignments with the help of hierarchical linear models, a linear growth in the solution rates over the course of the 5 weeks was proven, which weakened towards the end of the training. Significant differences in the growth rates among the students were also confirmed. Skills in time management, learning goal orientation and self-efficacy that were evidenced by the students prior to the training proved to be able to explain variances among the growth curves.

Keywords Self-regulated learning · Training program · Elementary school · Mathematics · Growth curves · Time management · Homework activities

Evaluation of a classroom based training to improve self-regulated learning. Which pupils profit the most?

There is a serious lack of evaluated classroom implementations of self-regulatory learning (Boekaerts et al. 2000; Schunk and Zimmerman 2003). Furthermore, relatively few approaches have surfaced in which several of the essential self-regulated learning variables (such as goal setting, monitoring, self-evaluation etc., for an overview refer to Zeidner et al. 2000) are simultaneously trained and practiced in regular classroom instruction over a long

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period of time. This article takes a first step to filling this gap by systematically examining and evaluating one of the few comprehensive programs designed to mediate self-regulated learning in the classroom.

Theoretical background and base model

One approach originating from Zimmerman et al. (1996) is capable of meeting high theoretical demands, and is easily executed because it can be conducted during regular classroom instruction as well as through homework assignments. Their training program, which has not yet been subjected to evaluation, consists of five modules (time management, comprehension and summarization skills, note taking, test preparation skills, writing skills). It is based on the social-cognitive approach (Bandura 1977, 1986; Zimmerman 1989, 2000a), in which self-regulation is understood as an interaction among personal, behavioral, and environmental processes. At the core of the training modules developed by Zimmerman et al. (1996) are daily achievement measurements and systematic feedback, as well as measures which contribute to increase self-regulatory skills. The training mediates both procedural and conditional knowledge (Renkl et al. 1996; Winne and Butler 1994). In the following pages we will examine the general conception of the training modules, giving particular consideration to activities which aim to increase self-regulatory skills. A detailed description of the training and the training materials is supplied in the method section.

Each of the five training modules lasts for five weeks. During these weeks, the students work through all four steps of the self-regulated learning cycle a total of four times (see Fig. 1). The students' *self-evaluation and monitoring* of their own learning which is conducted by the pupils at the beginning of the training, as well as the ensuing systematic observation and discussion of their learning and performance behavior with the assistance of standardized forms, helps them to become actively aware of their strengths and weaknesses. This provides them with information for appropriate *goal setting and strategic planning* to improve their learning and performance behavior. Teachers help pupils set intermediate goals, based on their specification, difficulty level, and proximity in time (Bandura and Schunk 1981; Locke et al. 1981). The goals for the following week are documented on a standardized handout for the second training week.

Fig. 1 Cycle of self-regulated learning according to Zimmerman et al. (1996)



To find the best method of attaining their goals, the students are instructed on how to use strategic planning. This means pupils execute decisional processes for the selection or alteration of self-regulatory strategies (Bandura 1982; Mischel 1968; Zimmerman 1983, 1989). The chosen methods should be appropriate for the task and setting. The teachers encourage this process by presenting the students with appropriate strategies for each new task, or consulting with them on whether the strategies already decided on are suitable for the tasks at hand. Since each strategy is not equally appropriate for each pupil, and the personal, behavioral and environmental components constantly change, cyclical adjustments are necessary over the course of the training.

The next step in the cycle of self-regulated learning is *strategy implementation and monitoring*. Performance or volitional control, which is ensured through, among others, self-control processes (e.g. self-instruction, imagery, attention focusing) and self-observation processes (e.g. self-recording, self-experimentation) (for details see Zimmerman 2000a), plays an important role here. In the modules developed by Zimmerman et al. (1996) self-control is primarily assured through attention focusing. This increases concentration among the pupils and eliminates potential disruptions, and should lead to improvements in strategy application and learning behavior (Corno 1993; Weinstein et al. 1987). Since the application of strategies occurs primarily while a student completes homework assignments, topics such as the proper workplace organization and avoidance of distraction by television etc. are addressed.

At the end of the week, time is taken for self-reflection or *strategic outcome monitoring*. With the help of the teachers, the students establish a link between their learning outcome and the strategic processes they used. To reach this goal a systematic comparison is made using the self-compiled records of learning behavior and performance results produced each day. This allows the students to discern the effectiveness of the strategic processes they chose and continuously adapted over the course of the previous week.

In the modules developed by Zimmerman et al. (1996), mastery and previous performance (Bandura 1991) are primarily used as evaluation criteria. Covington and Roberts (1994) showed that these variables are particularly advantageous because they allow persons to observe their personal learning progress. This enables students to make *adaptive or defensive inferences*, i.e. to come to conclusions as to how they need to alter their self-regulatory approaches. Adaptive inferences guide learners to new and potentially better forms of performance self-regulation, such as shifting the goals hierarchically and adapting or choosing a more effective strategy (Zimmerman and Martinez-Pons 1992). Defensive inferences, in contrast, merely safeguard individuals from future dissatisfaction and aversive affects and undermine appropriate adaptations. For this reason, through feedback and support in self-evaluation in the training modules, attempts are made to inspire primarily adaptive inferences, thereby encouraging advantageous forms of self-reactions.

These self-reactions lead to adaptations in learning behavior, and thus affect learning in the following week in so far as the pupils are now able to use their self-reflections to adapt their goals and strategies. A major advantage of the training modules developed by Zimmerman et al. (1996) is that the cycle of self-regulated learning is repeated several times over the course of the 5-week training period, and the pupils, thereby, subject their self-regulation processes to constant monitoring, improvement and intense practice. To summarize, emphasis should be placed on the fact that the modules developed by Zimmerman et al. (1996) are based on a cyclic model of self-regulation which incorporates the most important components of self-regulation (self-evaluation, goal setting, strategic planning, monitoring, etc.).

The present study and its aims

We administered the first of the five modules suggested by Zimmerman et al. (1996). This module aims to improve time management skills. However, it may be more appropriate to refer here to training homework behavior with a focus on time management because the training is deeply rooted in activities at home, and the materials are supplemented by several handouts on homework behavior.

Although several studies have been able to show that primary school children are capable of acquiring self-regulatory skills (Schunk and Swartz 1993a, 1993b, Stoeger and Ziegler 2005, see also Schunk and Zimmerman 2003), comparatively few studies addressing pupils of this age have been published to date (Endler and Kocovski 2000; Schunk and Zimmerman 2003; Winne and Perry 2000; Zeidner et al. 2000). We decided to conduct our study with fourth grade students for various reasons. First, self-regulated learning embodies a very important key skill (Weinert and Schrader 1997), one which should be enabled as early as possible. In addition, many public school pupils in Germany move on to a specific school format following the fourth grade. With secondary education, the German school system is generally divided into three formats: Gymnasium (approx. upper third in ability), Realschule (middle third) and Hauptschule (lower third). The school format attended has wide ranging consequences for future educational and occupational opportunities. In order to gain admittance to a Realschule or a Gymnasium, pupils need to attain a certain composite mark in their fourth grade coursework, which is why such a strong focus is placed on learning and performance behaviors in this grade. After transferring into a Gymnasium or Realschule, the children are no longer instructed by one teacher, but rather different teachers for each course. As a result, less time is available for the mediation of learning strategies. These circumstances, and the increased performance demands placed on children by these two academic formats, particularly necessitate a more efficient use of learning behaviors (also during homework activities). The realization of self-regulated learning and increase in self-efficacy can also help prevent a drop in motivation following a transfer to a new school format (Anderman et al. 1999; Harter 1992; Rogers et al. 1994; Wigfield et al. 1991).

In our study three scientific concerns were considered: (1) the examination of the effectiveness of a training program that was developed by Zimmerman et al. (1996) and expanded with components developed by us. To this end, five weeks of training were conducted with nine fourth grade classes, both during regular classroom instruction and through homework activities. In a pretest–posttest design with a training group and a control group, we examined whether the training was able to improve time management, self-efficacy and self-reflection of own learning among the students. Furthermore, the effect of the training on various aspects of motivation (willingness to exert effort, interest, goal orientation, helplessness) and achievement was examined. According to the deliberations made above, improvements should be found in all of these variables.

(2) Hierarchical linear models should enhance assessments of the type of performance growth realized during the training. The solution rates (weekly averages of correctly solved homework exercises) were modeled as a function of progress over time during the training, individually for each student in the training group, as a so-called “growth curve” (Bryk and Raudenbush 1987; Snijders and Bosker 1999). Since it was not yet known how the training would affect performance growth, no specific hypothesis was developed, and the choice was made to execute an exploratory procedure. Since the research literature makes clear (e.g. Coleman 1968) that performance development does not necessarily follow a linear trajectory, and that stages of stagnation can very well occur, in our model both a linear and a quadratic trend as well as a combination of both were calculated. The linear trend assesses

the average increase or decrease in the solution rate, while the quadratic trend measures the rate at which these solution rates change, recording the acceleration (or deceleration) of the changes in the solution rates as expansions (or slowdowns) in the solution rates over time (for more information refer to the “[Results](#)” section).

(3) The third concern of our study was to explore how possible inter-individual differences in average solution rates and growth curves can be explained. Here we examine the influence of three variables found in the literature to be meaningful, namely time management skills, self-efficacy and learning goal orientation demonstrated by the students prior to the training. These variables were chosen for the following reasons: according to Zimmerman, self-regulated learning should always be understood in the context of skills, such as note taking, text comprehension skills or, as in our case, time management skills. The training period corresponded with the teaching phase at the end of the first half of the fourth grade; in this teaching phase all previously covered material is repeated. Since all of the material covered in the fourth grade is also subjected to review in the assigned homework exercises, it was assumed that pupils with high *time management skills*, due to their more favorable learning habits, would be in possession of more foreknowledge prior to the training, which should lead to higher solution rates. A further assumption, in accordance with the Matthew effect (Bast and Reitsma 1998; Ceci and Papierno 2005), was that students with better time management skills would profit more from the training, which in turn should produce a significant clarification of variance in the linear trend. These pupils are more aware of their learning behavior, and are therefore presumably in a better position to set suitable goals, select more appropriate learning strategies etc. A prediction regarding the influence of time management skills on potential quadratic trends is, nevertheless, difficult, since one cannot predict the relative effectiveness of the training (for instance with respect to potential strategies, possible goals etc.) or how quickly, for example, corrective feedback from teachers may take effect. Better time management skills prior to the training could be compensated for over the course of the training, resulting in a negative correlation with the quadratic trend.

According to numerous empirical findings, *self-efficacy* has a favorable influence on self-regulated learning and, consequently, on performance (Bouffard-Bouchard et al. 1991; Kurtz and Borkowski 1984; Pajares and Miller 1994; Zimmerman and Bandura 1994). Therefore, a positive correlation between self-efficacy prior to the training and solution rates was expected. If the training turned out to be suitable in increasing the perception of self-efficacy among the pupils, then those pupils with low self-efficacy levels before the training should show particularly strong growth in their solution rates. Negative relationships with the linear trend were therefore expected. Again it is difficult to predict the influence of self-efficacy prior to the training on a possible quadratic trend because no concrete prognoses can be derived here according to the social-cognitive approach. This line of questioning can be seen as rather exploratory in nature.

A large number of studies have proven a learning goal orientation to be beneficial for self-regulated learning (for an overview, refer to Pintrich 2000). For this reason this variable was included in our study in addition to time management and self-efficacy. As German classrooms are, however, rather performance goal oriented (Stoeger 2002) and various studies have demonstrated that the achievements of learning goal oriented pupils are impaired by the prevalent atmosphere in a performance oriented classroom (Newman 1998) for our study a negative relationship between *learning goal orientation* and the average solution rates was expected. Since (approach) learning goal oriented pupils essentially pursue the goal of advancing their competence and this goal orientation goes well with a favorable (self-regulated) learning style (Middleton and Midgley 1997; Radosevich et al. 2004), we expected to find positive relationships between a learning goal orientation and

performance growth to be reflected in the linear trend. Whether the advantage held by students displaying a learning goal orientation prior to the training would weaken over the course of the training, since the training should also raise learning goal orientation among those students formerly weak in this aspect, was once again difficult to predict. Should this, nevertheless, be the case, a negative relationship with the quadratic trend should appear.

Method

Design and participants

The training was administered by nine teachers within the framework of normal classroom instruction after participating in a 3-day seminar (see below for detailed description). These nine teachers were randomly chosen from a pool of 17 teachers who volunteered to participate in the 3-day seminar and the training study. The eight teachers who were assigned to the control group were assured that they would be invited to participate in the next 3-day seminar following the evaluation phase of the study. The teachers were employed at different schools which were comparable with respect to size and location. The pupils in the training group received the training described below. The pupils in the control group worked on the same mathematics assignments as the training group, but did not receive training in self-regulation skills. An entire data set was collected from 219 children. The training group (nine classes) consisted of 115 pupils (52 girls, 63 boys); the control group (eight classes) consisted of 104 pupils (58 girls, 46 boys). Three children in the training condition were excluded from the analyses because they were absent at least ten of the 25 training days. The children in the training and control groups filled out a questionnaire both prior to and after the completion of the 5-week training period (see measurement instruments). Additionally, the children in the training group used daily journal entries to record their homework activities, self-assessments, and their actual performances on the daily homework exercises and weekly quizzes (see training on self-regulated learning skills).

At the start of the investigation the average age of the boys was 10.64 years ($S=0.65$), and the average age of the girls was 10.57 years ($S=0.67$). Participation in the study was voluntary and required parental permission.

Self-regulated learning skills training

The teachers who administered the training attended a 3-day seminar which was conducted by the authors of this report. On the first day, the theoretical groundwork of self-regulated learning was presented. The second day was dedicated to the topics of time management and behavior patterns relevant to home study. Discussions related to self-regulated learning were also conducted. In addition, all learning materials relating to the training were distributed and discussed. On the third day, the teachers worked together to conceptualize 25 sets of math exercises, five math quizzes (see below), and a comprehensive final exam which was to be completed by all students in all classes. The intention of this exam was to provide an indicator of the training's success.

The training's content addressed the abilities associated with time management, self-regulated learning and the preparation of classroom materials at home (for more details and the materials see Zimmerman et al. 1996). In order to mediate these skills a particular domain and subject matter had to be specified. In our case mathematics was the chosen domain and the subject matter was the math content described below. However, as long as

the construction principles concerning the exercise sheets and quizzes are upheld, the training can be implemented in alternative domains and with other types of subject matters.

The training was conducted over a 5-week period. During the first week the focus was on self-evaluation and monitoring, that is, the pupils were to identify their own personal strengths and weaknesses in homework behavior for the subject of mathematics (see “[Introduction](#)”). For this reason the students were to recount their own learning behaviors on standardized forms, for example, when and for how long the student studies, what kinds of breaks are made, what types of distractions are present, if the student studies alone or with partners and where these activities take place. Additionally, these forms had room for the students to predict both how well they expected to do on the homework exercises and the “Math Quiz” (for more information see below) and to record the actual results.

From the first day of training, the students received math exercise sheets to be completed at home on which they could score up to 10 points, which were based on the topics currently being covered in the classroom. A grade in the traditional sense was not given. These daily homework exercises were composed by the teachers taking part in the study. Effort was made to insure that these exercises had a standardized level of difficulty so that effective learning, or less effective learning, could be directly reflected by the performance on these exercises. The students were able to inspect the exercises at the end of the periods in which the material was covered, and were to estimate how many points they thought they could attain. The aim of this procedure was to stimulate an improvement in self-efficacy. Additionally, at the end of each week a math quiz was given during the classroom period which covered the subject matter discussed that week. Once again each pupil had the opportunity to attain ten points per quiz and the difficulty level remained appropriate for the achievement one would expect of a pupil who did not undergo this training.

It was demonstrated in a previous study (Stoeger and Ziegler 2005) that fourth grade students have difficulties understanding the point of such training without benefit of additional explanations, therefore, a worksheet on the cycle of self-regulated learning was distributed and discussed with the children. The cycle of self-regulated learning is depicted on this handout along with pictures and comments from a “learning expert” (see [Appendix B](#)). In this manner, self-regulated learning could be modeled and discussed in a way which is accessible to children. This worksheet and the cycle of self-regulated learning were frequently referred to over the course of the training.

On the basis of how the above described materials were worked through and various classroom discussions, after the first training week the students possessed an outline of their homework behavior skills for the prior week, their daily achievement levels on the exercise sets, and their first math quiz score. This information was used at the start of the second training week in the goal setting and strategic planning phase described in the introduction. To support the pupils here, the teachers addressed the entries made in the first week during the class period. They drew a relationship between the quality of the homework behavior skills and the performances on the exercise sets and quizzes, and gave hints on how to improve homework skills. Then the students set achievement goals (for example, six out of ten points on the next exercise sets or five out of ten points on the next math quiz), which were then recorded in the materials prepared for them. They also recorded which strategic methods they intended to use in order to attain these achievement goals. This procedure was also supported by a worksheet in which the learning expert again modeled the desired behavior. In addition to the clues given by the teachers and the worksheet, the children were able to refer to five leaflets on effective homework skills while planning their strategies. The leaflets were distributed and introduced to the children in discussion rounds prior to the training. The worksheets contained tips on how to organize a workplace, regulate study time and breaks, deal with distractions etc.

In the second week's records, the pupils once again received standardized forms, and denoted (a) the goals they set for themselves and (b) the strategies they chose to practice in order to attain these goals. As already done in the first week, the students continued to record (c) their daily scores on the exercise sets (both the predictions they made in school after viewing the exercise sets for the first time and the actual scores attained after working through the exercises at home) as well as those for the (d) math quiz. Since (e) analog to the documentation made for the first week, the learning behaviors with respect to home study were also recorded; (f) notice was also taken as to how well the implementation of the chosen learning strategy supported the attainment of the set goals. In addition, at the end of the week strategic outcome monitoring was conducted (for more information, refer to the introduction). Children completed a profile sheet to establish a relationship between the effectiveness of their strategies and their learning performances. The pupils used this sheet to also assess their own performance on the homework assignments for the entire week.

At the start of every subsequent training week, discussions were held with the pupils about examples of effective, as well as ineffective learning strategies. Each pupil continued choosing specific goals for the coming week and making concrete decisions for, in his or her opinion, suitable learning strategies to meet these goals. The completion of the homework exercises, the math quiz and filling out the materials etc. was formulated analogously to the procedure followed for the second training week. The regular cycles of self-regulated learning, described in the introduction, started with the second week. Based on the self-evaluation and monitoring conducted in the previous week, the following week started with a new phase of goal setting and strategic planning. Strategy implementation was monitored with the help of the above described materials and classroom discussions and, at the end of the week, strategic outcome monitoring could be implemented, supported by the profile sheet described above.

Measurement instruments

In order to evaluate the effectiveness of the training, the pupils filled out a questionnaire both prior to and following the training. Interests, attitudes and self-related cognitions about a particular topic assume a high degree of domain specification; therefore, measuring instruments specifically designed for the domain of mathematics were used. The participants evaluated statements on various subjects along a six-point Likert scale. The assessments were conducted as paper and pencil tests during regular mathematics instruction, under the supervision of the class teacher and required approximately 45 min to complete. The mathematics achievement assessment was conducted separately and took about 40 min to complete.

Time management and self-reflection of own learning In order to assess the constructs of time management and a self-reflective approach to one's own learning process, two subscales derived from the questionnaire "How do you learn?", which was developed by Gold and Souvignier (2000), were used. This measuring instrument unifies items found in the questionnaire *Lernstrategien im Studium* [Learning Strategies for University Studies (LIST)], developed by Wild and Schiefele (1994) using questions from the KSI developed by Baumert (1993) and the WLI developed by Metzger et al. (1994). Both scales were adapted for the present investigation so they could be answered along a six-point Likert scale, whereby the endpoints were marked with the statements (1) *very seldom* and (6) *very often*.

The scale used to measure time management skills consisted of five items. Sample items were: Prior to every learning unit, I establish a specific period of time for it. I always determine how far I want to proceed in the learning material before I start to study. I follow

a specific time plan. The Cronbach's α for the two measuring points came to 0.79 and 0.87. The scale used to assess self-reflection of ones own learning included four items. Sample items: When I am studying math and don't understand everything, I try to determine what the source of my problem is. When I am studying math and a specific point seems to be confusing and unclear, I change my methods in order to get a better grip on the major difficulties. The Cronbach's α for the two measuring points came to 0.71 and 0.79.

Self-efficacy A pilot study proved that scales previously used (Ziegler and Stoeger 2002) were inappropriate for children attending the fourth grade, therefore, five new items were constructed to assess the self-efficacy of the students. When these items were constructed, all efforts were made to insure they were task specific, addressed various degrees of difficulty and captured degrees of confidence (Zimmerman 2000b). Sample items: In math I am sure I will keep getting more answers correct, I am sure I will keep getting better grades on my math exams. The items were assessed along a six-point Likert scale with the points (1) *absolutely disagree* to (6) *agree completely*. The analyses of the internal consistencies of the scale ($\alpha=0.77$ and $\alpha=0.76$) yielded satisfactory results.

Helplessness The degree of helplessness was assessed with four items taken from the Helplessness Scale (HiS) advanced by Breikopf (1985). The items were assessed along a six-point Likert scale with the points (1) *absolutely disagree* to (6) *agree completely*. This scale appraises anxiety (*I cannot think clearly in school*) as well as the self-perceived non-contingency of ones own actions and thus, the consequences (e.g. *Even when I study a lot, I still won't be good in school*). The analyses of the internal consistencies of the scale ($\alpha=0.93$ and $\alpha=0.94$) yielded satisfactory results.

Willingness to exert effort The students' willingness to exert effort was measured with a comprehensive, self-developed eight-item scale which had been verified in prior studies. The scale offered insight into the amount of effort students apply while learning (sample items: *I spend a lot of time at home doing math exercises* and *I only do my math exercises when I feel like it*). The Cronbach's α for the two measuring points came to 0.83 and 0.87.

Motivational orientations In order to assess motivational orientation, a scale developed in conjunction with the Manual for the Patterns of Adaptive Learning Scales by Midgley et al. (1998) was applied. Previous studies have shown that this scale is also appropriate for use among fourth grade pupils in Germany (Stoeger and Ziegler 2005). The scale comprises 14 items. Six of these items measure mathematics related learning goal orientation.¹ The remaining eight items address mathematics related performance goal orientation, whereby four of these items measure performance approach goal orientation and four measure performance avoidance goal orientation. Sample items: *One of my goals is to master a lot of new skills this year* (learning goal orientation), *It's important for me that other students in my class think I am good at my class work* (performance approach goal orientation), *One of my goals is to keep others in class from thinking I'm not smart* (performance avoidance goal orientation). All answers were made on the basis of Likert scales with the points (1) *absolutely disagree* to (6) *agree completely*. The Cronbach's α for the first and second

¹ Current research discussions are debating whether a differentiation should be made in a learning goal orientation analog to the sub-classification of a performance goal orientation into approach and avoidance components. However, in two preliminary studies no evidence of an avoidance component for a learning goal orientation was isolated, and subsequently no assessments of this variable were made.

measuring points came to: for learning goal orientation 0.73 and 0.74; for performance approach goal orientation 0.70 and 0.87; and for performance avoidance goal orientation 0.74 and 0.84.

Interest Interest in mathematics was measured with a six-item scale developed by Ziegler, Dresel and Schober (1998). This instrument is based on the person–object conception of interest (refer to Krapp 1998; Krapp and Prenzel 1992). The importance of something is defined as a “function of the characteristics of a task and as a function of the needs, goals and values of a person” (Hodapp and Missler 1996, p.146). Sample items: Mathematics instruction is generally very useful; Mathematical skills are important to me. For the two measuring points Cronbach’s α came to 0.68 and 0.85.

Scholastic achievement Two tests designed to measure scholastic achievement were developed by all teachers participating in the study, either in the training group or the control group. One test was conducted with the pupils in both the training and control groups prior to the training period the other was completed by both groups following the conclusion of the training. The content of the tests was based on the material covered in the classes prior to and during the 5-week training period. Validity and comparability among the various classes were closely monitored, for example, no question formats were included which had not yet been introduced in all participating classes. The internal consistency of the 15 items included in the examination came to $\alpha > 0.75$ for both tests. The tests were graded in accordance with the scholastic grading system commonly used in Germany, on a scale from 1 to 6. Here note should be made that the German grading system is inversely scaled, whereby 1 is the best grade possible and 6 the poorest. Grades lower than 5 indicate that the classroom goals were not attained.

Daily math exercises (Monday to Thursday) and math quizzes (Friday) Both the training group and the control group were assigned daily math exercise sheets and weekly quizzes over the course of the five week period. The exercise sheets contained ten exercises each. The same types of exercises were used on all of the sheets (exercises on addition, subtraction, multiplication, division, problems using parameters, word problems, sequences and operational tasks). The level of difficulty used was comparative, in order to allow the pupils to acknowledge their own learning progress. A sample of the tasks used on the exercise sheets can be found in Appendix A.

Homework handouts Each week the students were given homework handouts in the form of tables with spaces for the following entries: time homework exercises were started (e.g. 2:30 PM), time homework exercises were ended (e.g. 4:00 PM), interruptions during homework exercises (e.g. 20 min), cause for interruption (e.g. telephone call from a friend), distractions during homework exercises (e.g. radio), workplace (e.g. kitchen table), persons present while homework exercises were being done (e.g. younger siblings). These entries were not statistically analyzed, but rather they served as a basis for classroom discussions concerning learning and homework behaviors. Furthermore, before the four homework sheets were completed, the pupils made entries in the homework handouts on how many of the ten exercises they thought they would be able to correctly solve. After the assignments were corrected, the actual number of exercises the pupil was able to solve correctly was also recorded. The differences between self-estimations and the actual solution rates served as a foundation for discussions on the quality of the self-estimations. The actual solution rates (from 0 to 10) served as a basis for the specification of growth curves in HLM (see below).

Results

The results will be reported in two steps. First, using the data raised with the questionnaire, the effectiveness of the training will be examined. This involves computing an analysis of variance in repeated measurements, using group membership (treatment vs. control group) as the independent variable. In the second step, data amassed with the journals will be evaluated with the assistance of hierarchical linear models. An examination will be made to determine how the performances of the pupils changed over the course of the five weeks, whether the participants perceived an increase in their learning abilities and what variables can be used to explain these differences.

Examining the effectiveness of the training

In order to examine the effectiveness of the training, we used a 2 (condition: treatment vs. control group) \times 2 (time: pretest vs. posttest) mixed design. For all analyses the first factor, condition, was a between-subjects factor, and time was a within-subjects factor. The number of participants in each cell was 115 in the treatment group and 104 in the control group for all analyses pertaining to this question. The mean values, standard deviations and Δ changes for the variables considered for both the training group and the control group are contained in Table 1.

Time management, perception of self-efficacy, self-reflection of own learning: The main purpose of the training was to promote the skills involved with time management, and the overriding goal was to bring about improvements in self-efficacy and self-reflection of ones own learning (cf. Zimmerman 2000b). For all three of these variables,

Table 1 Means, standard deviations and Δ 's by treatment

		t_1	t_2	t -test	Δ Change
Time management	Treatment	2.65 (1.15)	2.93 (1.31)	$t(112)=2.29, p<0.05$	0.25
	Control	2.55 (1.05)	2.52 (1.17)	$t(103)=-0.35, p>0.10$	-0.03
Perception of self-efficacy	Treatment	4.64 (0.79)	4.83 (0.79)	$t(112)=3.16, p<0.01$	0.25
	Control	4.73 (0.74)	4.63 (0.78)	$t(103)=1.88, p<0.10$	-0.13
Self-reflection of own learning	Treatment	3.96 (0.98)	4.29 (1.07)	$t(112)=3.61, p<0.001$	0.35
	Control	4.36 (0.85)	4.40 (1.01)	$t(103)=0.35, p>0.10$	0.04
Willingness to exert effort	Treatment	4.22 (0.74)	4.38 (0.81)	$t(112)=2.59, p<0.05$	0.22
	Control	4.31 (0.70)	4.24 (0.80)	$t(103)=-1.21, p>0.10$	-0.10
Interest	Treatment	5.19 (0.56)	5.28 (0.60)	$t(112)=2.06, p<0.05$	0.17
	Control	5.36 (0.52)	5.24 (0.84)	$t(103)=-1.89, p<0.10$	-0.22
Learning goal orientation	Treatment	4.91 (0.78)	5.20 (0.72)	$t(112)=4.51, p<0.001$	0.41
	Control	5.00 (0.64)	5.07 (0.70)	$t(103)=1.15, p>0.10$	0.09
Approach orientation	Treatment	4.20 (1.06)	4.23 (1.25)	$t(112)=0.31, p>0.10$	0.03
	Control	4.01 (1.02)	3.95 (1.23)	$t(103)=-0.58, p>0.10$	-0.06
Avoidance orientation	Treatment	3.91 (1.28)	4.21 (1.44)	$t(112)=2.18, p<0.05$	0.25
	Control	3.55 (1.16)	3.79 (1.44)	$t(103)=1.66, p<0.10$	0.20
Helplessness	Treatment	2.47 (1.24)	1.94 (1.15)	$t(112)=-6.37, p<0.001$	-0.43
	Control	2.23 (1.21)	2.17 (1.21)	$t(103)=-0.73, p>0.10$	-0.05
Grade on class examination ^a	Treatment	2.68 (1.13)	2.63 (1.11)	$t(112)=0.72, p>0.10$	-0.05
	Control	2.73 (1.05)	3.11 (1.29)	$t(103)=3.87, p<0.001$	0.34

Note: All scales are based on Min=1 and Max=6

^a Achievement is scaled inversely, the higher the grade the lower the achievement

a 2×2 repeated measures analysis of variance (ANOVA) of the pretest and posttest data showed a significant main effect of time (time management: $F(1,217)=2.27$, $MSE=0.69$, $p<0.05$, $\eta^2=0.01$; self-efficacy: $F(1,217)=6.94$, $MSE=0.263$, $p<0.01$, $\eta^2=0.03$; self-reflection of own learning: $F(1,217)=6.70$, $MSE=0.55$, $p<0.05$, $\eta^2=0.03$), and a significant interaction between condition and time (time management: $F(2,216)=3.83$, $MSE=0.69$, $p<0.05$, $\eta^2=0.02$; self-efficacy: $F(2,216)=16.01$, $MSE=0.263$, $p<0.001$, $\eta^2=0.07$; self-reflection of own learning: $F(2,216)=4.20$, $MSE=0.55$, $p<0.05$, $\eta^2=0.02$). In order to examine the differences between conditions at the pretest and the posttest, we applied independent sample t -tests, whereby the Bonferroni-corrected alpha score came to 0.025. For time management, independent sample t -tests found no significant differences between the conditions at the pretest, $t(218)=0.58$, $p>0.10$, but there were differences at the posttest, $t(218)=2.42$, $p<0.025$. For self-efficacy independent sample t -tests found no significant differences between the conditions at the pretest, $t(218)=-1.99$, $p>0.10$, and the posttest, $t(218)=-0.43$, $p>0.10$. For self-reflection of own learning independent sample t -tests found significant differences for the pretest, $t(218)=-3.27$, $p<0.025$, but no significant differences for the posttest $t(218)=-0.80$, $p>0.10$. Although the training group did demonstrate a significantly lower degree of self-reflection prior to the training sessions, differences between the two groups could no longer be detected afterwards.

The results indicate significant training effects for all three variables. While the values for time management and self-reflection of ones own learning remained stable in the control group from the first measuring point to the second, and the perception of self-efficacy dropped slightly, significant gains were reported on these variables in the training group.

Motivational components (willingness to exert effort, interest, learning goal orientation, approach goal orientation, avoidance goal orientation, helplessness): Significant training effects were also confirmed with respect to various motivational components. For willingness to exert effort and interest a 2×2 repeated measures ANOVA on the pretest and posttest data showed no significant main effect of time (willingness to exert effort: $F(1,217)=0.86$, $MSE=0.19$, $p>0.10$, $\eta^2=0.00$; interest: $F(1,217)=0.10$, $MSE=0.15$, $p>0.10$, $\eta^2=0.00$), but a significant interaction between condition and time (willingness to exert effort: $F(2,216)=7.11$, $MSE=0.19$, $p<0.01$, $\eta^2=0.03$; interest: $F(2,216)=7.68$, $MSE=0.15$, $p<.01$, $\eta^2=0.04$). For willingness to exert effort, independent sample t -tests found no significant differences between the conditions at the pretest, $t(218)=-0.81$, $p>0.10$, and the posttest, $t(218)=1.26$, $p>0.10$. For interest, independent sample t -tests found significant differences at the pretest, $t(218)=-2.38$, $p<0.025$, but there were no differences at the posttest, $t(218)=0.38$, $p>0.10$. The reported willingness of the training group to apply effort increased from the first to the second measuring point, while a slight decrease was reported in the control group. A similar pattern was shown for interest. A 2×2 repeated measures ANOVA on the pretest and posttest data for the expression of a learning goal orientation (beneficial for learning and achievement behaviors) showed a significant main effect of time, $F(1,217)=16.41$, $MSE=0.20$, $p<0.001$, $\eta^2=0.07$, and a significant interaction between condition and time, $F(2,216)=6.10$, $MSE=0.20$, $p<0.05$, $\eta^2=0.03$.

Independent sample t -tests found no significant differences between the conditions at the pretest, $t(218)=-1.01$, $p>0.10$, and the posttest, $t(218)=1.25$, $p>0.10$. The pupils in the training group reported a higher learning goal orientation at the second measuring point than the first, while the values for the control group remained relatively steady. With respect to performance approach goal orientation, a 2×2 repeated measures ANOVA on the pretest and posttest data showed no significant main effect of time, $F(1,217)=0.06$, $MSE=0.58$, $p>0.10$, $\eta^2=0.00$, and no significant interaction between condition and time, $F(2,216)=0.41$, $MSE=0.58$, $p>0.10$, $\eta^2=0.00$. Independent sample t -tests found no significant

differences between the conditions at the pretest, $t(218)=1.35$, $p>0.10$, and the posttest, $t(218)=1.65$, $p>0.10$. For performance avoidance goal orientation, a 2×2 repeated measures ANOVA on the pretest and posttest data showed a significant main effect of time, $F(1,217)=7.36$, $MSE=1.05$, $p<0.01$, $\eta^2=0.03$, but no significant interaction between condition and time, $F(2,216)=0.11$, $MSE=1.05$, $p>0.10$, $\eta^2=0.00$. Independent sample t -tests found significant differences between the conditions at the pretest, $t(218)=2.29$, $p<0.025$, and the posttest, $t(218)=2.14$, $p<0.25$. Treatment group pupils reported a higher performance avoidance goal orientation. Independent of condition, the perception of performance avoidance goal orientation increased from the first measuring point to the second. Regarding the perception of helplessness, a 2×2 repeated measures ANOVA on the pretest and posttest data showed a significant main effect of time, $F(1,217)=26.35$, $MSE=0.35$, $p<0.001$, $\eta^2=0.11$, and a significant interaction between condition and time, $F(2,216)=17.17$, $MSE=0.35$, $p<0.001$, $\eta^2=0.08$. Independent sample t -tests found no significant differences between the conditions at the pretest, $t(218)=1.50$, $p>0.10$, and the posttest, $t(218)=-1.46$, $p>0.10$. Training group pupils reported lower perceptions of helplessness at the second measuring point than the first, while control group pupils reported similar levels of helplessness at both measuring points.

In order to measure training effects on scholastic performance, comparisons were made between grades obtained on the mathematics tests administered before and after the training. These tests were constructed with the support of the teachers in both the training and control groups, and before the tests were given, all of the teachers worked together to establish a common grading key that was not open to interpretation. A 2×2 repeated measures ANOVA on the pretest and posttest data showed a significant main effect of time, $F(1,217)=6.54$, $MSE=39.02$, $p<0.05$, $\eta^2=0.03$, and a significant interaction between condition and time, $F(1,217)=11.84$, $MSE=39.02$, $p<0.01$, $\eta^2=0.06$. Independent sample t -tests found no significant differences between the conditions at the pretest, $t(218)=0.19$, $p>0.10$, but there were differences at the posttest, $t(218)=-3.00$, $p<0.01$. While control group member performances dipped between the first measurement and the second, performances by the training group members remained rather constant.

Assessment of the data compiled with the journals with respect to the average weekly solution rates

In order to assess the effect of the training on scholastic performance, we took a close examination of the average weekly solution rates on the homework handouts. Consideration was taken of how many of the ten exercises on the homework sheets could be solved by the pupils on average. The average number of tasks which were solved correctly on the weekly homework handouts here modeled the progress in the training as a function of time for each student in the training group as an individual “growth curve”. Statistical modeling of the individual growth curves was realized through hierarchical linear modeling (Bryk and Raudenbush 1987; Snijders and Bosker 1999). The idea behind this evaluative method is that several measurements (level 1) are nested within persons (level 2). On the first level (within unit level) time is introduced as a predictor for the changing variable under observation. The individual regressive weight of the predictor time represents the variance proportion of a person. On level 2 (between unit level) attempts are undertaken to predict this variance proportion and the initial ability with the help of personality characteristics.

Since—as mentioned above—performance development does not necessarily follow a linear trajectory (Coleman 1968) in our model both a linear and a quadratic trend as well as the combination of both were calculated. The linear trend assessed the average increase or

decrease in the solution rate (determined through the sign (negative or positive) and the value of π_1 in the equation to follow, Eq. (1)), while the quadratic trend measured the rate at which these solution rates changed, recording the acceleration (or deceleration) of the changes in the solution rates as expansions (or slowdowns) in the solution rates over time (determined through the sign and the value of π_2 in the equation to follow Eq. (1)). The third variable in the individual “growth curve” consisted of the global solution rates of an individual, as a representation of the intra-individual solution rates over all measuring points (π_0). All of the solution rates for person i (level 1 data), were then used to calculate these three directional parameters for this individual.

$$\text{Solution rate} = \pi_{0i} + \pi_{1i}(\text{total weeks})_{it} + \pi_{2i}(\text{total weeks})_{it}^2 + e_{it} \quad (1)$$

Simultaneously, from a broader perspective, one must keep in mind that personal variables (e.g. perception of self-efficacy, learning goal orientation and time management at the start of the training) can also have an influence on the course of the training as well as solution rates on the homework handouts.² This is a consequence of the fact that the *within* person parameters influencing the solution rates, linear increase/decrease and expansion/slowdown in this growth over time are all seen as dependent variables, whose *inter-person* variance is explained by the so-called level 2 predictors. To this end, it must be determined whether a level 2 predictor merely influences the average weekly solution rates of a person,

$$\pi_0 = \gamma_{00} + \gamma_{01}(\text{Confidence}) + \gamma_{02}(\text{Intelligence}) + u_0 \quad (2.1)$$

or if the linear increase/decrease in the solution rate and the expansion/slowdown in the growth of the solution rates over time are also affected by level 2 factors:

$$\pi_1 = \gamma_{10} + \gamma_{11}(\text{Confidence}) + \gamma_{12}(\text{Intelligence}) + u_1 \quad (2.2)$$

$$\pi_2 = \gamma_{20} + \gamma_{21}(\text{Confidence}) + \gamma_{22}(\text{Intelligence}) + u_2 \quad (2.3)$$

In order to get a better understanding it is helpful to consider the two levels (variables which change over time vs. variables which are constant over time) separately (Bryk and Raudenbush 1992). However, in order to make a concrete assessment of these diverse parameters, both levels must be incorporated into a single equation by plugging Eqs. (2.1), (2.2) and (2.3) into Eq. (1). This yields (in contrast to the singular, individual error terms of a regression equation) several error terms in the equation which are correlated with one another, which in turn calls for the application of specific estimation procedures. The analyses were conducted with HLM (release 5.04; for estimation procedures refer to Bryk et al. 1996). The various issues surrounding these questions were calculated stepwise in a “statistical modeling” process, and not simultaneously in a single “confirmatory test.” The results will be presented in the same sequence used for the statistical analyses in conjunction with interpretative comments.

Table 2 provides information pertaining to the mean solution rates attained on the weekly homework handouts on each of the five measuring points and their corresponding standard deviations. As previously mentioned, three children were excluded from the analyses due to incomplete data sets.

² An examination of the multicollinearity of the three variables learning goal orientation, time management and self-efficacy provided satisfactory results. The absolute values of the correlations between each of the three variables was less than 0.27, tolerance (learning goal orientation: 0.91, time management: 0.88, self-efficacy: 0.96) and the variance inflation factor (learning goal orientation: 1.09, time management: 1.13, self-efficacy: 1.04) also fulfilled the guidelines for acceptable scores, namely close to 1 and under 4.

Table 2 Average weekly performances on the homework handouts

Week 1	Week 2	Week 3	Week 4	Week 5
6.80 (1.91)	7.57 (1.72)	7.67 (1.65)	7.72 (1.64)	7.68 (1.54)

Growth curves

The intent of the analyses was to respond to questions of whether (a) the growth curves of the average weekly solution rates can actually be described by a linear and quadratic trend, and whether (b) significant differences in these growth curves can be verified among the individuals taking part in the study. In statistical terms, the first question seeks to determine whether the parameters π_0 , π_1 and π_2 are significantly different from null. With $\pi_0=7.48$ (SE=0.14, $t=53.45$, $p=0.000$), $\pi_1=0.87$ (SE=0.14, $t=6.17$, $p=0.000$) and $\pi_2=-0.11$ (SE=0.02, $t=-4.99$, $p=0.000$) as estimators for the so-called “fixed effects,” this question can be answered with an unequivocal yes. In essence, these figures suggest that pupils were able to correctly answer an average of 7.48 of the ten exercises on each of the weekly handouts across all five measuring points. This solution rate showed a linear increase of 0.87 exercises per week, regardless of all other variables. The rate of improvement, on average, slowed down as the end of the training was approached.

The second question, regarding differences in individual growth curves, is also statistically confirmed: The variance components for the differences among the individuals (u_0 , u_1 , u_2 , see Bryk and Raudenbush 1987, 1992) are likewise all significant (for exact values refer to Table 3), meaning that the subsequent analyses intending to explain these inter-personal differences will be “productive.”

The reliabilities of the estimators for the rate of change parameters (Level-1) across all pupils came to 0.947 for the initial status (π_0 -estimator), to 0.314 for the π_1 -estimator (average increase) and to 0.304 for the π_2 -estimator (average slowdown). The relatively low reliability on the individual level for the π_1 and π_2 estimators does not provide evidence against the chosen growth curves, but rather reflects the high level of homogeneity for the growth rates among the pupils. This interpretation is also supported by observing the relations between the initial status and the growth curves. This shows that solution rates at the start of the training demonstrated little correlation to the increase in the solution rates and the slowdown of this increase over the course of the training (correlation between π_0 and π_1 : -0.008 , correlation between π_0 and π_2 : -0.097). In this first model the influence of personality variables was not taken into consideration.

Influence of personal variables

In the next step we analyzed relationships between self-efficacy, learning goal orientation and time management prior to the training and the average weekly solution rates, the linear

Table 3 Estimated variance components

Dependent variable	Estimated parameter variance	Chi-square	p -value
Solution rate	2.08033	2109.75	0.000
Linear	0.70622	161.80	0.001
Quadratic	0.01801	159.44	0.002

increase in the solution rates, and the slowdown of this increase over the course of the training. To this end, for all three equations describing the level 2 model (see above), the parameters describing the influence of self-efficacy (SE), learning goal orientation (LG) and time management (TM) were estimated:

$$\pi_0 = \gamma_{00} + \gamma_{01}(\text{SE}) + \gamma_{02}(\text{LG}) + \gamma_{03}(\text{TM}) + u_0 \quad (2.1.a)$$

$$\pi_1 = \gamma_{10} + \gamma_{11}(\text{SE}) + \gamma_{12}(\text{LG}) + \gamma_{13}(\text{TM}) + u_1 \quad (2.1.b)$$

$$\pi_2 = \gamma_{20} + \gamma_{21}(\text{SE}) + \gamma_{22}(\text{LG}) + \gamma_{23}(\text{TM}) + u_2 \quad (2.1.c)$$

Table 4 contains selected results from these analyses. First, let us consider the estimates for the fixed effects. Although the time management skills prior to the training had no effect on the solution rate, learning goal orientation and self-efficacy were significantly related to the solution rate. Higher perception of self-efficacy and lower learning goal orientation prior to the training correlated with higher solution rates. The negative relationship between learning goal orientation and solution rates may appear to be surprising at first. However, if one keeps

Table 4 Effects of time management, learning goal orientation and self-efficacy on growth parameters for average weekly performance on the homework handouts

Effects	Coefficient	Standard Error	T-ratio	P-value
Fixed, g				
Effect of time management on solution rate	0.188	0.117	1.611	0.107
Effect of learning goal orientation on solution rate	-0.378	0.176	-2.152	0.031
Effect of perception of self-efficacy on solution rate	0.840	0.169	4.973	0.000
Effect of time management on linear trend	0.362	0.119	3.031	0.003
Effect of learning goal orientation on linear trend	0.543	0.179	3.029	0.003
Effect of perception of self-efficacy on linear trend	-0.340	0.172	-1.971	0.048
Effect of time management on quadratic trend	-0.066	0.019	-3.412	0.001
Effect of learning goal orientation on quadratic trend	-0.085	0.029	-2.947	0.004
Effect of perception of self-efficacy on quadratic trend	0.035	0.028	1.262	0.207
Random, p				
Total variance in growth parameters estimates				
Solution rate	2.197			
Linear trend	2.249			
Quadratic trend	0.059			
Unconditional parameter variance				
Solution rate	2.080			
Linear trend	0.706			
Quadratic trend	0.018			
Reduction in parameter variance due to SE, LG and TM				
Solution rate	0.401			
Linear trend	0.380			
Quadratic trend	0.011			
R2: percentage of parameter variance explained by				
Solution rate	19.28			
Linear trend	53.82			
Quadratic trend	61.11			

in mind that German classrooms are highly performance goal orientated (Stoeger 2002) and that various studies have demonstrated that a congruence of individual motivational goal structures and the goal structures which are predominant in the learning environment have a favorable effect on the learning process (Ames 1981; Ames 1984; Anderman et al. 2002; Urdan and Midgley 2003), then these results are perfectly understandable.

All three variables (time management, learning goal orientation and perception of self-efficacy) relate significantly to individual linear growth rates. Children who exercised better time management skills and those who were more learning goal orientated at the start of the training show the largest increase in learning over the course of the 5-week training. The lower the perception of self-efficacy among the children at the start of the training the quicker the increase in the solution rate over the course of the training period. These results indicate that children who demonstrate good time management skills, a high orientation on learning goals, and/or low perceptions of self-efficacy profit most from the training.

Turning our attention to the quadratic trends, significant relationships could only be confirmed for skills in time management and learning goal orientation. Towards the end of the training, learning growth reduced at slower rates for pupils who demonstrated higher learning goal orientations and more time management competencies prior to the training.

Returning to Table 4, estimates are also provided for the variances associated with the random effects in the model. The table displays the percentage of parameter variance explained, which is more informative than the percentage of total variance explained because a part of the total variance is sampling error, which by definition cannot be explained by background variables. Our variables (time management, learning goal orientation and perception of self-efficacy) account for 19.28% of the parameter variance in the solution rate, for 53.82% of the parameter variance in learning growth and for 61.11% of the parameter variance in the slowdown of this growth over the course of the 5-week training period. Our model made it possible to explain the linear and quadratic trends, so that the residual variances were no longer significant (level 2: linear trend: $p=0.115$, level 2: quadratic trend: $p=0.132$, see also Table 3).

Discussion

In our study, the effectiveness of a training program on self-regulated learning was examined by analyzing three areas: (1) the effect on different (student) variables (e.g. time management, self-regulation, motivation), (2) performance growth, (3) inter-individual differences in solution rates and performance growth. The training we executed was a slightly modified version of a classroom training developed by Zimmerman et al. (1996) based on the social cognitive approach (Bandura 1977, 1986; Zimmerman 1989, 2000a, 2006). In accordance with several theoretical models, (for an overview refer to Boekaerts et al. 2000; Schunk and Zimmerman 2003) self-regulated learning is defined as a cyclical process, in which the individual steps are executed repeatedly. These individual steps (self-evaluation, monitoring, goal setting, strategic planning, strategy implementation and monitoring, strategic outcome monitoring) are practiced systematically over a long period of time. The training mediates both procedural and conditional knowledge (Renkl et al. 1996; Winne and Butler 1994) and attention is given to various peripheral personality variables such as self-efficacy (Pajares 1996; Zimmerman 2000b) and environmental factors (Zimmerman 1989, 2000a). In addition to these theoretical arguments, the decision to use this training was based on the fact that it can be carried out by teachers during normal classroom instruction and homework assignments.

The study's results show that the training is well suited to attain its immediate goals. Following the training, the pupils in the training group reported improved time management skills and self-reflection of own learning in comparison to the control group. Furthermore, the self-efficacy of the pupils, which was encouraged directly through daily comparisons and discussions of self-estimations with actual solution rates on the homework assignments, increased over the course of the training. This finding is particularly meaningful in that an improved perception of self-efficacy, due to its implications for self-regulated learning (Zimmerman and Bandura 1994; Bouffard-Bouchard et al. 1991), is very likely to contribute to beneficial learning processes in the future (Bandura 1986; Pajares and Miller 1994; Schunk 1986; Zimmerman 1986).

In addition to the favorable effects recorded for self-regulatory skills and self-efficacy, the training group also reported increased motivation. The willingness to exert effort, interest and learning goal orientation all increased in the students as a consequence of the training, and helplessness sharply decreased. The rise in learning goal orientation can, in addition to its own merit (Covington 2000; Pintrich 2000), be seen as especially advantageous for self-regulated learning. Empirical studies (Radosevich et al. 2004; Wolters et al. 1996) show that learning goal orientation is positively correlated with self-efficacy, strategy use and cognitive self-regulatory processes.

Although pupils in the training group showed no immediate performance growth in the classroom activities, the relative gains won through the training were found to be significant with a Δ_{change} of .29 (difference in the Δ_{change} between the training and control groups). While the control group demonstrated a significant reduction in performance from the first to the second measuring point, the training group members' achievement rates remained relatively constant. Since the teachers in both groups were involved in the formulation of the final examination, and the mathematical content covered during instruction was identical for both groups, the missing improvement in the training group can probably be attributed to lower practice times during the training. The teachers in the training classes reported through questionnaires, completed during and after the training, that only about half as much time was available than normal to do math exercises in the classroom during the training, due to a great deal of time devoted to the self-regulation materials. It may be that performance improvements on class tests among the members of the training group will materialize only after some time, when the time intended for mathematics instruction is again available. Unfortunately, due to school-administrative reasons, a follow-up investigation was not permitted. However, the nine teachers who led the training courses informed us two months after the second measuring point that, for the first time ever, all of the 18 pupils who took the entrance exam³ for a higher level school form were able to pass it, which translates into an increase of more than 50%.

Although significant training effects are shown for all variables, most effect sizes were small, a few were medium, and none were large (Cohen 1988). To begin with, one might ask if these effects could be attributed to a Hawthorne effect, in other words, that the found behavioral and performance changes are in response to new or increased attention. This is, however, rather unlikely, since the pupils and teachers in the control group also knew from the start that they would participate in an investigative study and that student success and, indirectly, teacher success would be assessed (Adair 1984). In fact, there are three arguments which support the belief that the effect sizes found actually underestimate the realistically attainable effects of the trainings. In the first place, the available mathematics

³ Those students who were not able to attain the composite score needed for entry to a higher school form have the option of taking an entry examination.

practice time for the training group was less than that for the control group because a substantial portion of instructional time had to be used for training instructions. Second, only one of the five training modules suggested by Zimmerman et al. (1996) was carried out. Third, one should keep in mind that the teachers in the training group had only participated in one 3-day seminar, and continued teaching with their customary instructional styles. Thus, the training's effectiveness should be examined in further classroom studies where the instructional styles of the teachers are standardized and are completely in line with the basic principles of self-regulatory learning.

Another shortcoming is that the results reported above are based on data derived from questionnaires. Since disputes have arisen regarding the measurement of self-regulated learning with such instruments (Butler 2002), further studies should incorporate the use of data based on observations and case studies. The homework handouts used in our study were useful in the comparison of actual student performance with self-estimations, but are certainly not sufficient on their own.

In order to obtain insight on performance behavior—independent of questionnaire data—we analyzed the pupils' actual achievement growth on the homework assignments and quizzes. The analysis of the growth rates in the daily homework handout sheets, with the assistance of hierarchical linear models (Bryk and Raudenbush 1987; Snijders and Bosker 1999), confirmed a significant improvement in performance throughout the training. The solution rates of the homework assignments demonstrated a linear increase of approximately one exercise per week, over the course of the training. This positive trend slowed down towards the end of the training period. Although the performance growths were relatively homogeneous (reliability of the linear trend: 0.30, reliability of the quadratic trend: 0.31, relation of change to initial status: $r < 0.10$), the pupils can be significantly distinguished with respect to their average weekly solution rates and their performance growth rates.

Explanations of the variances in *solution rates* could be traced to pre-training expressions of both self-efficacy and learning goal orientation by the students. The higher the self-efficacy and the lower the learning goal orientation were for the pupils before the training, the higher the average solution rates were during the training period. While the findings for self-efficacy are in accord with research literature on this topic (Pajares 1996; Zimmerman 2000b), the findings pertaining to learning goal orientation appear at first to contradict expectations (Dweck and Leggett 1988; Pintrich 2000; Urdan 1997). However, empirical studies (Ames 1981, 1984; Anderman et al. 2002; Urdan and Midgley 2003) have shown that a congruence of individual motivational goal structures and the goal structures which are predominant in the learning environment have a favorable effect on the learning process. The classrooms where the training took place were presumably strongly performance goal oriented (Church and 2001; Maehr and Midgley 1991), therefore, one would assume that primarily pupils with high performance goal orientation would have demonstrated better performances due to their congruent goal orientation. This actually turned out to be the case according to a post hoc analysis of the data. While a learning goal orientation showed no connections to test performances ($r = -0.05$, $p > 0.10$), pupils with higher approach or avoidance performance goal orientation achieved better results ($r = 0.18$, $p < 0.01$ resp. $r = 0.15$, $p < 0.01$). However, one must also address the question of whether the increase in learning goal orientation through the training is positive or not. In our opinion the answer is yes. Although the learning goal orientation of the pupils can not be brought into connection to average solution rates, it can be tightly linked to the performance *growth rates*. The more learning goal oriented the pupils in the training group were, the stronger their solution rates on the homework assignments grew over the course of the 5 weeks (linear trend) and the less this growth slowed down towards the end of the training period (quadratic trend). Thus, it appears as though pupils profit all the

more from the training, the more learning goal orientated they are. This hypothesis corresponds with results reported in other studies (Bouffard-Bouchard et al. 1991; Diener and Dweck 1978; Kurtz and Borkowski 1984; Pajares and Miller 1994; Pintrich 2000; Radosevich et al. 2004; Wolter et al. 1996).

In addition to learning goal orientation, time management skills were able to explain the variances among the pupils regarding performance growth rates. The more time management skills the pupils possessed prior to the training, the stronger the increase in solution rates (linear trend) was throughout the training and the smaller the slowdown in this rate (quadratic trend) was towards the end of the training. If one considers that in the course of the training, all of the material covered in the fourth grade, not to mention everything covered in primary school up to that point, was repeated, then one could cautiously interpret this finding as a Matthew effect (Bast and Reitsma 1998; Ceci and Papierno 2005). The pupils' self-efficacy perceptions prior to the training also proved to be closely related to performance growth (linear trend), however, not to the eventual slowdown in this growth (quadratic trend) towards the end of the training.

The three variables observed were able to explain 19.28% of the variances in the average weekly solution rates. They were also responsible for 53.82% of the variances in performance growth (linear trend) over the five week period and 61.11% of the variances in slowdowns in these performance increases (quadratic trend) towards the end of the training period. The remaining variances were no longer significant. We can therefore declare that pupils with high learning goal orientation, high self-efficacy levels and good time management skills were able to profit most from the training.

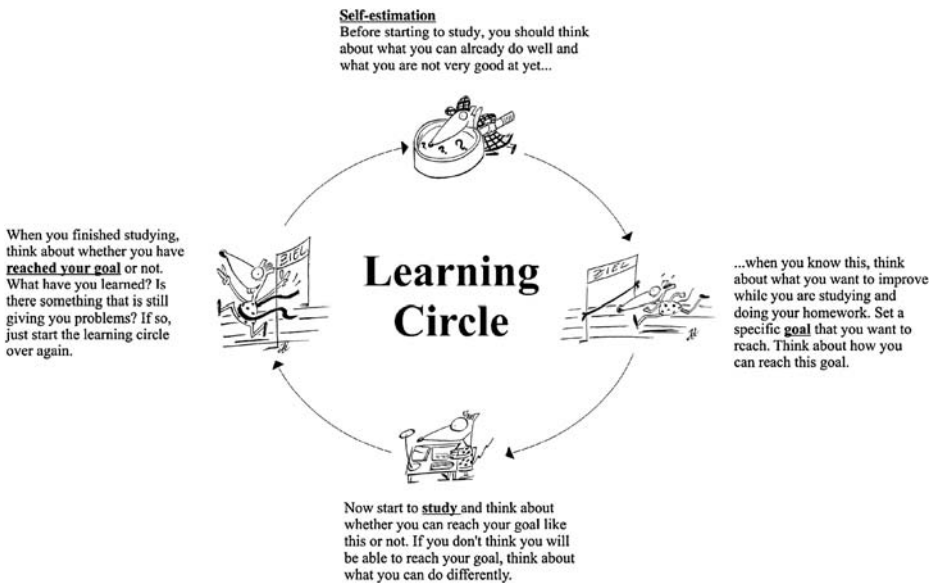
From a pedagogic point of view, four aspects of the study should be mentioned. (1) The results of the immediate training effects confirm that the training developed by Zimmerman et al. (1996) can be used gainfully in a classroom setting. (2) The results of the evaluation more than likely underrate the effectiveness of the training, in that the practice time available for the training group was lower than for the control group because time usually used for mathematics instruction was dedicated to the explanation of how the training materials were to be applied. Also, only one of the five training modules was carried out. (3) In the training study the teachers were able to conduct their courses using their preferred style of teaching. The results of the investigation did, nevertheless, point out that the execution of the training in a learning goal oriented classroom may well have led to even better results. In future studies, this assumption should be taken into consideration. (4) Should our hypothesis regarding the Matthew effect turn out to be true, this would signify that children should be provided with time management skills and learning strategies as early as possible. In further studies the age at which the training can be gainfully employed should be addressed and clarified.

Appendix A: Ten sample tasks from a math exercise sheet

- 1) First make an estimation then calculate the following:
 $92,361 + 71,673 =$ Estimation:
- 2) First make an estimation then calculate the following:
 $834,656 - 236,987 =$ Estimation:
- 3) First make an estimation then calculate the following:
 $834,656 - 236,987 =$ Estimation:
- 4) First make an estimation then calculate the following:
 $129 \times 87 =$ Estimation:

- 5) A manned spaceship flies 386 km in 1 min.
To orbit the earth the spaceship needs 96 min.
How long is the orbital period around the earth?
- 6) Calculate and give your answer in t and kg:
 $16 \text{ t } 21 \text{ kg} - 5 \text{ t } 93 \text{ kg} = \text{Estimation:}$
- 7) Put the following numbers in order according to size.
Start with the smallest number:
90,090, 990,090, 90,909, 909,009, 990,990
- 8) What number must be put in the box so that the equation is correct?
 $-405 = 196$
- 9) Calculate and give your answer in m and km:
 $1 \text{ km } 37 \text{ m} \times 27 = \text{Estimation:}$
- 10) I am thinking of a number. When I decrease this number by 216 and split the result in half, I get half of 450.
What number am I thinking of?

Appendix B



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