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Self-regulated learning (SRL) and the gifted learner in primary school: the theoretical basis and empirical findings on a research program dedicated to ensuring that all students learn to regulate their own learning

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Abstract
After defining self-regulated learning (SRL), explaining its importance for all ability groups, and summarizing findings on gifted learners' scarcer use of and lower preference for SRL, we describe two instructional modules designed for teaching SRL during regular classroom instruction and homework. We then explain how the modules are theoretically grounded in Zimmerman's (1986, 2000) social-cognitive-theory-based SRL framework and designed according to a seven-step normative model of SRL (Ziegler & Stoeger, 2005) and report empirical findings from seven studies—together involving 2019 participants—on the modules' general and differential effectiveness for in-class primary school SRL interventions. We conclude with remarks on the implications of the modules for primary school gifted education.

Keywords
Gifted education Self-regulated learning Learning strategies Metacognition Primary school

What is self-regulated learning (SRL) and why is it important?

Self-regulated learning is ''an active, constructive process whereby learners set goals for their learning and then monitor, regulate, and control their cognition, motivation, and behavior, guided and constrained by their goals and contextual features in the environment'' (Pintrich, 2000a, p. 453). This approach to learning is becoming increasingly important for a number of reasons.

First, due to technological progress, the rate of information growth has increased dramatically (Hilbert, 2014). Substantial increases in knowledge have, in turn, led to ever-increasing bodies of relevant knowledge within professional domains. Therefore, reaching expertise in a field now requires much more knowledge and more intense learning processes than in the past.

Second, the frequency with which people change jobs and careers continues to rise (Brown, 2001), and with the rising number of different careers pursued by individuals within their working lives, their need for constantly learning new things has grown accordingly. But even when individuals do remain within one profession or job, they are nevertheless typically confronted with frequent, often technology-related changes, which also make lifelong learning essential. As lifelong learning has become more important, major educational reforms have evolved accordingly all over the world by emphasizing, among other things, SRL (e.g., Chan and Rao, 2010)

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Third, numerous studies suggest that self-regulated learners show more adaptive learning behavior and thus appear to be more effective overall at learning. They report higher motivational levels and more positive motivational characteristics (e.g., McInerney et al., 2012; Pintrich, 2000b), perform better (McInerney et al., 2012; Nota et al., 2004), and show more positive emotions when learning (Ahmed et al., 2013; Pekrun et al., 2002).

Why and when do gifted and talented persons need SRL?

While SRL is just as important for gifted learners as it is for learners of average abilities, it becomes even more important for gifted learners when they are working toward excellence in a certain talent domain. Reaching excellence in a talent domain requires the optimization of numerous learning processes, and this optimization dpends on self-regulation. Studies indicate that learners need to invest about 10,000 h of deliberate practice to achieve excellence (Ericsson et al., 1993). This rule appears to hold largely independent of the talent domain. Deliberate practice is a demanding type of learning where learners continually practice skills at more and more challenging levels. When it comes to planning, designing, and evaluating such learning processes, various educational agents—including, for instance, school teachers and mentors—are important (Degner & Gruber, 2011). Yet, despite their importance, educational agents cannot monitor these comprehensive and intense learning processes every step of the way. There will be decisive moments on any given path to excellence when an individual is on her or his own. Therefore, the optimization of SRL processes is essential for those working toward high levels of domain-specific achievement.

To optimally prepare individuals for this kind of learning, self-regulation skills should be taught as early as possible. Ideally, self-regulation skills should be taught no later than during primary school years; and learners should continue to develop these skills over time. Empirical studies show that self-regulation skills can be taught successfully at a very early age (Blair & Razza, 2007; Ponitz et al., 2008; Stoeger et al., 2014). These results have led some countries to include SRL skills in their primary school curricula (e.g., in Germany: Bayerisches Staatsministerium für Unterricht und Kultus, 2014). For students to achieve the adaptive effects of SRL reported in research studies, SRL skills need to be taught systematically (Dignath and Büttner, 2008; Dignath et al., 2008; Stoeger et al., 2014). Gifted students are no exception here. Their need for an early, systematic introduction to SRL may be even greater.

Competence in learning strategies, frequency of application, and preference of learning styles among gifted primary school children

Cognitive learning strategies (e.g., organizational strategies, rehearsal strategies, elaboration strategies; cf. Weinstein and Mayer, 1986) as well as metacognitive learning strategies (e.g., goal setting, strategy monitoring, strategy adjustment) are integral parts of SRL. Studies that compare gifted and averagely gifted primary school students' learning behavior are scarce. The few existing studies examine either gifted and averagely gifted students' knowledge about learning strategies, their competence in the application of cognitive and metacognitive learning strategies, the frequency of applying these strategies, or their preferred learning styles (i.e., self-regulated, externally regulated, and impulsive learning styles).

With regard to primary school students' knowledge about learning strategies, gifted students seem to possess greater knowledge of cognitive learning strategies than non-gifted students (for an overview, refer to Stoeger & Sontag, 2012). However, some empirical studies show that gifted primary school students do not differ from their peers with respect to their competence in correctly applying metacognitive self-evaluation strategies (Schneider & Bjorklund, 1992). There also seems to be no difference concerning the frequency with which cognitive learning strategies are applied among gifted and non-gifted primary school students (e.g., Alexander & Schwanenflugel, 1994; Borkowski & Peck, 1986). To our knowledge, no study reports on the frequency of gifted primary school students' use of metacognitive strategies. Focusing on students' preferred learning styles, Sontag et al. (2012) found that gifted students prefer impulsive learning compared with self-regulated and externally regulated approaches.

One reason for the relatively scarce use of and low preference for SRL strategies among gifted students might be that these students tend to do well in school for a long time without using learning strategies or self-regulating their learning (Stoeger et al., 2014) and thus fail to recognize the usefulness of such strategies. This, however, does not mean that SRL is not important for gifted primary school students. When gifted primary school students self-regulate their learning process and use learning strategies, they, too, achieve at higher levels, are more motivated, and experience more positive emotions. Scruggs and Mastropieri (1988), for example, were able to show that gifted students achieve significantly better learning results when using mnemonic strategies. When evaluating a training program for self-regulation, Sontag and Stoeger (2015) could demonstrate that highly intelligent as well as high-achieving learners attain better results in textual work after having been instructed in self-regulation than a control group of students with comparable intelligence and achievement that was not instructed in self-regulation. Moreover, for high-achieving primary students, metacognitive self-regulation predicts a positive attitude toward mathematics (Ocak & Yamac¸ 2013). Gifted self-regulated learners also report experiencing more positive and fewer negative emotions than gifted students who adopt an impulsive style of learning (Obergriesser & Stoeger, 2014). It can thus be assumed that gifted students who self-regulate their learning process may be more academically successful when they move on to college preparatory or gifted schools (Marsh et al., 2008), as their familiarity with self-regulating their learning will allow them to adapt more readily to increased academic demands.

Teaching SRL during regular primary school instruction

An essential part of integrating SRL instruction into regular primary school instruction is making sure that it addresses the needs of students of varying achievement levels. To ensure that both gifted students and those of average abilities profit equally from SRL interventions, all students need SRL learning situations that are tailored to their respective achievement levels and, thereby, provide them with authentic opportunities to experience the benefits of SRL. Only once an SRL intervention succeeds in offering learning contents that are appropriate for students of differing achievement levels will all students be able to realize, through experience, that improving their learning behavior leads to higher achievements. Teachers can help students recognize this connection by, for example, providing them with regular feedback that draws attention to the connection between strategy use and achievement (cf. Dignath & Büttner, 2008; Hattie & Timperley, 2007).

Our research group has developed intervention modules with which self-regulation skills can be taught in primary school. The modules, which are based on a normative model of SRL that we will describe below, systematically introduce students to metacognitive (e.g., self-assessment, goal setting, monitoring) and cognitive strategies (e.g., ecological strategies, text-reduction strategies) as they work on specific learning contents (e.g., mathematics exercises, scientific texts). Teachers implement the interventions during regular classroom instruction and homework. In designing our interventions, we made it a priority that gifted students and their peers of average abilities profit equally. The modules were developed for fourth graders of different ability levels in regular classrooms. They are also appropriate for younger students in gifted programs. In the following sections we will describe the theoretical background of our intervention modules, their typical sequence, and the results of some evaluation studies.

Theoretical background

As meta-analyses indicate that self-regulation interventions during primary school achieve the largest effect sizes when they are based on social-cognitive theory (Dignath & Büttner, 2008; Dignath et al., 2008), we based our training modules on Zimmerman's model of SRL (1986, 2000), which provides a theoretical framework based on social-cognitive theory. This model of SRL, referred to below as the *Zimmerman model*, considers numerous cognitive, metacognitive, and motivational aspects of SRL and allocates these to a *forethought phase*, a *performance or volitional-control phase*, and a *self-reflection phase*. The forethought phase encompasses those prerequisite processes that precede actions and learning efforts. The performance or volitional-control phase includes processes that are important during learning and influence the learner's focus and behavior. During the self-reflection phase, which begins after learning activities have ceased and concludes the Zimmerman model, learners evaluate the outcome of their learning.

Models such as the Zimmerman model (1986, 2000) provide information about optimal SRL and can serve as a basis for designing interventions and researching SRL. Numerous studies show that interventions are more successful and facilitate the transfer to other contexts and domains when they make participants aware of the theoretical framework on which the intervention is predicated (Salomon & Perkins, 1989; Weinstein et al., 2000). However, with all of its numerous components, the Zimmerman model (1986, 2000) cannot be easily explained to learners in an intervention, especially if these learners are primary school students (Zimmerman, 1990). For this reason, our research group developed a normative model of SRL, the seven-step cycle of self-regulated learning (Ziegler & Stoeger, 2005), which we will refer to throughout as the *Ziegler–Stoeger model*. This normative model, intended for use among primary school students, only includes seven selected aspects from the Zimmerman model. All seven aspects included in the Ziegler–Stoeger model belong to the cognitive or the metacognitive domains, as skills from these domains have been identified as particularly effective for primary school students (Dignath & Büttner 2008; Dignath et al., 2008). Less emphasis is put on motivational aspects, as motivation appears to play a greater role in interventions for secondary school students (Dignath & Büttner, 2008). Figure 1 illustrates how the Ziegler–Stoeger model and the Zimmerman model relate to one another.

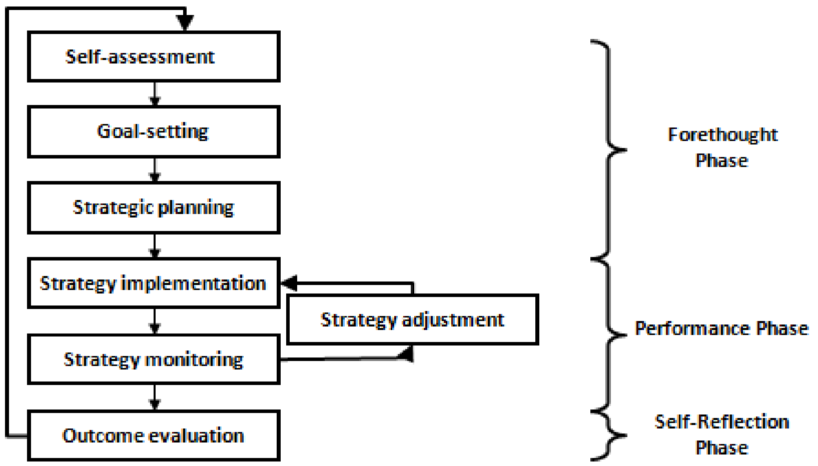

Figure 1. Seven-step normative model of self-regulated learning by Ziegler and Stoeger (2005) and its relationship to the three phases of Zimmerman model (1986, 2000)

The first three steps in the Ziegler–Stoeger model (*self-assessment*, *goal setting*, and *strategic planning*) fit into the Zimmerman model's *forethought phase*. The next three steps in the Ziegler–Stoeger model—*strategy implementation*, *strategy monitoring*, and *strategy adjustment*—reflect selected aspects within the performance or volitional-control phase of the Zimmerman model. They constitute an internal cycle within the Ziegler–Stoeger model and can be applied to various cognitive strategies (e.g., ecological strategies, organizational strategies, rehearsal strategies; cf. Weinstein & Mayer, 1986). By working through these three steps repeatedly, students come to understand that a learning strategy is not something one is immediately able to use effectively, but that strategy use needs to be developed through constant monitoring and adjustments, whenever necessary.

The final step in the Ziegler–Stoeger model, outcome evaluation, is an aspect taken from the third phase, self- reflection, in the Zimmerman model. The central concern here is to assess whether strategic learning has helped learners to achieve their individual goals. As in the Zimmerman model, the final step in the Ziegler–Stoeger model influences the way students approach future learning processes.

Concept behind the intervention modules

Over the last decade, our research group has developed and evaluated several SRL training modules. We based them on the theoretical model described above. Before providing an overview of the sequence and contents of the two most intensely evaluated intervention modules (module 1: SRL and ecological learning strategies in mathematics; module 2: SRL and text-reduction strategies for basic science texts), we will first discuss the principles we followed when developing them. Our design priorities reflect the key insights of earlier research.

1. Studies show that introducing learning strategies in the context of *specific learning contents* improves the effectiveness of strategy implementation and the transfer process (e.g., Hattie et al., 1996; Dignath & Büttner, 2008). For this reason, our training modules introduce the cognitive and metacognitive strategies included in the Ziegler–Stoeger model (Fig. 1) in combination with specific learning contents. We chose math problems for the first module and expository texts on topics from basic science for the second training module.
2. In each module the students are taught to implement, monitor, and adapt a *certain type of learning strategy* (refer to steps 4 through 6 of the Ziegler–Stoeger model) while working on specific contents. Module 1 trains ecological learning strategies (e.g., avoiding distractions, organizing a desk, time management). Module 2 trains text-reduction strategies (e.g., drawing mind maps, underlining main ideas, writing summaries).
3. As studies indicate that interventions are most likely to be effective when they offer learners enough time and numerous opportunities for practice (Alexander et al.,1998; Dignath & Büttner, 2008; Pressley et al., 2006), our modules require work on a day-to-day basis for at least 6 weeks. In particular, we provide students with several weeks of highly focused, systematic practice of the individual cognitive and metacognitive learning strategies to ensure that they actually *proceduralize* (Renkl et al., 1996) the new knowledge about SRL and learning strategies rather than merely review declarative knowledge.
4. To demonstrate to students that SRL is relevant in various settings (Ramdass & Zimmerman, 2011; Stoeger and Ziegler 2011), the intervention modules require student work *in class and at home*. Whenever possible, the students also apply the acquired strategies while learning in various additional school subjects.

5. Students need to be able to recognize that better learning behavior actually leads to improvements in performance. To help students *make explicit connections between learning behavior and performance*, the modules' daily tasks are comparable in length and difficulty level. In designing the modules, we also made sure that students would have ample opportunities for drawing systematic connections between their learning behavior and their performance.
6. As the effectiveness of SRL interventions depends on the teachers who are introducing students to this form of learning (Dignath & Büttner, 2008), our training modules mandate *thorough training of participating teachers*. The teachers who implement our interventions participate in a two-day preparatory seminar that provides them with a total of 16 h of instruction on how to teach SRL. They learn about the concept of SRL, the day-to-day implementation of the intervention modules, and the instructional materials. Participating teachers also come together for additional meetings while they are implementing the training modules in their classrooms.
7. 7. To make sure that also gifted students get the opportunity to improve their achievements with the help of enhanced learning behavior, we developed tasks and exercises that are sufficiently challenging for these students, too (Stoeger & Ziegler, 2008a; Ziegler & Stoeger 2005).

Structure of the intervention modules

We considered these basic principles when developing our intervention modules. Each module takes 7 weeks to implement and is applied on a daily basis during regular classroom instruction and homework. The seven-week modules are subdivided into two informational weeks and five so-called learning-cycle weeks. During the informational weeks, teachers introduce information about SRL and learning strategies (ecological strategies in module 1, text-reduction strategies in module 2). Then, during the learning-cycle weeks, students systematically practice applying the various steps of the Ziegler–Stoeger model while working on learning contents in class and during homework (mathematics exercises in module 1, basic science texts in module 2).

During the *informational weeks* teachers devote approximately 45–60 min of instruction time per day to the intervention program. They present the concept of SRL to their students. Over the course of several instructional units, teachers thoroughly discuss each cycle step and how the steps fit together. They also use various student-centered everyday examples, such as caring for a pet or practicing a particular sports skill, to show how SRL can be transferred to a variety of situations. This process is supported by various learning materials (cf. Stoeger & Ziegler, 2008a; Ziegler & Stoeger, 2005).

Just as teachers introduce students to the basic concept of SRL during the informational weeks, they also introduce certain types of learning strategies. In module 1 the teachers introduce ecological learning strategies such as avoiding distractions, organizing a work space (i.e., a desk), or timemanagement strategies. In module 2 teachers introduce three text-reduction strategies: underlining and copying main ideas verbatim, drawing mind maps, and writing summaries. The knowledge presented during the informational weeks is then proceduralized during the *learning-cycle weeks*. In other words, once students have understood the basic ideas behind the skills described in the seven-step cycle of self-regulated learning (during the two informational weeks), they then use the learning-cycle weeks to actually start developing these skills through practice with specific contents and with the help of various learning materials (cf. Stoeger & Ziegler, 2005, 2008a, 2011).The timenecessary for training during the learning-cycle weeks varies between approximately 40 min on Tuesdays, Wednesdays, and Thursdays, and approximately 60 min on Mondays and Fridays.

During the learning-cycle weeks students repeatedly and mindfully work through all steps of the learning cycle (self- assessment, goal setting, strategic planning, strategy implementation, strategy monitoring, strategy adjustment, and outcome evaluation) by applying them to training tasks. Students *self-assess* their *strengths and weaknesses* concerning two areas: learning tasks and learning behavior. Students receive daily worksheets that support them in their self-assessment of *learning tasks*. In module 1 the work sheets contain ten similar math exercises of comparable difficulty level that students are asked to solve. In module 2 students receive daily science texts of comparable length and difficulty level. Each text contains ten main ideas that students are asked to identify. The similarity in length and difficulty level of the exercises makes self-assessment easier and ensures that students are able to draw connections between learning behavior and achievement (see description below). Students' self-assessment concerning learning tasks is guided by various kinds of material and is systematically supported by teachers. Students receive learning journals that help them self-assess their *learning behavior*. In module 1 the learning journals are meant to help students recognize their strengths and weaknesses concerning homework behavior (i.e., ecological strategy use). For example, students systematically record when they learn, how many breaks they take, and whether they experience any distractions during homework. In module 2 students keep records about their strengths and weaknesses concerning their use of text-reduction strategies. Teachers use the learning-journal entries to systematically and constructively discuss students' strengths and weaknesses in learning behavior.

The structured learning journals also accompany the students as they progress through the learning cycle. At the beginning of each learning-cycle week, students *set a specific outcome goal* for themselves. For example, in module 1 students specify how many math exercises they aim to solve every day and/or what they want to change in their homework behavior (e.g., avoiding distractions). The students are encouraged to set goals for themselves that are challenging but achievable. They record their goals in their learning journals, and they also record the strategy they plan to use (*strategic planning*) in order to achieve their goals. To do this, they use the learning strategies introduced during information weeks 1 and 2.

During the learning-cycle weeks students also proceduralize the learning strategies they learned about during the informational weeks (ecological strategies in module 1, text-reduction strategies in module 2). In order to ensure optimal proceduralization of the learning-cycle steps 4 through 6 (*strategy implementation*, *strategy monitoring*, and *strategy adjustment*), the students work on the provided learning tasks described above (mathematics exercises in module 1, basic science texts in module 2) at school during homework each day. They apply the learning strategies introduced during information week 2 and use their structured learning journals to monitor their strategy use and reflect on whether and how they are adapting their learning strategies.

The learning journal also facilitates *outcome evaluation* at the end of each learning-cycle week. Its structure gives students a chance to systematically and retrospectively evaluate the quality of their self-assessment, goal setting, learning behavior (strategic planning, strategy implementation, strategy monitoring, and strategy adjustments), and achievement each week (cf. Hübner et al., 2010). The primary goal of the outcome monitoring step is that students think about how their individual learning steps fit together and thus construct a coherent picture of their self-regulatory efforts. The outcome monitoring is also important in that it gives students a chance to recognize the usefulness of the metacognitive and cognitive strategies they have been practicing (Schunk & Rice, 1987). To further encourage effective outcome evaluation, connections between learning behavior and results are stressed systematically and consistently throughout the course of the program. To this end, the learning journals not only reflect students' learning behavior but also register their achievement in the daily training task. Students should see, for instance, that on days on which they recorded better learning behavior, they also solved more math exercises or, in the second module, identified more main ideas in the reading texts.

Empirical studies on the effectiveness of SRL intervention modules in primary school

Both intervention modules have been thoroughly evaluated. In the following, we first report results of evaluation studies in which the overall effectiveness of our modules was tested under different conditions. We then present studies on the differential effectiveness of our intervention modules. In particular, we will give an overview of studies in which the effectiveness of the intervention modules was tested for primary school students of different cognitive abilities and different achievement levels as well as for gifted achievers and gifted underachievers.

Overall effectiveness of the training modules

Module 1 (SRL and ecological learning strategies in mathematics), study 1

The overall effectiveness of module 1 was examined in a sample of 393 students from 20 different heterogeneous fourth-grade classrooms (Stoeger & Ziegler, 2006). Participating classrooms were randomly assigned to either an intervention or a control condition. The training module's effectiveness was evaluated with a pretest–posttest design. Special attention was paid to the motivational orientations of participating students just prior to the start of the training module. We differentiated between a learning-goal orientation, a performance-approach goal orientation, and a performance-avoidance orientation (Elliot & Church, 1997). Students with learning goals approach learning situations with the aim of mastering the acquisition of new skills; students with performance-approach goals aim to gain approval from peers and teachers; and students with performance-avoidance goals aim to conceal feelings of inferiority in achievement situations.

In research literature, one frequently encounters the assumption that learning-goal orientation is an important prerequisite for acquiring self-regulation skills (e.g., Pintrich, 2000a). When members of our research group designed the first module 1 study (Stoeger & Ziegler, 2006), no empirical results existed to support this assumption. The study thus examined the extent to which differences in motivational orientation contributed to the success of the intervention module. The evaluation study documented training effects for time management, self-regulatory abilities, and performance that were independent of the students' motivational orientation prior to participation in the training module. Contrary to our expectations, students who were mainly learning-goal oriented did not profit more from the training. However, students who reported similarly high levels of all three goal orientations (learning goals, performance-approach goals, and performance-avoidance goals) profited more from the training concerning their success expectation and their mathematics self-efficacy.

Module 1, study 2

In a second evaluation study, module 1 was implemented and evaluated with 219 students from 17 heterogeneous classrooms who were randomly assigned to a training group or a control group (Stoeger & Ziegler, 2008b). The results of the first evaluation study led us to make a number of small changes to the instructional materials used during the second evaluation study. For evaluation study 2, we had three concerns: First, we assessed the effectiveness of the revised version of the training module in a manner comparable to the assessment in the first evaluation study. Second, we modeled possible learning improvements in mathematics with the help of hierarchical linear modeling using the program HLM. Third, we examined which variables explained differences in learning gains.

The results of the second evaluation study indicate that the intervention module is well suited to achieving ist stated goals. Time-management skills and homework behavior as well as self-regulatory and metacognitive skills improved for students in the training condition in comparison with students in the control group. The training module also led to increases in students' self-efficacy and motivation. Students' willingness to exert effort, their interest, and their learning-goal orientation improved. Their levels of helplessness sank considerably. We also observed significant training effects for mathematics performance. Growth curves modeled in HLM revealed a clear improvement in performance in the daily mathematics worksheets. The rate of correct answers in the mathematics worksheets increased linearly over the course of the intervention module by about one problem per week. This increase became smaller toward the end of the intervention module. While the magnitude of improvements in performance was relatively homogenous, students showed significant individual differences in their average weekly rates for correct answers and in their performance improvements. Students' self-efficacy, their learning-goal orientation, and their time-management skills before the training explained the variances in solution rates.

Module 2 (SRL and text-reduction strategies for use with basic science texts), study 1

The overall effectiveness of module 2 was evaluated with a sample of 763 students from 31 heterogeneous classrooms (Stoeger et al. 2014). One goal of our study was to test whether teaching text-reduction strategies within a framework of SRL—that means in combination with metacognitive strategies—is more effective than just teaching text-reduction strategies alone. We compared a group of students (*n* = 229) who worked through intervention module 2, in which text-reduction strategies are taught within the SRL framework of Ziegler and Stoeger (2005), with a group of students (*n* = 286) who received an adapted intervention of about the same duration in which only text-reduction strategies were conveyed. Both groups were compared with a group of students (*n* = 266) who received regular classroom instruction without any intervention. We used pretests, posttests, and follow-up tests in all three groups as well as process data (to monitor treatment integrity) from the two intervention groups to assess the effectiveness of the training.

Our evaluation results confirm the general effectiveness of intervention module Students who received this intervention showed increases in their preference for SRL compared with the other two groups. Students in this intervention group who did not have an immigration background (i.e., neither the students themselves nor either of their parents was born outside of Germany) also achieved better results on standardized reading comprehension tests at the posttest than did the students without an immigration background who received regular classroom instruction. This advantage persisted at the follow-up test.

Hierarchical linear modeling revealed that both intervention groups—the group of students who worked through module 2 and the group of students who worked through the pure text-reduction-strategy version—showed linear increases in solution rates on the training task (i.e., finding main ideas in science texts) over the course of the intervention. However, the increase was steeper among students of module 2. In the final week of the training, students who worked through module 2 were able to correctly identify one main idea more than the students in the pure text-reduction-strategy group, thus demonstrating the advantage of module 2 over the pure text-reduction-strategy version.

In summary, both training modules seem to achieve their main goals. They improve learning behavior and increase performance. There is also initial evidence that the intervention modules lead to positive side effects such as increased motivation or decreased helplessness. In a next step we tried to find out whether our intervention modules are similarly effective for students of different ability levels as well as for gifted achievers and gifted underachievers.

Effectiveness for students of differing intelligence and achievement levels

Module 1 (SRL and ecological learning strategies in mathematics), study 1

For module 1 we tested whether the training module was similarly effective for students of different cognitive abilities (Stoeger & Ziegler, 2010). Two hundred and one students from 16 heterogeneous fourth-grade classrooms participated in the study. Classrooms were randomly assigned to an intervention or a waiting-list control group. Prior to the training, students completed a cognitive abilities test. We assigned the students to quartile groups according to their cognitive ability test results. In a pretest-posttest design, we found positive training effects for homework behavior (avoiding distractions and homework organization), self-efficacy, metacognition, various motivational variables, and achievements that were independent of the students' cognitive ability level. Thus, we found no evidence in support of concerns that highly intelligent students might find the training module boring or that it might have overtaxed students with lower-than-average intelligence. Additionally, the training module appears well suited for promoting the development of self-regulatory and learning skills among highly intelligent students during regular classroom instruction.

Module 2 (SRL and text-reduction strategies for working with basic science texts), study 1

For module 2 we tested whether highly intelligent and high-achieving students benefit from an SRL intervention program as much as their peers of average intelligence and achievement (Sontag & Stoeger, 2015). We treated highly intelligent students and high-achieving students as two distinct groups with possible overlap; in the same sense, averagely intelligent and averagely achieving students were also viewed as two distinct groups with possible overlap. Overall, 322 students from heterogeneous classrooms participated in the study. One group of students (n = 123) worked through module 2, and another group of students (n = 199) received regular classroom instruction. All students completed pretests, posttests, and follow-up tests, while process data (solution rates of the training task of finding main ideas) were only gathered for students in the intervention condition.

All four ability groups (i.e., students with high intelligence, students with high achievements, students with average intelligence, and students with average achievements) benefited from the intervention concerning preference for self-regulated learning and achievements. Highly intelligent students who had worked through module 2 demonstrated a long-term increase in the preference for SRL (i.e., from pretest to follow-up test), when compared to highly intelligent students who had received regular classroom instruction. For high-achieving students, immediate (i.e., from pretest to posttest) and long-term (i.e., from pretest to follow-up test) training effects were detected. Comparing the effect sizes suggests that the high-achieving students benefited more than any other subgroup with regard to the preference for SRL. At the same time, highly intelligent students benefited more than students of average intelligence and students with average achievements.

Furthermore, all four ability groups benefited from the intervention concerning their achievements. Trend analyses revealed improvements in performance in the training task of finding main ideas in science texts for all groups of students. Again, the training effect was largest among the high-achieving students.

Effectiveness for gifted achievers and underachievers

Module 1, study 1

In another study (Stoeger & Ziegler, 2005) we tested the effectiveness of intervention module 1 for gifted underachievers. There is now largely a consensus among researchers that underachievement (unexpectedly low performance among gifted students) poses one of the greatest challenges for promoting development among the gifted. Self-regulated-learning interventions target several primary causes of underachievement including lack of motivation, ineffective learning behavior, and low levels of confidence in one's own abilities. Therefore, we assessed whether our intervention concept was also effective for gifted underachievers.

Thirty-six gifted underachievers, who had been identified in a sample of about 1200 students, participated in the study. They were randomly assigned to a training (n = 15) or a control group (n = 21). We found clear training-related improvements for the primary goals of the training module (e.g., for time management and strategic learning). Thus, the intervention was successful at addressing some of the important causes of scholastic underachievement. Two further, rather indirect training goals were also achieved. Training-related improvements were found for confidence in one's own abilities and for reported levels of helplessness. The training module also had a positive influence on students' motivation, which many researchers view as a central cause of underachievement. With regard to the overarching goal of the training module—improving scholastic achievement—the recorded effect sizes indicated tendencies in the direction of improvement, but these were not statistically significant. In sum, our study supported an optimistic overall assessment of the training effects.

Module 2, study 1

In a recent study (Obergriesser et al. 2015) we tested whether students' learning behavior, their motivation, and their emotions could predict underachievement among gifted students and whether module 2 was also similarly effective for gifted achievers and gifted underachievers. The sample consisted of 85 gifted students, 24 of whom had been identified as underachievers. Consistent with existing research, logistic regression analysis revealed a lack of self-efficacy as a significant predictor of underachievement. In line with our theoretical assumptions, students who reported experiencing more anxiety in class were also more likely to be underachievers. Interestingly and contrary to our assumptions, however, the probability of being an underachiever was also higher for gifted students who frequently applied text-reduction strategies. Subsequent analyses suggest that this result may be attributable to the underachievers in our sample, who reported very frequent application of text-reduction strategies but who—as our analysis showed—did not apply them correctly.

As module 1 had already been shown to improve students' self-efficacy (Stoeger & Ziegler, 2008b) and to enhance SRL, which in turn is correlated with lower levels of anxiety (Pekrun et al., 2002), working through module 2—with its focus on the correct application of text-reduction strategies—should be effective and therefore helpful for underachievers in our sample. Analysis of growth curves in HLM corroborates this assumption. Both gifted underachievers' and gifted achievers' performance in the training task of finding main ideas increased over the course of the intervention period, and both groups showed improvements in their self-assessment. As a positive side effect, underachievers increasingly enjoyed working with texts.

Studies on the modules' differential effectiveness corroborate their effectiveness for students of differing cognitive abilities and achievement levels as well as for gifted achievers and gifted underachievers. We found comparably positive changes in learning behavior, performance, and motivation for different groups of students. The evidence also provides some indication that the intervention modules might positively influence students' emotions.

Implications for gifted education

We conclude by highlighting two implications of our results for gifted education. First, the reported evaluation studies show that SRL can be successfully taught to gifted students during regular classroom instruction. This finding is encouraging for the provision of gifted education within inclusive classrooms. In designing our intervention modules, we kept this contingency in mind. Typically, the difficulty levels of classroom tasks are oriented toward the performance levels of students with average achievements (Weinert, 1997). When provided with such tasks, gifted students achieve at high levels without using cognitive and metacognitive learning strategies. We designed our tasks to be challenging for students with average achievements as well as for gifted students. This ensures that gifted students will only be able to improve their performance by using appropriate learning strategies and thereby offers gifted students an authentic situation in which they can discover the usefulness of learning strategies. Our intervention modules can, of course, just as well be used in gifted-only classes and programs. When gifted students are learning in smaller groups, the teacher's job of introducing self-regulation strategies becomes easier, because the teacher has more capacity for providing extensive feedback and individualized coaching on how to learn.

Second, our studies show that our intervention modules are appropriate for addressing various determinants of underachievement. The positive changes in motivation, learning behavior, and academic emotions brought about by teaching SRL should make a long-term contribution to preventing or ameliorating underachievement. Both of our studies with gifted achievers and gifted underachievers provide initial indications of positive changes in the extent of underachievement. Further studies will be needed to better understand just how the intervention modules are helping to reduce underachievement.

While our findings are encouraging, it must be kept in mind that neither gifted achievers nor gifted underachievers will be able to automatically transfer the learning strategies they acquire in our intervention modules to other learning contents. In order to enable students to transfer these skills, teachers must see to it that students sequentially complete several intervention modules in different subject areas on various types of strategies. They must also ensure that students' use of self-regulation strategies is not limited to specific intervention modules and to the timeslots allotted to their implementation during class and homework. Rather, self-regulation strategies should be regularly discussed and used independently of the interventions.

Meeting these requirements can go a long way toward helping children to self-regulate and generally improve their learning. Such skills may not be necessary for gifted students who merely wish to keep up with the class during regular instruction. However, they become essential and thus potentially game changing for gifted students when they enter a more challenging learning environment or when they begin to make an earnest effort to achieve excellence in a given talent domain. With this in mind, teaching learning strategies and learning how to learn assume a new importance in gifted education. As our intervention modules show, this does not mean, however, that learning contents become less important. Rather, gifted education becomes more informed by careful reflection on the interrelatedness of learning-contents-specific knowledge acquisition and of learning skills development.

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