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Can highly intelligent and high-achieving students benefit from training in self-regulated learning in a regular classroom context?☆

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ABSTRACT

We examined if highly intelligent and high-achieving students benefit from training in self-regulated learning conducted in regular classrooms as much as their peers of average intelligence and with average scholastic achievement. Fourth-graders participating in a training program of self-regulated learning (SRL, $n = 123$) were compared with fourth-graders receiving regular classroom instruction (REG, $n = 199$) in a pretest, posttest, follow-up design. Students in the SRL group practiced self-regulated learning while working on identifying main ideas in expository texts. The training was effective for highly intelligent and high-achieving students as well as for their peers of average intelligence and with average scholastic achievement. Highly intelligent students benefited in their preference for self-regulated learning only in the long run; for high achievers, we found immediate and long-term effects. Both highly intelligent students and high achievers identified more main ideas correctly in the course of the training. We recommend this program for use by classroom teachers in heterogeneous classrooms.

1. Introduction

Self-regulated learning (SRL) represents a key skill in our rapidly changing society, where lifelong learning has become necessary for everyone (e.g., Council of the European Union, 2002). SRL-skills are therefore important for all students and should be fostered as early as possible. Accordingly, SRL competencies are part of elementary school curricula in several countries (e.g., in Germany: Bayerisches Staatsministerium für Unterricht und Kultus, 2000, 2014) and numerous empirical studies show that SRL can be effectively taught to elementary school students (for an overview cf. Dignath, Buettner, & Langfeldt, 2008). However, few studies exist that explore the effectiveness of SRL interventions in elementary school for students with differing cognitive abilities and achievement levels.

Existing studies on differential effects of SRL training mostly focus on low-achieving elementary school students and students with learning difficulties (e.g., Antoniou & Souvignier, 2007; Graham, Harris, & McKeown, 2013; Rogers & Graham, 2008). However, comparatively little is known about the effectiveness of SRL training for highly intelligent or high-achieving students. In particular, there are – to the best of our knowledge – no studies examining if and how highly intelligent and high-achieving students benefit from SRL training conducted in a regular classroom context. The aim of our study was therefore to test the effectiveness of an SRL training program that was already successfully implemented in regular elementary school classrooms (Stoeger, Sontag, & Ziegler, 2014), for highly intelligent students and for high-achieving students. We will treat highly intelligent students and high-achieving students as two distinct groups with possible overlap: Highly intelligent students may or may not also be high achievers, and high achievers may or may not also be highly intelligent.

1.1. Is it necessary to teach SRL to high-achieving and highly intelligent students?

We understand SRL as an active process, in which students accept responsibility for their own learning by actively setting goals, and by then planning, monitoring, regulating and evaluating their learning progress (cf. Boekaerts, Pintrich, & Zeidner, 2000). Although many current models of SRL comprise cognitive, metacognitive, motivational and emotional aspects of SRL (cf. Boekaerts et al., 2000), we chose to focus on the combination of cognitive and metacognitive strategies, as they seem to be of particular importance for elementary school students (Dignath & Büttner, 2008).

It is often assumed that highly intelligent and high achieving students know more about learning strategies and self-regulated learning than their peers and that they optimally shape and regulate their learning process without outside help. Sometimes it is also assumed that highly intelligent and high-achieving students do not need learning strategies to succeed in regular classroom settings (cf. Treffinger, 2009). However, research findings only partially confirm these assumptions (for overviews cf. Hoh, 2008; Stoeger & Sontag, 2012; Veenman, 2008).

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On average, highly intelligent and high-achieving students do seem to possess more metacognitive knowledge – a prerequisite of SRL – and understand better why strategies are useful (for an overview, cf. Alexander, Carr, & Schwanenflugel, 1995). However, this does not mean that they actually use SRL strategies more often or better than their peers. Sontag, Stoeger, and Harder (2012) showed that highly intelligent students (top 5% in an intelligence test) did not prefer SRL over other forms of learning in regular classroom instruction and that they did not prefer SRL more than their peers in the same classrooms. In a study by Zimmerman and Martinez-Pons (1990), highly intelligent (top 1% in an intelligence test) high achievers from a school for academically gifted students reported using some strategies more often than their peers, but there were no differences in the reported use of other strategies. Bouffard-Bouchard, Parent, and Larivée (1993) studied the actual behavior of highly intelligent students (top 11% in a test of mental ability) and their peers of average intelligence in a learning task and also found that highly intelligent students outperformed their peers only in the use of some strategies, but not in the use of others. Regarding the question if highly intelligent and high-achieving students need to self-regulate their learning to be successful, evidence suggests that in some, relatively unchallenging contexts SRL is in fact not necessary to attain high achievement (Ablard & Lipschultz, 1998; Stoeger, Steinbach, Obergriesser, & Matthes, 2014).

However, although in certain contexts, highly intelligent and high-achieving students do not need to self-regulate their learning to be successful, it is justified to assume that SRL will become necessary in more challenging contexts (e.g., gifted tracks, selective universities) (cf. McCoach & Siegle, 2003; Spörer, 2003). Findings from expertise research (e.g., Zimmerman, 2006) indicate furthermore that SRL is indispensable to achieve excellence in a certain domain. Therefore, SRL training is also relevant for highly intelligent and high-achieving students. In the following section, we will report intervention studies with highly intelligent and high achieving students.

1.2. Can highly intelligent students and high-achieving students benefit from SRL interventions?

To the best of our knowledge, there are no studies examining if and how both highly intelligent and high-achieving students benefit from SRL training conducted in a regular classroom context. There are studies, however, that – taken together – suggest that both highly intelligent and high-achieving elementary school students could in fact benefit from such interventions as much as their peers. The interventions examined in existing studies fall into three categories: short one-on-one trainings of cognitive strategies; trainings in which cognitive and metacognitive strategies were practiced in small groups; trainings conducted in a regular classroom context with students of above-average intelligence and with underachieving students.

Highly intelligent and high-achieving students seem to benefit from the training of cognitive strategies in one-on-one settings at least as much as their peers. McCauley, Kellas, Dugas, and DeVellis (1976) reported an experiment, in which fifth- and sixth-graders practiced a rehearsal strategy in two one-on-one sessions scheduled in the same week. Both students of above-average intelligence (IQ ≥ 115) and students of average intelligence (IQ ≤ 95) benefited from the practice sessions, with students of above-average intelligence benefiting slightly more ($p < .07$). Scruggs and Mastropieri (1988) trained high-achieving fifth- and sixth-graders (SAT math or reading percentile rank ≥ 94) and their peers with average scholastic achievement (with average SAT math scores corresponding to the 59th percentile, and average SAT reading scores corresponding to the 55th percentile) in the use of a rehearsal strategy during one one-on-one session. They found that both high achievers and students with average scholastic achievement benefited from the training, with a greater training benefit for the high-achieving students.

Highly intelligent and high-achieving students can also benefit from SRL training conducted in small-group settings. Schunk and Swartz (1993b) conducted a program with gifted fourth-graders that had been proven effective for regular fourth-grade students (Schunk and Swartz, 1993a). Participants were students from two gifted classrooms (PR ≥ 98 in a score combining the results of a cognitive ability test and a reading test) who were randomly assigned to one of three experimental conditions. All students received 20 sessions of 45 min of cognitive writing strategy instruction in small groups delivered by teachers from outside the school. One group of students was instructed to monitor their strategy use and received feedback on their writing strategy use (SRL condition); the second group was instructed to monitor their strategy use but did not receive strategy feedback (partial SRL condition), and the third group of students was not instructed to monitor their strategy use and did not receive strategy feedback (cognitive strategy condition). Students in the SRL condition outperformed students in the other two conditions in writing achievement, writing strategy and motivational variables. Fischer (2008) reported two interventions in which gifted students practiced SRL in small groups. The first program was a three-day extracurricular intensive course designed according to the needs of gifted students with learning difficulties of grades three through nine. Pre-test–post-test comparisons showed improvements in strategy knowledge and in scholastic performance for participating students (intelligence test scores: $M = 132.48$, $SD = 9.33$); results for a control group were not reported. In the second program, gifted students (intelligence test scores: $M = 123.59$, $SD = 1.87$) in grades three to six were pulled out for one ninety-minute block of regular school instruction per week over the course of an entire school year in order to participate, in small groups, in a program promoting SRL. In comparison with their non-gifted peers who stayed in regular instruction and did not participate in the program, the gifted students showed greater improvements in their strategy knowledge, their learning behavior and their scholastic performance. A comparison with a control group of gifted students who did not receive the intervention was not reported.

To our knowledge, there are only two studies on SRL training conducted in regular classroom contexts, in which effects for students with above-average intelligence (Stoeger & Ziegler, 2010) and highly intelligent underachievers (Stoeger & Ziegler, 2005) were reported. In both studies, the SRL training was integrated into fourth-grade mathematics instruction at regular elementary schools and led by the students' regular classroom teachers who had received extensive training before implementing the program. All students in the participating classrooms received seven weeks of daily SRL and math training, while students in control classrooms received regular mathematics instruction. To examine the possibility that the training program had differential effects on students of different cognitive abilities, Stoeger and Ziegler (2010) divided the participating students into four subgroups (quartiles) on the basis of their intelligence test scores; thus, with the top 25% most intelligent students in this group, the group of students with above-average intelligence was relatively broad. The authors concluded that – in comparison to a control group – students benefited from the program irrespective of their cognitive ability level in terms of homework behavior, motivational variables and math performance. Stoeger and Ziegler (2005) showed furthermore that gifted underachievers (defined as students with an intelligence test score of at least 130 and z-standardized math grades one standard deviation below their z-standardized intelligence test score) who were trained in regular classrooms benefited from the training program compared to a control group of gifted underachiever who received regular classroom instruction.

Summing up, existing studies suggest that highly intelligent and high-achieving elementary school students can benefit from SRL programs as much as their peers. However, we only know of one study in which the effects of SRL training conducted in a regular classroom context were analyzed for students with above-average intelligence

(Stoeger & Ziegler, 2005). In this study, the defining criterion of above-average intelligence was relatively broad, and effects for high achieving students were not analyzed separately.

1.3. Current study

Due to the lack of sufficient empirical evidence, we designed a study to examine whether both highly intelligent and high-achieving elementary school students can benefit as much as their peers from an SRL intervention conducted during regular classroom instruction. For our study, we chose an SRL training program that we deemed suitable for highly intelligent and high-achieving students as well as for their peers of average intelligence and their peers with average scholastic achievement. We deemed a program suitable for our purpose, if it offered all students the opportunity to experience the benefits of SRL. To ensure that all students experience the benefits of SRL, they have to realize that improving their cognitive and metacognitive strategy use results in higher achievement. This realization could be achieved, for example, by providing students with feedback that draws attention to the connection between strategy use and achievement (cf. Dignath & Büttner, 2008; Hattie & Timperley, 2007). Thereby, it is of particular importance that highly intelligent and high-achieving students also have the opportunity to improve their achievement with the help of enhanced learning behavior. To this end, the training must include tasks that are sufficiently challenging for these students.

For our study, we chose to work with the SRL training by Stoeger and Ziegler (2008) that uses tasks of an adequate difficulty level and incorporates systematic feedback about connections between learning behavior and achievement. The general effectiveness of this training for fourth-grade elementary students has already been shown (Stoeger, Sontag, et al., 2014). In this seven-week program, students are introduced to both cognitive and metacognitive strategies and are given ample opportunity to practice them while working on short scientific texts. The program consists of two information weeks and five SRL practice weeks and is designed for use in basic science and reading instruction in regular classrooms. In the information weeks, students are introduced to three cognitive text reduction strategies (underlining and copying main ideas verbatim, drawing a mind map containing main ideas, and summarizing main ideas in one's own words) and to a normative model of SRL (cf. Ziegler & Stoeger, 2005) consisting of seven steps (self-assessment, goal setting, strategic planning, strategy implementation, strategy monitoring, strategy adjustment and outcome evaluation). In the five SRL practice weeks, the students practice all of these strategies by applying them to the recurring training task: The students read one short scientific text of comparable difficulty each day (25 altogether) and are asked to identify the ten main ideas included in each text. The tasks in this program were designed with heterogeneous classrooms in mind: manageable for all students and sufficiently complex and challenging for highly intelligent and high-achieving students. The texts have a value of 69.16 ($SD = 3.73$) in the German version of the Flesh readability index, a value typically found in fifth-grade texts (cf. Amstad, 1978). Therefore, the text difficulty itself should be challenging for fourth-grade students. Weaker students are advised to aim at identifying a small number of main ideas in the beginning but to increase this number after a while; stronger students are advised to aim at identifying up to ten main ideas over the course of the five weeks. In this way, all students can have achievement gains.

Based on existing research and on the program's characteristics, we assume that highly intelligent students and high-achieving students as well as their classmates of average intelligence and their classmates with average scholastic achievement benefit equally from the intervention. Compared to a control group with regular classroom instruction we expect similarly positive training effects on the preference for SRL for students in all intelligence-based and achievement-based subgroups. We also expect that students in the training group will improve their achievement in the training task of identifying main ideas in the course of the training, irrespective of their intelligence or achievement level.

2. Method

2.1. Participants and design

In this study, we analyzed a subsample ($N = 322$) from a larger evaluation study conducted in Germany in which we had found effects of students' migration status. To enable a focus on the training effects for highly intelligent and high-achieving students in the current study and in order to keep the manuscript readable, we decided to restrict our sample to students without migration background. For this reason all students and their parents in this sample had been born in Germany. Particularly, we compared 123 fourth-grade students (67 boys, 56 girls) who participated in the abovementioned training of self-regulated learning (SRL) with 199 fourth-graders (107 boys, 92 girls) who received regular classroom instruction (REG). The students in our sample were on average 9.78 years old ($SD = 0.39$). The gender distribution within the sample was even (45.96% girls). Teachers' and students' participation in the evaluation study was voluntary and all participants consented to participation.

In our study, we examined if an SRL-training had differential effects on highly intelligent and high-achieving students and their peers of average intelligence and their peers with average scholastic achievement. We used a pre-test–post-test follow-up control-group design to examine potential differences in the effect on the preference for self-regulated learning both immediately after the training and 11 weeks later. We also examined potential differences in the training task of identifying main ideas in scientific texts. For this, we analyzed the achievement gains in the course of the five SRL practice weeks (PW 1–5). We compared the results of highly intelligent students and high-achieving students who participated in the SRL intervention with the results of their peers of average intelligence and their peers with average scholastic achievement. Table 1 shows the design of our study. We explain the independent variables (treatment conditions; subgroups based on intelligence and on achievement) and the dependent variables (preference for self-regulated learning, number of correctly identified main ideas) in more detail in Sections 2.2 and 2.3.

2.2. Independent variables

2.2.1. Treatment conditions

In the current study, we compared two treatment conditions: students who received a training program of self-regulated learning in which the abovementioned text reduction and metacognitive learning strategies were taught (SRL) and students who received regular classroom instruction (REG). Students in both treatment conditions received instruction during regular classroom hours and in their regular classroom contexts. As the students in the training condition read texts about topics from the natural sciences, the training was conducted mainly during reading instruction and instruction in basic science. Instruction in both conditions was delivered by the students' regular classroom teachers. Classroom teachers in the SRL condition attended a 2-day workshop before administering the training program in their classrooms. On the first day of the workshop the theoretical background of the training program was conveyed. On the second day the training material and its use during the training was discussed. Teachers received training manuals for the students that included the 25 basic science texts, learning diaries and various other training materials. They also received teacher manuals documenting the material covered in the workshop, checklists for each day of the training program as well as sample solutions for the reading tasks. Teachers in the SRL condition were supervised throughout the program (cf. Section 2.4.1).

Table 1
Study Design.

Treatment	Subgroup	T1 (pre-test)	Intervention							T2 (post-test)	T3 (follow-up)
			Info 1	Info 2	PW 1	PW 2	PW 3	PW 4	PW 5		
SRL condition	Top 10% intelligent Bottom 90% intelligent Top 10% grades Bottom 90% grades	Preference for SRL	–	–	Number of main ideas	Number of main ideas	Number of main ideas	Number of main ideas	Number of main ideas	Preference for SRL	Preference for SRL
REG condition	Top 10% intelligent Bottom 90% intelligent Top 10% grades Bottom 90% grades	Preference for SRL	–	–	–	–	–	–	–	Preference for SRL	Preference for SRL

Note. SRL = self-regulated learning; REG = regular classroom instruction; Info = informational week; PW = practice week.

2.2.1.1. Training in self-regulated learning (SRL). Students in the SRL condition received a training program in which they completed daily classroom activities and homework assignments to practice the seven steps of the cycle of self-regulated learning, a normative model by Ziegler and Stoeger (2005). This cycle encompasses self-assessment, goal setting, strategic planning, strategy implementation, strategy monitoring, strategy adjustment and outcome evaluation. Within this cycle students particularly learned to use, monitor and adjust three different text reduction strategies (underlining, mind mapping, summarizing) when working on the training task of identifying main ideas in basic science texts. The training program consisted of 2 informational weeks and, thereafter, 5 SRL practice weeks, with daily sessions lasting between 40 and 60 min.

During the first informational week, students learned why it is important to understand texts, what main ideas are, how they can identify them in expository texts, and how they can differentiate between main ideas and less important passages in a text. Teachers also presented and modeled three reduction strategies that are useful for identifying and displaying main ideas: (a) underlining and copying main ideas verbatim, (b) drawing a mind map containing main ideas, and (c) summarizing main ideas in one's own words. Students were given the opportunity to practice each text reduction strategy on a short expository text (approximately 200–240 words).

During the second informational week, teachers introduced the self-regulated learning cycle by Ziegler and Stoeger (2005). Teachers thoroughly discussed each phase of self-regulated learning with their students. To do this they used various examples drawn from everyday situations such as completing homework or practicing a certain sports skill. A poster of the learning cycle, provided in the training materials, was meant to ensure that students would have frequent and easy access to visualizations of the learning cycle and its individual phases while working through the training program. At the end of the second informational week, teachers provided their students with information on effective goal-setting and discussed common goal-setting mistakes with their students. As one goal of the intervention was to make students aware of the relationship between using learning strategies and achieving learning goals and as this is a very demanding task for fourth-graders, students learned to set relatively simple quantitative outcome goals (e.g. "My goal is to find 7 main ideas."). At the end of the second informational week, teachers informed their students about the structure of the training program in the upcoming weeks.

During the following weeks, the SRL practice weeks, students repeatedly and consciously worked through all phases of the learning cycle. Every school day, students were to read an expository text about a topic from the natural sciences (e.g., fungi and mushrooms; rainbows; desert plants; blood) and then to identify the ten main ideas. As described in Section 1.3, these texts were especially written for this training program with the aim to support all students in their efforts to improve strategy use and SRL.

During the SRL practice weeks, students kept a structured learning journal that accompanied them as they progressed through the learning cycle. At the beginning of each SRL practice week, students set a specific outcome goal for themselves that specified how many main ideas (ten being the maximum) per daily text they aimed to find. The students were encouraged to set goals for themselves that were challenging but achievable. They noted their goals in their learning journal, and they also wrote down what strategy they planned to use in order to achieve their goal. During SRL practice Weeks 1–3, one of the three previously introduced text reduction strategies for identifying and displaying main ideas was prescribed by the program per week: underlining and copying verbatim for the first SRL practice week, mind mapping for the second, and summarizing for the third. This way, all students had the opportunity to practice each strategy systematically. In the remaining two SRL practice weeks, students chose text reduction strategies that they felt had been particularly helpful during the previous weeks and/or text reduction strategies for which they felt they could profit from continued practice of their effective implementation.

During classroom instruction they read the daily text silently and then had the opportunity to ask their peers and teacher about unknown words. Then, before taking the text home and working further with it as homework assignment, they noted in their learning journal how many of the ten main ideas they thought they would find in that text (self-assessment). At home, they used that week's text reduction strategy to identify and display the main ideas in the text. Right after having finished this part of their homework assignment, they evaluated how well their strategy worked on that day and wrote it down in their learning journal. They also wrote down how they wanted to improve their strategy use the next day. The next day, the homework assignment was corrected and discussed in class. Teachers based this discussion on the sample solutions they had received as part of the teachers' manual. The students noted in their learning journal how many of the main ideas they actually found and compared this number with their self-assessments. In a teacher–class dialogue, the teacher addressed the connection between strategy use and outcome. Students were encouraged to use their experience with the text from the previous day to improve their self-assessment and strategy use when working on the next text.

Each Friday, Thursday's homework assignment was discussed first. Then, the students worked on a new text during classroom instruction. After discussing results and strategy use for this new text, the teacher initiated a discussion about learning behavior, strategy use, and results in the current week. Appropriate prompts were integrated into the students' learning journals to help facilitate this reflection process. The students thus also took time during classroom instruction on Fridays to summarize and reflect upon the current week in their journals. By answering various questions, students learned how to use their experience from this week to improve their learning behavior in the following week.

2.2.1.2. Regular classroom instruction (REG). Students in the REG condition received regular classroom instruction in reading and basic science according to the current curriculum. The curriculum explicitly lists the use of text reduction strategies such as underlining, making graphic representations, and summarizing as part of the reading instruction and summarizing basic scientific texts as part of the basic science instruction. In addition, the curriculum explicitly encourages teachers to emphasize self-regulated learning as the basis for lifelong learning and to transfer more and more responsibility for the learning process onto the students (Bayerisches Staatsministerium für Unterricht und Kultus, 2000, 2014). Students in this condition spent between 20 and 30 min on their reading and basic science homework assignments each day. All in all, it can be assumed that the content covered in the REG condition is similar to the content covered in the SRL condition.

2.2.2. Subgroups by intelligence and scholastic achievement

We classified students as highly intelligent when their intelligence test score was in the top 10% of the sample (cf. Gagné, 2004). We classified students as high-achieving when their grades were in the top 10% of the sample (cf. Ee, Moore & Atputhasamy, 2003).

2.2.2.1. Measuring intelligence. We used the German version of Raven's Standard Progressive Matrices (SPM) (Horn, 2009) as a measure of general intelligence. This non-verbal multiple choice test consists of 60 tasks in which students are asked to select a single item that completes a given pattern of six or eight items. In this study, we selected students scoring at or above the 91st percentile within our sample as "highly intelligent" students. The remaining students are referred to as "students of average intelligence". The SPM's internal consistency came to $\alpha = .90$ in our sample.

2.2.2.2. Measuring scholastic achievement. Teachers provided us with their students' report-card grades of the previous school year. As a measure of scholastic achievement, we calculated the average grade for the three main subjects (language arts, math, and basic science). The German grading scale ranges from 1 (very good) to 6 (insufficient). In this study, we refer to students scoring at or above the 91st percentile within out sample as "high achievers", and to all other students as "students with average scholastic achievement".

2.2.2.3. Intelligence and scholastic achievement in the subgroups. Table 2 shows the students' intelligence test scores and grades by treatment conditions and by subgroups based on intelligence and achievement. In both treatment conditions, highly intelligent student have better grades than their peers of average intelligence, and high-achieving students are more intelligent than their peers with average scholastic achievement ($p < .05$ in all t-tests). Still, a cross tabulation showed that the top 10% most intelligent students and the top 10% high-achieving students are two almost distinct groups: Only 5 students are in both groups, 24 students are only in the highly-intelligent group and 15 students are only in the high-achieving group.[1] The five students that were both highly intelligent and high-achieving were included in both groups for later analyses.

2.3. Dependent measures

2.3.1. Preference for SRL

Preference for SRL was measured with the 28 items of the "Fragebogen Selbstreguliertes Lernen-7, or FSL-7" [Questionnaire of Self-regulated Learning-7] by Ziegler, Stoeger and Grassinger (2010). The FSL-7 is based on Ziegler and Stoeger's (2005) seven-step cyclical model of self-regulated learning. Four school-relevant situations are described briefly: studying for school, preparing for the upcoming school year during the summer holidays, preparing for an in-class test, and catching up on school work after an illness. In each situation, the students are asked to indicate their preferred method of learning for each of the seven steps of self-regulated learning (self-assessment, goal-setting, strategic planning, strategy implementation, strategy monitoring, strategy adjustment, and outcome evaluation) by choosing one of three alternatives: self-regulated, externally regulated, or impulsive learning. The following is a sample item (Situation 1, Step 2: Goal-setting): How do you study for school? a) *I set a goal for myself describing what and how much I want to study* [self-regulated learning], b) *My teacher or parents should tell me which goal I should set for myself* [externally regulated learning], c) *When studying, I don't set a specific goal for myself. I can rely on my intuition* [impulsive learning]. In the present study, a research assistant or the classroom teacher read the four situations and the response alternatives out loud, ensuring that everyone, including weak readers, could complete the questionnaire in adequate time.

As we were only interested in the overall preference for SRL in this study, we calculated the SRL score by counting the frequency with which a student chose self-regulated learning and dividing it by the number of items answered. For ease of understanding, the scores are reported as percentages. For example, a student who chose the self-regulated learning option in 13 out of the 28 items would be given a score of 46.43%. The internal consistency came to .83 at T1 (Time 1/pretest), .90 at T2 (Time 2/posttest) and .94 at T3 (Time 3/follow-up test).

2.3.2. Main ideas

For students in the SRL condition, we used the weekly average of correctly identified main ideas in the SRL practice weeks (see Section 2.2.1.1 for details) as a measure of achievement. We collected all of the students' training materials after the end of the training program. Using a list of the correct main ideas for each text as a reference, trained research assistants counted the number of correctly identified main ideas in each text (range 0–10 main ideas). After completing this rating process, we returned the training materials to the students. As students had completed five SRL practice weeks with five texts each week, we obtained five achievement values (average number of main ideas per week) per student.

2.4. Procedure

2.4.1. Implementing the treatment conditions

We obtained permission to conduct this study from the local school authorities who also assisted in recruiting participating classrooms by notifying all fourth-grade teachers about our study. Teachers in both conditions signed up for participation in an evaluation study of a classroom-based text-strategy program as part of their professional development requirements. We then assigned teachers to the intervention or the regular instruction condition (under the pretense that we had a maximum number of participants and raffled off the spots). Teachers in the intervention condition completed a 2-day workshop before delivering the treatment, and we supervised them carefully throughout the program. We provided all teachers with the authors' phone number and e-mail address so they could contact them with any questions regarding the implementation of the training program or the evaluation. In addition, we met with all teachers of the intervention condition four weeks into the training program, discussing practical issues of administering the program and answering questions. Teachers were encouraged to continue contacting the authors if they had questions during the remaining weeks of the training program. In addition, teachers were encouraged to contact their colleagues from the same condition to discuss the implementation of the program.

Teachers delivered the treatment in 7 consecutive weeks during regular classroom hours in reading instruction and basic science. A checklist containing all training materials and activities helped teachers to implement the daily lessons as intended. Teachers in the regular instruction condition continued "business as usual". They were offered the training materials after the study ended and were promised preferential admission to future workshops. We debriefed all teachers at the end of our study.

[1] The Top-10% are not exactly 10% of the sample, because the grouping is based on percentile ranks (91st or higher for the respective Top-10%-group).

Table 2
Mean values for intelligence and achievement per treatment condition and intelligence- and achievement-based subgroup.

Variable	Subgroup	*n* (SRL)	*n* (REG)	SRL		REG	
				M	*SD*	*M*	*SD*
SPM test scores	All students	123	199	39.88	7.22	37.99	7.40
	Top 10% intelligent	13[a]	16[a]	50.13	2.20	50.89	2.22
	Top 10% grades	11[a]	9[a]	44.09	4.04	43.37	6.06
	Bottom 90% intelligent	110[a]	183[a]	38.69	6.63	36.90	6.61
	Bottom 90% grades	112[a]	190[a]	39.47	7.34	37.74	7.38
Grades[b]	All students	123	199	2.62	0.89	2.48	0.67
	Top 10% intelligent	13[a]	16[a]	1.96	0.71	1.95	0.42
	Top 10% grades	11[a]	9[a]	1.18	0.17	1.30	0.11
	Bottom 90% intelligent	110[a]	183[a]	2.69	0.88	2.53	0.67
	Bottom 90% grades	112[a]	190[a]	2.76	0.80	2.54	0.64

Note. SRL = self-regulated learning; REG = regular instruction.
[a] The Top-10%- and Bottom-90%-groups are not exactly 10% or 90% of the sample, because the grouping is based on percentile ranks (91st or higher for the Top-10%-group).
[b] Grades are scaled inversely with 1 = very good and 6 = insufficient.

2.4.2. Obtaining evaluation measures

At T1, students filled out the questionnaire on their preference for self-regulated learning during one 35-min session, questions on demographic information in another session that lasted 15 min, and completed the SPM intelligence test in a third session that lasted 50 min. The three sessions were scheduled for different days to minimize fatigue. At T2 and T3, the students completed the FSL-7. They had 35 min each time. The testing sessions were scheduled during regular classroom hours in the week before the training started (T1), in the week after it concluded (T2), and another 11 weeks later (T3). The sessions were led by the classroom teachers or trained research assistants. Classroom teachers in the intervention condition received information on conducting the evaluation as part of their workshop, teachers in the regular instruction condition and research assistants received this information in a separate session. To ensure comparable testing conditions, all persons conducting the evaluation followed a detailed manual and read out instructions verbatim. The instrument measuring achievement in the training task was included in the training materials in the SRL group and scored by research assistants as described in Section 2.3.2.

2.5. Sample drop-out and missing data

For preference for SRL, the following data are missing: three students (0.9%) missed the questionnaire on SRL at T1, five students (1.6%) at T2, and 13 students (4.0%) at T3. To handle missing data appropriately, we used the multiple imputation method implemented in SPSS 20 to generate five imputed datasets (cf. Graham, 2009; Schafer & Graham, 2002). We analyzed these five datasets simultaneously in SPSS and pooled all parameter estimates.

We received training materials from 121 of the 123 students in the SRL group to analyze achievement gains in the training task. Seventy-nine students (65.3%) completed all texts, 18 students (14.9%) missed only one text, nine students (7.4%) missed two texts, six students (5%) three texts, and nine students (7.4%) between four and thirteen texts. As with the SRL measure, we analyzed five imputed datasets simultaneously in SPSS and pooled parameter estimates.

3. Results

Our preliminary analyses comprise descriptive statistics and correlations for all variables as well as analyses of potential differences in the dependent variables at baseline. The differential training evaluation consists of analyses regarding the training effect on the preference for SRL and of analyses regarding the achievement gain in the course of the training.

3.1. Preliminary analyses

Table 3 contains descriptive statistics and correlations for all variables used in the evaluation. Descriptive statistics are presented for the whole sample (for descriptive statistics by treatment condition and intelligence- and achievement based subgroup, see Tables 4 and 6); descriptive statistics for and correlations with the number of correctly identified main ideas are available only for the SRL group.

Students chose SRL as their preferred approach to learning for slightly more than one third of all FSL-7 items before the start of the program and slightly more later in the school year. The rather large standard deviation indicates large differences between students. Students in the SRL group correctly identified slightly over six main ideas (out of 10) in the first practice week of the program and, on average, improved their performance to over seven main ideas in the last practice week. Intelligence scores are comparable to scores in the German norm sample (cf. Horn, 2009), and grades are as expected.

Correlations are presented for the two treatment conditions separately. In both conditions, the SRL measures at different points in time were strongly correlated. Intelligence test scores and grades correlated as expected; however, neither correlated with preference for SRL. The number of correctly identified main idea per practice week was collected only for students in the SRL condition. The measures in the different practice weeks were strongly correlated. The number of correctly identified main ideas was not correlated with preference for SRL, with the (unexpected) exception of preference for SRL at T1 and number of correctly identified main ideas in PW 2. The number of correctly identified main ideas correlated with non-verbal intelligence and with grades as expected.

At T1 (before the training), students in the SRL and the REG group did not differ in their preference for SRL ($p = .32$). Differential analyses showed, however, that high-achieving students in the SRL condition preferred SRL more than high-achieving students in the REG condition ($p = .03$), and that students of average intelligence in the SRL condition preferred SRL more than students of average intelligence in the REG condition ($p = .03$). There were no differences between treatment conditions for highly intelligent students and students with average scholastic achievement ($p = .90$ and .19, respectively) (for descriptives, cf. Table 4). Within the SRL condition, highly-intelligent students did not prefer SRL more than their peers of average intelligence ($p = .78$), but high-achieving students preferred SRL more than their peers with average scholastic achievement ($p < .01$). Within the REG condition, highly intelligent students and high achievers did not differ from their respective peers in their preference for SRL ($p = .86$ and .99 respectively). In the first practice week of the program, highly intelligent students correctly identified more main ideas than their peers of average intelligence ($p < .01$), and high achievers correctly identified more main ideas than their peers with average scholastic achievement ($p < .01$) (for descriptives, cf. Table 6).

3.2. Differential training effects

3.2.1. Effects on preference for self-regulated learning

Descriptive statistics for the preference for SRL in the different subgroups at the different data-collection points are shown in Table 4. Before testing for differential training effects we conducted ANOVAs to examine the training's general effectiveness for the whole sample and the four different subgroups, running five separate 3 × 2 (Time points × Treatment condition) repeated measurement ANOVAs and examining the interaction between Time points and Treatment condition. Mauchly's test indicated that the assumption of sphericity had been violated in the analyses of the whole sample ($X^2(2) = 27.86, p < .01$), in the subsample of students of average intelligence ($X^2(2) = 26.63, p < .01$), and in the subsample of students with average scholastic achievement ($X^2(2) = 30.43, p < .01$). Following a recommendation by Girden (1992; see also Field (2009) for sphericity estimates greater

Table 3
Descriptive statistics and bivariate Pearson correlations.

		Scale	*M*	*SD*	1	2	3	4	5	6	7	8	9	10
1	Preference for SRL (T1)	0;100	33.88	19.98	–	.59**	.45**	–	–	–	–	–	−.05	−.04
2	Preference for SRL (T2)	0;100	37.05	25.23	.61**	–	.67*	–	–	–	–	–	.11	−.04
3	Preference for SRL (T3)	0;100	38.79	29.32	.52**	.72**	–	–	–	–	–	–	.02	.02
4	Main ideas (PW 1)	0;10	6.13	1.77	.13	.04	.09	–	–	–	–	–	–	–
5	Main ideas (PW 2)	0;10	6.10	1.76	.25**	.13	.15	.70**	–	–	–	–	–	–
6	Main ideas (PW 3)	0;10	6.79	2.07	.15	.05	.04	.67**	.74**	–	–	–	–	–
7	Main ideas (PW 4)	0;10	6.78	1.97	.13	.00	.03	.67**	.71**	.79**	–	–	–	–
8	Main ideas (PW 5)	0;10	7.33	1.72	.13	.01	.00	.54**	.63**	.70**	.72**	–	–	–
9	Intelligence (T1, SPM)	0;60	38.71	7.38	.04	−.04	.05	.25**	.31**	.28**	.33**	.32**	–	-.31**
10	Grades[a]	1;6	2.53	0.77	−.12	−.06	−.13	−.50**	−.55**	−.61**	−.47**	−.54**	−.54**	–

Note. Correlations in the SRL group ($n = 123$; n = 121 for main ideas per week) are presented below the diagonal line, correlations in the REG Group ($n = 199$) are presented above the diagonal line. SRL = self-regulated learning; PW = SRL practice week; SPM = Standard Progressive Matrices Test.
[a] Grades are scaled inversely with 1 = very good and 6 = insufficient.
* $p < .05$, two-tailed.
** $p < .01$, two-tailed.

than .75, we used the Huynh–Feldt correction of degrees of freedom in these analyses ($\varepsilon = .93$, .92, and .92, respectively). We found interaction effects in all groups, showing the training's effectiveness for the total sample ($F(1.86, 595.11) = 8.19$, $p < .01$, partial $\eta^2 = .02$) and for all four subgroups (Top 10% intelligent: $F(2, 53) = 4.37$, $p = .04$, partial $\eta^2 = .12$; bottom 90% intelligent: $F(1.86, 541.35) = 6.28$, $p < .01$, partial $\eta^2 = .02$; top 10% grades: $F(2, 36) = 3.68$, $p = .04$, partial $\eta^2 = .17$; bottom 90% grades: $F(1.86, 552.07) = 6.65$, $p < .01$, partial $\eta^2 = .02$). As shown in Fig. 1, preference for SRL increased in all four intelligence- or achievement-based subgroups for students in the SRL condition (solid lines), whereas for students in the REG condition (broken lines), preference for SRL increased and then decreased for highly intelligent students, decreased for high achievers, and remained constant for students of average intelligence and for students with average scholastic achievement.

As the effect size partial η^2 cannot be compared across studies (e.g., Bortz & Döring, 2006), we additionally report the effect size *d*. In particular, we report the effect gain in the preference for SRL, that is post-test effects and follow-up-test effects adjusted for pre-test effects for all subgroups (cf. Table 5). Positive values indicate an advantage for the intervention group. At post-test, we found a small negative effect on preference for SRL for highly intelligent students, small positive effects for the total sample, for the students of average intelligence, and for students with average scholastic achievement, and a medium effect for high achievers. The effects on preference for SRL were greater at the follow-up test: We found small-to-medium effects for the total sample, the students of average intelligence, and students with average scholastic achievement, a medium effect for highly intelligent students and a large effect for high achievers.

To formally test for differential training effects on the preference for SRL, we conducted two 3 x 2 x 2 (Time x Treatment condition x Subgroup) repeated measurement ANOVAs, with subgroups operationalized via intelligence in the first analysis and via achievement in the second analysis. As Mauchly's test indicated that the assumption of sphericity had been violated in both analyses ($X^2(2) = 28.86$, $p < .01$, and $X^2(2) = 27.43$, $p < .01$), we used the Huynh–Feldt correction to adjust the degrees of freedom in these analyses ($\varepsilon = .93$ and .94). The significance of the three-way-interaction Time × Treatment condition × Subgroup would indicate differential training effects. We did not observe such differential effects, neither with intelligence-based subgroups nor with achievement-based subgroups ($F(1.87, 593.89) = 1.28$, $p = .28$, partial $\eta^2 = .00$; and $F(1.87, 596.17) = 1.28$, $p < .28$, partial $\eta^2 = .00$).

3.2.2. Achievement gains in the identification of main ideas

Table 6 shows the mean number of correctly identified main ideas in each training week (*SD*) for all students in the SRL training group, and separately for highly intelligent students, high achievers, students of average intelligence, and students with average scholastic achievement. Five separate repeated measurement ANOVAS showed an increase in the number of correctly found main ideas in the course of the training both in the whole training group ($F(4, 480) = 29.53$, $p < .01$, partial $\eta^2 = .20$), and in all four subgroups (Top 10% intelligent: $F(4, 46) = 4.09$, $p < .01$, partial $\eta^2 = .26$; bottom 90% intelligent: $F(4, 430) = 26.10$, $p < .01$, partial $\eta^2 = .20$; top 10% grades: $F(4, 40) = 4.09$, $p < .01$, partial $\eta^2 = .31$; bottom 90% grades: $F(4, 436) = 26.87$, $p < .01$, partial $\eta^2 = .20$). In order to examine potential differential effects for the different intelligence- and achievement-based groups, we calculated two 5 × 2 (Training week × Subgroup) repeated measurement ANOVAs; the subgroups were operationalized via intelligence in the first analysis, and via achievement in the second. A significant interaction between Training week and Intelligence- or Achievement-based subgroup would indicate differential training effects; we did not observe such interactions (Intelligence groups: $F(4, 476) = 0.31$; $p = .87$; partial $\eta^2 = .00$; achievement groups: $F(4, 476) = 0.76$; $p = .55$;

Table 4
Descriptive statistics for preference for SRL per treatment condition and intelligence- and achievement-based subgroup.

Sub-group	*n* (SRL)	*n* (REG)	T1				T2				T3			
			SRL		REG		SRL		REG		SRL		REG	
			M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
All	123	199	36.92	20.80	32.00	19.27	42.98	25.99	33.57	24.17	48.24	30.48	32.95	27.04
I-10.	13[a]	16[a]	35.15	25.25	33.94	24.50	42.50	29.17	44.12	25.48	53.90	30.85	36.61	31.87
G-10	11[a]	9[a]	56.17	22.98	32.08	26.77	59.81	29.43	20.70	25.36	66.56	33.63	16.67	18.30
I-90.	110[a]	183[a]	37.11	20.31	31.84	18.84	42.68	25.69	32.67	23.91	47.57	30.47	32.65	26.67
G-90	112[a]	190[a]	35.03	16.69	32.00	18.94	41.00	25.15	34.18	24.01	46.44	29.71	33.73	27.18

Note. SRL = preference for self-regulated learning; I-10 = Top 10% intelligent, G-10 = Top 10% grades, I-90 = Bottom 90% intelligent, G-90 = Bottom 90% grades.
[a] The Top-10%- and Bottom-90%-groups are not exactly 10% or 90% of the sample, because the grouping is based on percentile ranks (91st or higher for the Top-10%-group).

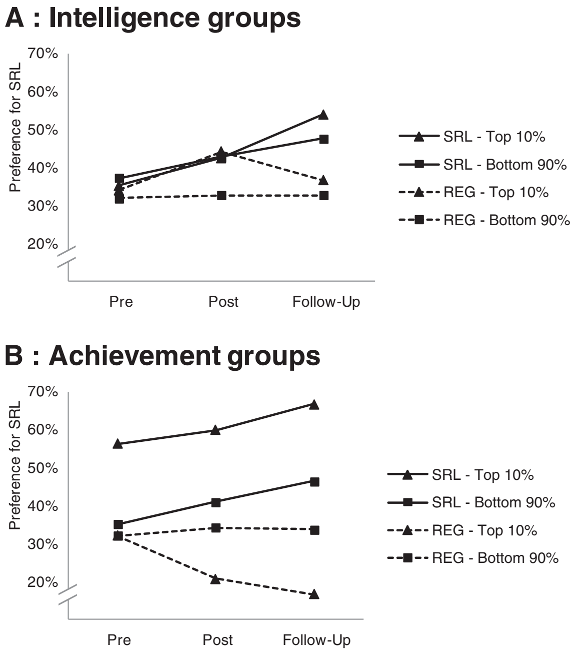

Fig. 1. Preference for SRL by treatment condition and time. Panel A: Highly intelligent students vs. students of average intelligence. Panel B: High-achieving students vs. students with average achievement. SRL: Students in this group trained self-regulated learning and text reduction strategies, REG: Students in this group received regular classroom instruction.

partial $\eta^2 = .01$). Fig. 2 shows the students' progress in the training task in the four subgroups.

Again, we also report effect sizes that are comparable across studies. We report the effect size d to describe the gain in finding main ideas in the course of the training. From Week 1 to Week 5, we found a medium-to-large training effect for the total sample, for students of high and of average intelligence, and for students with average scholastic achievement; for high achievers, the effect size was large (cf. Table 6, column on the right).

4. Discussion

Our aim in this study was to examine if highly intelligent and high-achieving students can benefit from a training of self-regulated learning (SRL) conducted in a regular classroom context as much as their peers of average intelligence and with average scholastic achievement. To this end, we compared fourth-graders who participated in an SRL training program in their regular classroom context (SRL condition) with fourth-graders who received regular classroom instruction (REG condition). In differential analyses, we examined the training effects on highly intelligent students (top 10%) and on high-achieving students (top 10%) as well as on their peers of average intelligence and on their peers with average scholastic achievement. We examined the effect gain (post-test group differences between students in different training conditions adjusted for pre-test group differences for students in different training conditions) for preference for SRL immediately after the end of the training (T2, post-test) and another 11 weeks later (T3, follow-up). We also examined the progress in the training task of identifying main ideas in an expository text for students participating in the program. In differential analyses, we compared the progress of highly-achieving and of highly intelligent students with the progress of their respective peers of average intelligence and with average scholastic achievement.

Our results showed the general effectiveness of the SRL training for students in all intelligence- and achievement-based subgroups with regard to preference for SRL and to the training task of identifying main ideas. We did not find differential effects for students in different intelligence- or achievement-based subgroups. However, small interaction effects might have gone undetected due to low statistical power that resulted from the small sample sizes in the top-10% groups. To get a more comprehensive picture, we also reported the size of training effects for the overall sample and for every intelligence- or achievement-based subgroup. In the following, we will focus on the effects for highly-intelligent and high-achieving students.

Highly-intelligent students who participated in the training demonstrated an increased preference for SRL in the long run, while highly intelligent students in regular instruction showed no long-term increase in their preference for SRL. This resulted in a medium long-term training effect (cf. Fig. 1 and Table 5). Immediately after the training, we found no training effect for highly-intelligent students, as highly intelligent students in the regular instruction condition had also increased their preference for SRL. The increase for students in the regular instruction condition was not expected, and apart from the possibility of a measurement artifact, we cannot think of a conclusive post-hoc explanation for this phenomenon. In our opinion, the positive long-term training effect is more relevant for students as it indicates that they maintained the preference for self-regulated learning even when external support was reduced.

High-achieving students clearly benefited from the program with regard to preference for SRL. Participating high achievers demonstrated an increased preference for SRL immediately after the training and a further increase in preference for SRL in the long term, while high achievers in regular instruction showed the opposite pattern: decreased preference for SRL in the short term and a further decrease in preference for SRL in the long term. This pattern resulted in a medium immediate training effect and a large long-term training effect. The effects for high-achieving students are larger than the effects for any other intelligence- or achievement-based subgroup.

Highly intelligent students improved their performance in the training task in the course of the training (medium-to-large effect, cf. Fig. 2 and Table 6). This is especially noteworthy as their performance in the first practice week of the training was already relatively high.

Table 5
Effect sizes for preference for SRL per treatment condition and intelligence- and achievement-based subgroup.

Dependent variable	Subgroup	n (SRL)	n (REG)	Post-test effect size adjusted for pre-test effect size[a,b]	Follow-up effect size adjusted for pre-test effect size[a,c]
Preference for SRL	All students	123	199	0.13	0.29
	Top 10% intelligent	13[d]	16[d]	−0.11	0.50
	Top 10% grades	11[d]	9[d]	0.44	0.82
	Bottom 90% intelligent	110[d]	183[d]	0.14	0.26
	Bottom 90% grades	112[d]	190[d]	0.11	0.28

Note. SRL = self-regulated learning.
[a] Effect size was computed as $d = (M_A - M_B) / SD_{AB}$ with $SD_{AB} = \sqrt{[(n_A - 1) * SD_A^2 + (n_B - 1) * SD_B^2] / [((n_A - 1) + (n_B - 1)]}$ (cf. Bortz & Döring, 2006, pp. 606–607, formula 9.1 and 9.4, recommended to compare samples of different sizes). Positive values indicate an advantage for the treatment condition.
[b] Adjusted effect size was calculated as post-test effect size minus pre-test effect size.
[c] Adjusted effect size was calculated as follow-up effect size minus pre-test effect size.
[d] The Top-10%- and Bottom-90%-groups are not exactly 10% or 90% of the sample, because the grouping is based on percentile ranks (91st or higher for the Top-10%-group).

Table 6
Number of correctly identified main ideas per week and effect sizes d, by intelligence- and achievement-based subgroup.

Subgroup	*n*	Number of correctly identified main ideas										Effect size d[a]
		Week 1		Week 2		Week 3		Week 4		Week 5		Week 5 − Week 1
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	
All students	121	6.13	1.77	6.10	1.76	6.79	2.07	6.78	1.97	7.33	1.72	0.69
Top 10% intelligent	13[b]	7.49	1.46	7.26	1.56	7.95	1.91	8.08	1.62	8.35	1.27	0.63
Top 10% grades	11[b]	7.49	1.11	7.85	1.22	8.36	0.96	8.45	1.18	8.45	0.99	0.91
Bottom 90% intelligent	108[b]	5.98	1.74	5.96	1.74	6.65	2.06	6.63	1.96	7.21	1.73	0.71
Bottom 90% grades	110[b]	6.00	1.77	5.92	1.72	6.63	2.03	6.61	1.92	7.22	1.75	0.69

[a] Effect size was computed as $d = (M_A - M_B) / SD_{AB}$ with $SD_{AB} = \surd(SD_A^2 + SD_B^2) / 2$ (cf. Bortz & Döring, 2006, pp. 606–607, formula 9.1 and 9.3; we chose this formula to facilitate comparisons with other studies, cf. p. 609).
[b] The Top-10%- and Bottom-90%-groups are not exactly 10% or 90% of the sample, because the grouping is based on percentile ranks (91st or higher for the Top-10%-group).

Further analyses showed that highly intelligent students – like students of average intelligence and students with average scholastic achievement – improved their performance in the first and in the second half of the program's practice phase, with a nominal increase of 0.46 main ideas from PW 1 to PW 3 and of 0.40 main ideas from PW 3 to PW 5. The overall increase of .86 main ideas from PW 1 to PW 5 was highly significant ($p = .01$).

The baseline situation for high achievers was almost identical to the baseline situation of highly-intelligent students: They also started with relatively high values in the first practice week. High-achieving students also benefited from the program, and in fact, the training effect for this group was the largest of any of the intelligence- or achievement-based subgroups again. Moreover, the pattern of *when* the increase in number of correctly identified main ideas occurred for high achievers is noteworthy: With a nominal increase of 0.87 main ideas from PW 1 to PW 3 and of only 0.09 main ideas from PW 3 to PW 5, the large training effect occurred already in the first half of the program's practice phase and remained stable thereafter. Again, the overall increase of 0.96 main ideas was highly significant.

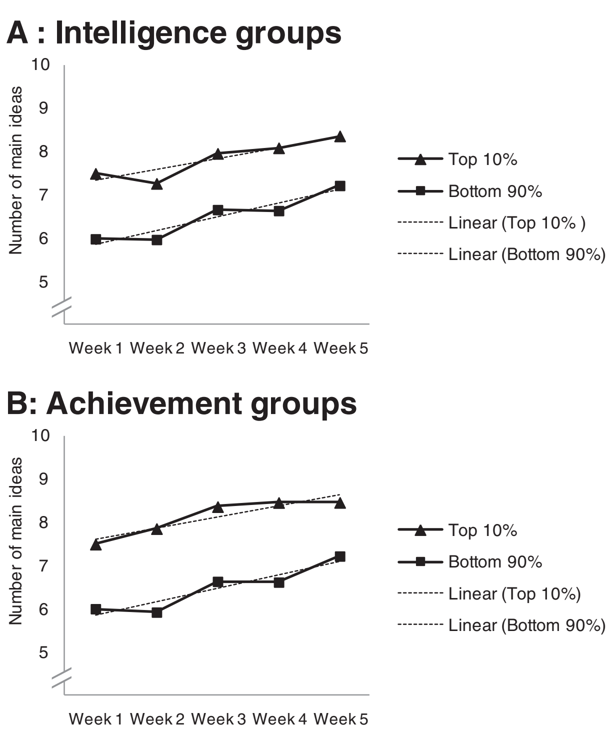

Fig. 2. Number of correctly identified main ideas per week. Panel A: Highly intelligent students vs. students of average intelligence. Panel B: High-achieving students vs. averagely achieving students.

4.1. General conclusions

Although we detected no differential effects for students in different intelligence- or achievement-based subgroups in ANOVA analyses, a comparison of effect sizes suggests that high achievers might have benefited even more than any other subgroup and that highly-intelligent students might have benefited more than students of average intelligence and students with average scholastic achievement in terms of long-term effects on SRL.

Larger effects for high achievers might be explained by the Matthew effect (Walberg & Tsai, 1983), according to which students with higher baseline values benefit more from instruction than students with lower baseline values. It is also possible that high achievers in the training group had an advantage in terms of previous knowledge and willingness to self-regulate their learning (mirrored by their high baseline preference for SRL) and that this enabled them to focus their attention on those components of the training that helped them improve their learning behavior and achievement. Finally, the subgroup of high achievers is the most homogenous of all subgroups in terms achievement (cf. *SDs* in Table 6), which means that the same increase in number of correctly identified main ideas resulted in a larger effect size than in the other, more heterogeneous groups.

The training effects for highly intelligent students were somewhat smaller than the effects for high achievers, and only the effects on preference for SRL were larger than for their peers of average intelligence. Highly intelligent students' baseline value in SRL does not exceed their peers' baseline value, so the Matthew seems not to apply here. The fact that training effects on preference for SRL were larger for highly intelligent students than for their peers of average intelligence could be explained by their greater aptitude to select, remember and automatize (e.g., Sternberg, 1986) the most important aspects of this rather complex training. In comparison to the high achievers, highly-intelligent students seem to have had less previous knowledge and willingness to self-regulate their learning and might be generally less keen to meet school's academic demands, which could have contributed to the comparably smaller effects.

4.2. Practical implications

We showed that high achievers and highly intelligent students can benefit from an SRL training program in a regular classroom context and can therefore dispel concerns that these students might not benefit from such a program. We can recommend the program we used in our evaluation for use in heterogeneous classrooms. To achieve the desired effects, it is essential that teachers understand what the crucial components in the program are and emphasize them in their teaching: teach strategies explicitly, give students ample opportunity to practice newly acquired strategies and learning behavior, offer systematic feedback on students' improvements in learning behavior and achievement gains and, thereby enabling students to see the relationship between learning behavior and achievement.

We recommend adjustments to the program evaluated in this study only in the special case of a classroom with a large number of high-achieving students. In this case, more challenging texts could be used to allow achievement gains in the second half of the practice phase. This adjustment is relatively time-consuming and complex, as texts have to be rewritten in a way ensuring that all 25 texts are still of comparable difficulty. We do not recommend shortening the practice phase to three weeks, as students need time to internalize the new learning behavior. Instead, we would recommend more refined feedback on the strategy use, supporting students in "fine-tuning" their strategy use.

With all this being said, our findings should generalize to other programs that feature the aspects enumerated above and that ensure that tasks are both manageable and challenging, thereby allowing all students to have achievement gains over time. Programs that have already been evaluated for the target group are preferable, but when programs are not available for a given target group or subject matter, we encourage teachers to integrate as many of the crucial training aspects as possible into their regular teaching routines (cf. Perry & Rahim, 2011).

4.3. Limitations and future directions

Finally, we would like to mention limitations of our study and make suggestions for future research. First, we used a self-report questionnaire to measure self-regulated learning. Due to economic constraints, we did not measure students' actual behavior, but asked students to self-report their preference for self-regulated learning over externally regulated and impulsive learning. Self-report data can be distorted by social desirability and should not be interpreted as actual behavior. Therefore, in future research, this measure should be supplemented by measures that are closer to actual student behavior, for example by learning journals (cf. Schmitz, Klug, & Schmidt, 2011), think aloud protocols (cf. Green, Robertson, & Croker Costa, 2011), or microanalytic assessments (cf. Cleary, 2011).

Second, we limited our analyses to students without migration background after we had found effects of students' migration status in the larger evaluation study. This choice enabled us to keep the focus on highly intelligent and high-achieving students and to keep the manuscript readable. A drawback of this choice is that we cannot say for sure how our results generalize to highly intelligent and high-achieving students with migration background. A challenge in addressing this issue in future research is posed – at least in some areas – by the comparably smaller number of students with migration background in many regular classrooms. As highly intelligent and high-achieving students are, by definition, also small in number, a combination of these characteristics may result in sample sizes too small for quantitative research. We therefore believe that case studies (cf. Butler, 2011) could be an appropriate and valuable method for addressing this issue in future research. Alternatively, the study could be replicated in classrooms with larger proportions of students with migration background, either in areas where this is the norm rather than the exception or by way of selectively recruiting participating classrooms.

A final limitation concerns the rather low statistical power to detect three-way interaction effects in the differential analyses. This is a common problem in research with individuals who share a rare characteristic like high intelligence or high academic achievement, resulting in small group sizes. We addressed this issue by supplementing our ANOVA analyses with effect size measures for all intelligence- and achievement based subgroups. We recommend a similar approach in future studies that attempt to replicate our findings. In addition, when more similar studies are conducted, the pooling of samples could be considered to achieve larger sample sizes.

In summary, we showed that highly-intelligent and high-achieving students can benefit from a training program in self-regulated learning conducted by regular classroom teachers in heterogeneous classrooms. Future research should replicate these findings using the same or similar training programs and various assessment methods. Extending our findings to other content areas and to students of other age groups is also desirable.

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