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Developing young adolescents' self-regulation by means of formative assessment: A theoretical perspective

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Abstract: Fostering self-regulated learning (SRL) has become increasingly important at various educational levels. Most studies on SRL have been conducted in higher education. The present literature study aims toward understanding self-regulation processes of students in primary and secondary education. We explored the development of young students' self-regulation from a theoretical perspective. In addition, effective characteristics for an intervention to develop young students' self-regulation were examined, as well as the possibilities of implementing formative assessments in primary education to develop self-regulation. The results show that SRL can be supported in both primary and secondary education. However, at both school levels, differences were found, regarding the theoretical background of the training and the type of instructed strategy. Studies so far suggest avenues toward formative assessment, which seems to be a unifying theory of instruction that improves the learning process by developing self-regulation among students. But gaps in knowledge about the impact of formative assessments on the development of SRL strategies among primary school students require further exploration.

ABOUT THE AUTHORS

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PUBLIC INTEREST STATEMENT

The present study aims toward understanding self-regulation processes of students in primary and secondary education. We explored the development of young students' self-regulation from a theoretical perspective and examined effective characteristics for an intervention to develop young students' self-regulation. We also explored possibilities of implementing formative assessments in primary education to develop self-regulation. The results show that from a theoretical point of view self-regulated learning (SRL) can be supported in both primary and secondary education. However, there are differences between both school levels, with respect to the theoretical background of the training and instruction strategy. Studies so far suggest that formative assessment can improve the learning process by developing self-regulation among students. But gaps in knowledge about the impact of formative assessments on the development of SRL strategies among young adolescents require further exploration.

Subjects: Assessment & Testing; Child Development; Classroom Practice; Educational Psychology; Teaching & Learning

Keywords: self-regulated learning; self-regulation; formative assessment; primary education; secondary education

1. Introduction

The transition from primary school to secondary school can be experienced as a complex one, due to differences inherent in the respective educational environments, content, and pedagogical approaches (Inspectorate of Education, 2007b). Learners with high self-regulation skills seem to have a more smooth transition, than learners without these self-regulation skills. This study describes the theoretical and empirical background of developing self-regulation in the context of primary and secondary education.

Children in European countries transfer from primary to secondary education at different ages. In Germany, children enter secondary school at the age of 10 years. In Great Britain, children move on from primary school to middle school at the age of 11 years, and then to junior high school at the age of 13 years. The transition in the Netherlands occurs when children are approximately 12 years old. By then, Dutch children have received eight years of education in primary education. There, an annual 190,000 (approximately) students leave primary school, and continue their education in one of three levels that can be recommended to them: pre-vocational secondary education (vmbo), senior secondary education (havo), and university preparatory education (vwo) (Inspectorate of Education, 2007a). Pre-vocational secondary education can be completed in four years; senior secondary education takes five years, and university preparatory education requires six years (see Figure 1). The various tracks differ in their content, difficulty, and school characteristics. Based on the previous academic performances of the students, as well as estimates of the students' abilities and

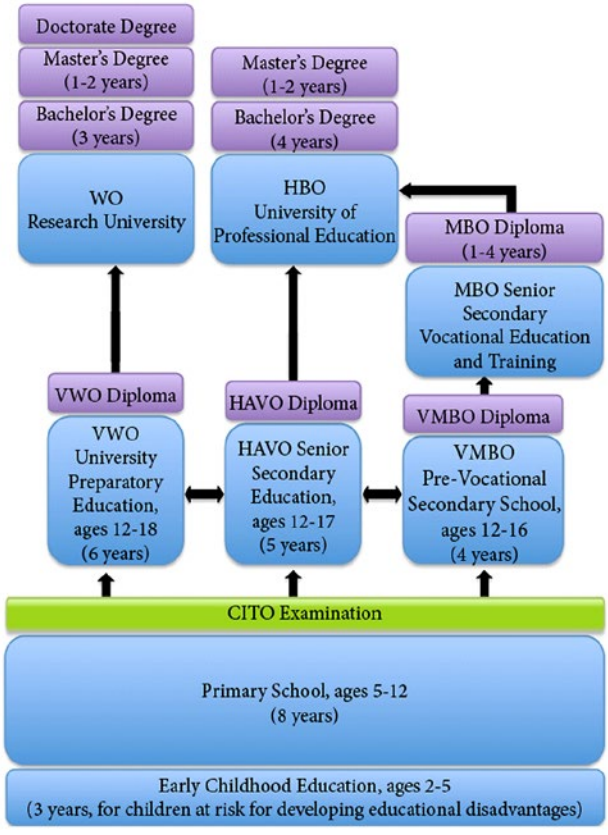

Figure 1. The structure of the Dutch education system.

Source: Center of International Education Benchmarking (2009).

capacities made by their teachers, the students are placed in one of the tracks (Inspectorate of Education, 2007a).

In primary education, one teacher teaches almost all of the students' courses to a group of approximately 25 children in relatively small schools. By contrast, in secondary education, children meet different teachers each teaching different courses, which now include foreign languages, science, and math, in different classrooms every hour, in much larger schools. Because of the major environmental and curricular differences between primary and secondary schools, the relative safety that is experienced by students in primary schools, diminishes after their transition to secondary school (Pellegrini & Long, 2002).

Difficulties during the transition from primary school to secondary school can also be related to students' motivation and self-efficacy. Self-efficacy refers to the learner's beliefs about their ability to effectively engage in actions and behaviors in order to pursue academic goals (Bandura, 1986). In secondary education, higher demands are made on the students with regard to their academic performance and learning outcomes (Cleary & Zimmerman, 2004). Students need to study more independently meanwhile using various study strategies, such as planning, selecting, and monitoring learning strategies, and evaluating the use of them, and must cope with different assignments from many teachers. Some students become overwhelmed and struggle to cope with the new demands and standards. Consequently, some students suffer a decrease in their self-esteem, motivation, and task interest (Cleary & Zimmerman, 2004; Eccles et al., 1993; Fredricks & Eccles, 2002). Also, a lack of explicit opportunities to gain personal autonomy in setting and achieving academic goals may result in a decrease of self-motivational beliefs (Eccles et al., 1993), which can lead to deterioration of attention in class, failing to prepare for exams and even a total absence in school (Cleary & Zimmerman, 2004).

The major changes experienced in secondary school can also lead to decline in academic motivation, lower levels of achievement, and negative attitudes towards learning (Eccles & Midgley, 1989; Eccles et al., 1993; Rudolph, Lambert, Clark, & Kurlakowsky, 2001). This seems to be caused by a discrepancy between students' learning skills and needs, and expected performances in secondary school (Cleary & Zimmerman, 2004; Eccles et al., 1993). Students seem to lack effective learning strategies and skills needed to select and evaluate strategies or adapt faulty ones (Cleary, 2004). Self-regulated learners analyze, orientate, specify, plan, and evaluate knowledge and information, while monitoring and controlling their own learning processes to regulate their learning (Azevedo, 2010; Veenman, Van Hout-Wolters, & Afflerbach, 2006; Zimmerman, 2008). Explicit opportunities need to be given to students to develop effective strategies, assume personal responsibility, and learn how to regulate their learning. Children need to be prepared for secondary education, especially those who lack the skills to cope with their new educational situation and the demands made on their academic performance. Developing self-regulation skills in primary education, prior to the complex transition to secondary education, might empower students, and enable them to become successful learners.

Self-regulated learning (SRL) is defined as the degree to which students are motivationally, metacognitively, and behaviorally active participants in their own learning process (Zimmerman, 2008). Students who can self-regulate cognitive, motivational, and behavioral aspects of their learning are more effective learners (Zimmerman, 2002). Teachers have an important role in developing self-regulation skills among their students. Over time, opinions about what teachers should instill in their students have changed. According to Bargh and Schul (1980), the essence of teaching is structuring and presenting knowledge to others, which results in a good understanding of knowledge on the part of the learners. According to Biswas, Jeong, Kinnebrew, Sulcer, and Roscoe (2010), teaching consists of three critical aspects with regard to learning interactions: structuring, taking responsibility, and reflecting. Effective teachers monitor and reflect on their students' progress and understanding, while applying knowledge and ideas to answer students' questions and solve problems (Biswas et al., 2010). The role of the teacher extends to supporting, stimulating, and guiding students' self-regulation, and to construct self-regulated knowledge by their students (Verloop &

Vermunt, 2009). Only few teachers seem to implement explicit instruction on learning strategies in their classroom practices (Hamman, Berthelot, Saia, & Crowley, 2000), even though content matter and self-regulation skills can be integrated during knowledge building (Vrieling, Bastiaens, & Stijnen, 2010). Schunk and Zimmerman (2007) suggest that the development of SRL involves several levels. The first level deals with observation, where students observe someone else, for example, the teacher, who models learning or performance. In the second level, the student imitates the model's performance. At the third level, the student learns to exercise self-control on the performance task. The student performs independently under structured conditions. Finally, at the fourth level, one is able to self-regulate their learning. At this level, the student displays an adaptive use of skills, adjusted to personal and environmental conditions (Schunk & Zimmerman, 2007). It is critical for teachers to identify potential difficulties that may hinder students' learning goals and achievement. Teachers can advance students' learning by using a combination of informal and formal strategies (Ruiz-Primo, 2011). A teacher's guidance and feedback are essential during students' learning and development.

In this study, we focus on young students' self-regulation. There is clear evidence that students' self-regulation is predictive of academic achievement and motivation in higher education (Clark, 2012; Cleary & Zimmerman, 2001; Dignath & Büttner, 2008; Zimmerman, 2000; Zimmerman & Bandura, 1994). Students who are able to self-regulate their learning have greater understanding of underlying learning processes and development of self-regulation skills. However, self-regulation skills hardly develop spontaneously, and need to be learned (Winne, 2005). Most research on self-regulation has focused on higher education. Primary school students seem to lack the essential strategies for SRL (Cromley, Snyder-Hogan, & Luciw-Dubas, 2010). Available knowledge on the understanding of SRL by children in the age group of 11–14 years is scattered and discussions seem to be dominated by assumptions instead of empirically grounded arguments. Therefore, the present study aims toward understanding self-regulation processes of students in upper primary and lower secondary education. The focus of the current study is on the development of young students' self-regulation and takes a theoretical perspective. In addition, this study explores effective characteristics and requirements for the development of primary and secondary school students' self-regulation. As current discussions about the conceptual similarities of formative assessment and self-regulation have led to the assumption that formative assessment and self-regulation share theoretical and practical applications (Andrade, 2010). As Black and Wiliam (2009) argue, self-regulation is not an alternative strategy for a formative approach; formative assessment encapsulates SRL. This study investigates the differences and similarities of formative assessment and developing self-regulation. The main research question is: *How to stimulate students' self-regulation in upper primary and lower secondary education?*

The following sub questions were specified:

(1) What are differences between primary and secondary school students in how self-regulation can be developed?

(2) What are characteristics of an effective intervention in primary education to develop self-regulation?

(3) What are characteristics of formative assessments, and to what extent do they meet the requirements of an intervention to develop self-regulation?

2. Method

To get an overview of the development of the SRL skills of primary and secondary school students, recent international scientific literature on the topic was explored. Four electronic databases were used: Academic Research Elite, Eric, Google Scholar, and SpringerLink. As Dignath and Büttner (2008) emphasize, SRL seems to be a fuzzy concept that is associated with an abundance of extensive terminology. Therefore, search terms such as "metacognition", "self-regulation", and "self-regulated learning" were added to describe effective learning. Based on the review of learning skills interventions for student

learning that was conducted by Hattie, Biggs, and Purdie (1996), the following keywords were further included: "study skills", "learning strategies", "self-regulatory strategies", "self-regulatory skills", "metacognitive skills", and "metacognitive strategies". For the first research question, the search terms were combined with keywords such as "primary education", "secondary education", "elementary school" and "junior high school". The selected literature was analyzed to identify conditions, methods, and outcomes with regard to the effectiveness of SRL. This search strategy resulted in 2,449 articles. Many studies, 737 publications, reported on the possibilities for fostering self-regulation at the primary and secondary school levels. For the third research question, terms related to "assessment" were added. Several studies focused on effective formative assessment intervention programs that were implemented in order to enhance self-regulation in students. Of these articles, 48 publications examined formative assessment in upper primary and lower secondary education. After this, references within the articles were used to find more studies. The articles included in this review are from 1998 to 2013. The literature was used to write a narrative synthesis (Popay et al., 2006) to provide a theoretical view of a child's development.

3. Results

3.1. Research question 1: What are the differences between primary and secondary school students in how self-regulation can be developed?

Before researchers started to investigate self-regulation, they focused on the concept of metacognition. Flavell (1979) conceptualized metacognition as one's ability to regulate cognitive processes, also typified as "thinking about thinking". The necessary skills for metacognition are control, planning, monitoring, evaluating, and self-regulation (Brown, 1978). Coutinho and Neuman (2008) described metacognition as the higher order mental processes that occur during task performances, which enable individuals to monitor and plan out their learning, analyze their own performance, and identify the skills and strategies required to undertake tasks. The essence of metacognition is the individual's knowledge about learning, whereas SRL focuses on learning behavior and the inclusion of self-initiated interactions with his environment, such as seeking help from peers and teachers (Zimmerman & Schunk, 2011). The process of SRL allows students to gather information about their level of understanding, evaluate the strategies that they used, take into account the contributions and opinions of others, and consider improvements in regard to their goals and expectations (Hattie & Timperley, 2007). Students with the ability to self-regulate are determined to proactively redirect strategies or behavior to achieve self-set goals (Zimmerman, 1989). Noushad (2008) emphasize that success in learning and development depends on self-regulation, motivation, and self-efficacy. Supportive self-beliefs and motivational beliefs are essential, in order to set goals proactively and to engage in self-regulation (Zimmerman & Schunk, 2011).

Zimmerman (1989, 2000) proposes that learners self-regulate in three cyclical phases. This first phase, the forethought phase, involves the processes that require any effort to act. The next phase, the performance control phase, involves processes that occur during learning. The last phase, the self-reflection phase, consists of the processes that occur after learning or performance (Schunk & Zimmerman, 2006). The forethought phase influences the performance control processes, which in turn influences self-reflection. The cycle is completed when the self-reflection processes influence future learning attempts, starting again with a forethought phase. During all phases, learners use feedback on performances to modify current strategies, and adjust and improve future learning efforts and attempts (Zimmerman, 2000).

Several researchers have emphasized the importance of developing self-regulation skills among students (Bandura, 1986; Bembenutty, 2007, 2009; Schunk, 2004; Zimmerman, 1989). Self-regulated learners apply self-observation, self-judgment, and self-reflection, and adopt self-regulation skills such as goal setting, planning, knowledge activation, metacognitive monitoring, regulation, and reflection (Azevedo, 2010; Bembenutty, 2009; Zimmerman, 2008). Most research on self-regulation in school settings has been conducted in secondary or higher education, and some research shows that self-regulation can be trained at a young age (Veenman, Wilhelm, & Beishuizen, 2004). Self-regulation develops

from preschool to elementary school years, during secondary school grades and higher education (Dignath, Buettner, & Langfeldt, 2008). Veenman et al. (2006) argued that metacognitive skills started to develop at the age of 8–10. This assumption is disputed by Whitebread et al. (2009), who did a literature review which suggested that there are emerging metacognitive skills in young children by the age of 3–6-year olds. Children, at the start of their schooling, develop learning attitudes and self-efficacy, which are easier to influence or change at an early age, compared to students who already have developed fixed learning styles and learning behavior (Hattie et al., 1996). Rothbart, Posner, and Kieras (2006) also reviewed evidence linking various executive functions with self-regulation in children up to the age of six. The advantages of training self-regulation in early grades seem to be significant (Hattie et al., 1996).

Training self-regulation is important for the general student population, varying from gifted students, to students who are typically achieving, and for students with cognitive disabilities. Most studies on self-regulation have examined typically achieving students with less attention paid to students with learning difficulties (LD). Many students with LD have difficulty with self-regulation. Research shows that those students were less skilled in problem solving and performance monitoring, and reported lower self-regulation (Klassen, 2007). They might have difficulty with comprehending task demands and select effective strategies. Of almost equal importance is students' belief in their capabilities to manage the learning environment (Klassen, 2010). Explicit instruction needs to be provided to the extent needed by individual children, which should be integrated into the larger context. Students' perceptions of what they are doing and why, are critical in this integration.

Although self-regulation skills can be learned at various ages, differences could be noted between the approaches to develop students' self-regulation by primary school versus secondary school (Dignath et al., 2008). At the start of primary education, children do not reflect and control their learning as much as children at the start of secondary education (Paris & Newman, 1990). Research shows that self-regulation strategies extend during their elementary school years if children are trained in using and developing them (Veenman et al., 2004).

Secondary school students often demonstrate better metacognitive knowledge and regulation strategies than primary school students (Dignath & Büttner, 2008). When students attend secondary education with an established strategy repertoire, strategies can be refined. They can build upon previously acquired strategies. In both primary and secondary schools, training of self-regulation strategies seems to be vital for student learning. Students need to gain experience in strategy use, in order for their strategic behavior to change in both quantitative and qualitative ways (Cazan, 2013). Interventions seem to be most effective the longer they run. Not only the length of the intervention, but also the lack of knowledge regarding self-regulation training by schoolteachers, need to be rectified. Waeytens, Lens, and Vandenberghe (2002) claim that teachers in both school types need to be taught about (developing) SRL in their students. Teachers' goals and actions should be based on ongoing assessment that includes students' abilities, skills, knowledge, prior experience, strengths and weaknesses, needs, and characteristics (Graham, Harris, & Mason, 2005).

In conclusion, primary school and secondary school students differ in how they develop self-regulation. In primary education, SRL should aim on building a strategy repertoire. Motivational support and encouragement should be taken into account among primary school pupils. However, in secondary education SRL intervention programs should be based on building upon the strategy repertoire that has already been acquired by the student to reach a more advanced strategy use. In addition, emphasizing the use and functionality of regulation strategies seems to be very important.

3.2. Research question 2: What are characteristics of an effective intervention in primary education to develop self-regulation?

Students' self-regulation can be developed and facilitated, by making learning processes explicit, through training self-monitoring and the provision of opportunities to practice self-regulation (Schunk & Zimmerman, 1994, 2007). Research shows that self-regulation principles should be incorporated into

intervention programs (Weinstein, Husman, & Dierking, 2000), for example, by the instructional model self-regulated strategy Development (SRSD: Graham & Harris, 1993). The primary focus of this instructional program is on teaching students strategies for successfully completing an academic task, which is compatible with current theories on the development of competence in a subject-matter domain. The model includes instructional procedures that promote generalization, such as clarifying the purpose and value of strategies, learning to efficiently and correctly apply strategies, and providing feedback and self-reflection (Graham et al., 2005). However, not all students maintain or generalize all they have learned. This is particularly problematic with children who experience academic difficulties, as they are less likely to maintain and generalize learned strategies (Wong, 1994). Intervention programs for primary schools have different characteristics than programs for secondary schools. According to Dignath and Büttner (2008), training programs based on social-cognitive theories on SRL seem to be more effective and have more positive impact on academic achievement, strategy usage, and motivation than training programs based on theories on motivation or metacognition.

In primary education, SRL intervention programs should be based on building a strategy repertoire (Dignath & Büttner, 2008). Young children are still developing their metacognitive knowledge, and therefore might benefit more from instruction of metacognitive strategies (Kuhn, 1999). Interventions in primary education should also take motivational support and encouragement into account (Dignath van Ewijk, 2011). Primary school students seem to be rather motivated to learn. However, research shows that even though young children are motivated to learn when they arrive at school, motivation can decrease during schooling (Dignath & Büttner, 2008; Spinath & Spinath, 2005). Research shows that motivational aspects of SRL have positive effects on primary school students' strategy use (Dignath & Büttner, 2008; Dweck & Elliot, 1983). Therefore, the training program should be based on motivational support, which should be embedded in the training program (Dignath & Büttner, 2008). Dignath et al. (2008) suggest that developing metacognitive strategies, such as planning, monitoring, and evaluating, can be effective, but paying explicit attention to metacognitive reflection seems to be most important for primary and secondary school students. Students need feedback on their strategy use. Feedback on strategy use by both teachers and students are essential during learning, as feedback can improve learning outcomes and future strategies (Zimmerman, 2002b). A teacher's guidance and high-quality feedback are essential during students' learning and development in primary and secondary education. There seems to be a disagreement in the literature on whether self-regulation should be developed individually or cooperatively. Dignath et al. (2008) stress the importance of individual learning in primary education. In contrast, Slavin (1996) emphasizes cooperative learning, considering its positive effects on students' performance, motivation and strategy use in both primary and secondary education. Also, Whitebread (2000, 2007) stresses the importance of developing young children' self-regulation by peer-assisted learning.

At the secondary school level, training programs based on metacognitive theories seems to have the greatest effects (Dignath & Büttner, 2008). The training of self-regulation should build upon the strategy repertoire that has already been acquired by the student (Dignath & Büttner, 2008). Zimmerman (1990) suggests that secondary school students learn in a more strategic way, possibly because they have already acquired some strategies. Therefore, older students benefit more from practicing and applying strategies in order to reach a more advanced strategy use, than from learning about learning strategy formation (Schneider & Sodian, 1997). These assumptions are supported by Zimmerman (2002a), who stresses that students pass through different levels of self-regulation. Learners start with modeling and imitating, and dependent on external feedback, to end in the higher levels where they can self-regulate independently. In order to reach higher levels of self-regulation, metacognitive reflection should be included in the intervention (Dignath van Ewijk, 2011). Emphasizing the use and functionality of regulation strategies and training based on motivational theories are important in secondary schools (Dignath & Büttner, 2008). Strategic behavior appears to develop with experience and not with age. However, a longer intervention period is necessary to achieve and practice SRL skills.

Students in both primary and secondary education need to be provided with opportunities to practice strategy use, and to foster the transfer of strategic knowledge to learning contexts (Cazan, 2013), for example in the domain of writing. Writing is a complex and demanding task, during which extensive self-regulation and control are required to manage the writing environment and the processes involved in composing (Graham & Harris, 2000; Zimmerman & Risemberg, 1997). The writer must focus on both the rules and mechanics of writing, and maintain focused on aspects of writing such as organization, purpose and goals, needs and perspective, and evaluation (Graham et al., 2005). Writing requires extensive self-regulation and control. According to Graham and Harris (1993), skilled writers engage in purposeful and active self-regulation and self-direction. Less-skilled writers—however, and students with LD or other special needs frequently have greater difficulty regulating their learning and writing processes, as they lack critical knowledge of the writing process—have difficulty generating ideas and selecting topics as well as strategies, lack important strategies for planning, organizing, producing, and revising text, and frequently overestimate their (writing) abilities (Graham et al., 2005). When students' self-regulation is enhanced in the domain of writing, students are not only assisted in developing knowledge about writing, and developing skills and strategies involved in the writing process, students' development in SRL is also supported.

According to Paris and Paris (2001) self-regulation strategies need to be integrated in daily activities, so that both teachers and their students are offered opportunities to practice self-regulation skills in authentic activities throughout the curriculum. Training students to become more strategic writers involves making them aware of potential strategies, and helping them to choose and monitor appropriate strategies (Paris & Paris, 2001), for example by evaluating drafts, verifying the progress that has been made, and adjusting elements that need improvement. The use of self-regulation skills might lead to strategic adjustments in writing behavior. When self-regulation strategies are embedded into writing tasks, information can be generated that may influence the use of self-regulation strategies and other cognitive and affective processes (Graham & Harris, 2000). Developing SRL skills in the domain of writing within classroom practices involves setting up a routine where students are expected to plan, draft, revise, edit, and publish their work. For example, by means of a writing assignment during which students need to actively consider their goals choose strategies to attain those goals. To improve the quality of their work, students need to be explicitly and repeatedly taught strategies and skills to use these strategies, including goal-setting, planning, monitoring and adjusting selected strategies, and evaluating and reflecting on their drafts and progress.

Ramdass and Zimmerman (2011) found a relationship between self-regulation and homework. Homework can be described as assignments that are given to students by their teachers that need to be prepared and learned after school in addition to the regular school program that is followed within classes. Homework is an essential part of education, starting in primary school (mostly fifth or sixth grade), where teachers assign it to enhance students' learning outcomes. In secondary education, the amount and regularity of homework increases rapidly. Homework assignments are often used in both primary and secondary schools because they can improve learning performances (Ramdass & Zimmerman, 2011). The homework assignments that are most supportive of developing self-regulatory skills are those, which are both challenging and interesting. The assignments can help students to develop self-regulatory skills (Ramdass & Zimmerman, 2011). However, students' age, grade level, and the subject matter should be taken into account before assigning homework. Skilled learners from elementary grades to higher education engage in self-regulatory behavior during homework activities. Students develop self-regulation skills such as setting goals, and time management by means of homework. Cooper, Robinson, and Patall (2006) found weak to modest gains at the middle school level and no statistically significant gain at the elementary school level for homework. Homework is likely to benefit only the higher grades. Table 1 provides an overview of training characteristics for developing self-regulation. There is no insight available as to whether developing self-regulation skills during primary education influences the level of self-regulation skills of secondary education students.

Table 1. Characteristics of effective SRL intervention related to primary and secondary education

Intervention characteristics	Primary education	Secondary education
Self-regulation principles should be incorporated into intervention programs	●	●
SRL intervention programs should be based on social-cognitive theories	●	
SRL intervention programs should be based on metacognitive theories		●
SRL intervention programs should be based on building a strategy repertoire	●	
SRL intervention programs should build upon the strategy repertoire that has already been acquired by the student to reach a more advanced strategy use		●
Guidance and high quality feedback are essential during students' learning	●	●
SRL intervention programs should instruct on metacognitive strategy instruction and metacognitive reflection	●	
Interventions should take motivational support and encouragement into account	●	
Emphasizing the use and functionality of regulation strategies and training based on motivational theories are important		●
Strategic behavior appears to develop with experience	●	●
SRL can be developed both individually and cooperatively.	●	●
Strategic behavior develop with experience during longer intervention periods	●	●
Homework is an effective instruction to develop self-regulation skill		●

3.3. Research question 3: What are characteristics of formative assessments, and to what extent do they meet the requirements of an intervention to develop self-regulation??

Current discussions about the conceptual similarities of formative assessment and self-regulation have led to the assumption that formative assessment and self-regulation share theoretical and practical applications (Andrade, 2010). Formative assessment, also known as assessment for learning, is part of the instructional process, which has the intent to help students plan, identify strengths and weaknesses, and develop metacognitive, personal, and professional skills (Topping, 2009). It can be defined as "the process of seeking and interpreting evidence, for use by learners and their teacher, to decide where learners are in their learning, where they need to go, and how best to get there" (Broadfoot et al., 2002, p. 2). According to Andrade and Valtcheva (2009), formative assessment involves students who think about the quality of their work, instead of relying on external sources of evaluative judgments, such as their teachers. It is done on works in progress, and provides teachers and students with information about students' progress. It is not about students determining their own grades. Formative assessment involves awareness of the goals of a task and checking

one's progress toward them (Andrade & Valtcheva, 2009). Research shows that formative assessments have positive effects on students' learning and achievements (Black & Wiliam, 2003). The primary concern of formative assessment is the formative, developmental function of assessment; it encourages students to develop themselves and reconsider their learning behavior (Boston, 2002). It intends to improve and facilitate learning by generating feedback on performance (Nicol & Macfarlane-Dick, 2006; Sadler, 1998). Clark (2012, p. 234) considers formative assessment to be a "unifying theory of instruction, in which the learning process can be improved and practices can be guided by developing SRL strategies among learners". Formative assessment has the objective of gaining an understanding of what students know and do not know (Boston, 2002). Formative assessment seems to meet the requirements to be an intervention for improving self-regulation strategies among young students. It motivates students to self-regulate their learning, and assists them in gaining self-regulation skills (Bandura, 1997; Black & Wiliam, 2006; Nicol & Macfarlane-Dick, 2006).

Formative assessment has a strong emphasis on SRL, combining instructional methods and SRL strategies among the learners (Allal, 2010; Clark, 2012; Nicol, 2007). According to Wiliam (2014), self-regulation is a key aspect of productive formative assessment strategies. Self-regulation is not an alternative strategy for a formative approach; formative assessment instead encompasses SRL and can make distinct contributions to the development of a student's learning and achievement (Black & Wiliam, 2003, 2009). According to Clark (2012), formative assessment drives self-regulation strategy acquisition among learners and has been directly related to self-regulation by a growing body of research (Black & Wiliam, 2009; Clark, 2012; Nicol & Macfarlane-Dick, 2006). Clark describes formative assessment as (2012, p. 217) "a process with the potential to support learning beyond school years by developing learning strategies which individuals may rely on across their entire lifespan." Formative assessment is designed to support teaching and learning by emphasizing skills such as planning, monitoring, and reflecting while guiding further learning and improving performance outcomes. As Nicol and Macfarlane-Dick (2006) emphasize, formative assessment should be used to foster students' self-regulation and empower them as learners.

In order for formative assessment to support learning, three features appear to be important. The first feature is that the results of a performance should be "more than information about the presence of a gap between current and desired performance" (Wiliam, 2011, p. 4). It should also provide information about what kind of instructional activities will most likely result in students improving upon their performance. Therefore, teachers need to understand the power of assessment and feedback in order to strengthen students' learning processes, and need to be aware of the dependence on teachers' competence in assessment for the successful implementation of a formative assessment (Smith, 2011). The second feature is that learners are required to engage in actions to improve their learning, ask for help, or reflect on how to become a better learner (Wiliam, 2007). Students need to continuously assess whether particular strategies are effective in meeting their learning goals, evaluate their growing understanding of the topic, and make adjustments regarding their knowledge, behavior, and other aspects of the learning process, based on feedback received during their learning (Azevedo, 2010). According to Sluijsmans, Joosten-ten Brinke, and Van der Vleuten (2013) an important feature of formative assessment in developing self-regulation and motivation is to reflect on learning activities and increase such skills as reflecting, planning, and monitoring. The third feature stresses the importance of authentic learning environments. As the literature suggests, learning environments should be designed to have resources and constraints, or affordances on instructional design, which enhance the regulation of learning (Black & Wiliam, 1998; Hadwin, Nesbit, Jamieson-Noel, Code, & Winne, 2007).

Black and Wiliam (1998, 2003) describe five key strategies of formative assessment: peer assessment, self-assessment, rich questioning, feedback, and the sharing of success criteria with learners. Peer assessment and self-assessment can help learners to understand what their learning goals are, what approaches are needed to meet the goals, and make their revisions more effective (Black & Wiliam, 2003). Rich questioning is also an important aspect of the interventions that a teacher can conduct during student learning. Asking questions leads to assessment dialogs, during which stu-

dents raise issues about information-seeking that is needed or conducted, and become more active participants, who are made aware of their own level of understanding. The setting of criteria by both the teacher and students is an important strategy for understanding and improving the development of students. Students become more responsible and effective learners by systematically sharing their learning objectives and success criteria with teachers and peers. The criteria must be transparent to students in order for them to have an overview of the aims of their work and to be able to assess their own progress towards meeting these aims as they proceed (Black & Wiliam, 2009). Clarifying and sharing their success criteria helps students to guide their own work and become independent learners (Black & Wiliam, 2009).

Feedback on performance indicates how close the learner is to previously set learning goals and could provide information or indications as to the obstacles that the learner has to overcome (Allal, 2010). Feedback can close the gap between a person's performance and a particular reference point (Sadler, 1998). Butler and Winne (1995) suggest that feedback can match the learner's expectations about their performance, or it can confirm or change existing beliefs, add information, or restructure existing data and beliefs. Feedback encourages students to develop their understanding of key features, identifies the strengths and weaknesses in their development, and provides guidance about making improvements (Black & Wiliam, 2003). Educational research has given much attention to different types of feedback. Hattie and Timperley (2007) propose a model, which distinguishes four types of feedback. It lists feedback about understanding the students' level of task performance, feedback about processes, feedback that concerns students' self-regulation with respect to the task, and feedback about the self-concerning student qualities as a learner. Feedback about the learning processes and about students' self-regulation seems to be the most effective at promoting learning (Allal, 2010; Zimmerman & Schunk, 2001). However, the effectiveness of feedback is largely dependent on how learners act upon it. According to Shute (2007), in order for feedback to be effective, and useful for performance and learning, motive and opportunities to receive feedback, and the ability and willingness to use feedback by students are essential. All in all, the five strategies stressed by Black and Wiliam (2003) make distinct contributions to the development of a student's learning by means of formative assessment.

Formative assessment can play a pervasive role in the regulation of learning, when it is integrated into teaching and learning activities (Allal, 2010). As stated by Black and Wiliam (1998), formative assessments in classroom practices that stimulate SRL activities, are self-assessment and peer assessment. According to Epstein et al. (2004), self-assessment relates to the process of interpreting data or knowledge about one's performance and comparing these to an explicit or implicit standard. Internal and external data are integrated and used to assess current performance, while ongoing self-monitoring occurs during everyday practice (Sargeant, 2008). Self-assessment activities, that are used to inform and judge one's performance, seem to be very helpful to students (Sargeant, 2008). It helps them plan and organize their thoughts, and encourages them to be independent and reflective. Most importantly, training in self-assessment skills appears to improve the effectiveness of SRL (Kostons, 2010). Self-assessment that is conducted before and after an assignment forces the students to reflect on their own knowledge, skills, and development (Davies, 2002). It encourages students to evaluate their own work and improves their critical thinking skills (Thompson, Pilgrim, & Oliver, 2005) on specific tasks (Fontana & Fernandes, 1994). Self-assessment has a positive impact on student learning.

Peer assessment is also acknowledged to be a valuable assessment form (Ecclestone & Pryor, 2003; Yorke, 2003). Peer assessment is about considering the level, value, or quality of a product or performance (Topping, 2009). It is a collaborative and dialogic process where students co-produce the best possible outcomes (Nicol & Macfarlane-Dick, 2006; Yorke, 2003). Students first discuss task criteria and then assess each other's performances; meanwhile, self-regulation and cognition are developed, and motivation is stimulated (Towndrow, 2008). The peer assessment activities can vary and can operate within different disciplines by students of different ages and abilities. In addition, peer assessment can be one way, or reciprocal, with various objectives, and conducted in various

learning environments (Topping, 2009). An advantage of peer assessment is that peer-to-peer feedback seems to be understandable and accessible through peer interaction. It also encourages students to share in responsibility, reflect, discuss, and collaborate (Birenbaum, 1996).

The development of self-regulation skills by means of formative assessment can be derived from an authentic learning environment, and can be implemented in both primary and secondary education because it is effective for children of various ages and abilities. However, students need to be trained and able to practice (Sluijsmans, 2002). Meusen-Beekman and Joosten-ten Brinke (2010) found that primary school students are capable of assessing each other and of using criteria in a more conscious way. It remains unclear whether peer assessment or self-assessment is most effective in primary education.

4. Conclusions and discussion

The transition between primary and secondary education is complex due to differences in educational content, educational environment, and pedagogical approach (Inspectorate of Education, 2007a). Social, physical, and psychological developments also influence children during the transition. Meanwhile, higher demands on learning are strongly called upon of students in secondary education, leading to decreasing motivation and self-efficacy. Therefore, investing in students' learning processes—particularly in students' self-regulation prior to their transition to secondary education—results in empowering students in primary education to meet future expectations.

We explored how primary and secondary school students differ in developing self-regulation strategies. Self-regulation development appears to start at a young age. This can be used to enhance and stimulate learning skills and academic achievement in both primary and secondary education. Therefore, for students to become self-regulated learners in secondary education, self-regulation training should be started in primary education. However, there are differences in ways to best facilitate and develop self-regulation within both school types. With regard to SRL in primary education, it can be stated that even though metacognitive development starts at a young age, children rarely reflect upon or control their learning at the start of primary education. Children not only benefit from the instruction of metacognitive strategies, it is actually essential for their learning process. A training program that is designed to develop self-regulation should be based on social-cognitive theories and should focus on developing a strategy repertoire (Dignath & Büttner, 2008). Development of a strategy repertoire should be supported, particularly by means of metacognitive reflection. With regard to SRL in secondary education, it can be stated that metacognitive development continues during secondary school and has an influence on academic performance. However, secondary school students suffer from a decline of motivation. Therefore, knowledge about strategies and the benefits of using them need to be emphasized with the students. A training program that is used to develop self-regulation here should be based on metacognition and metacognitive reflection. In addition, the longer the interventions run, the more effective they are. Feedback about strategy use is essential in both primary and secondary education. Teachers need to be taught about giving good feedback to their students. SRL by means of group work can be effective, however, only when cooperative learning is implemented correctly. Teachers themselves should have self-regulation skills and enough knowledge to stimulate the exploration of the new insights that are to be made by students on learning and their performance (Stijnen, 2003). Educating teachers about SRL strategies and feedback is fundamental for a successful implementation of SRL in classrooms. The overview of training characteristics for developing self-regulation provided no insight as to whether developing self-regulation skills during primary education influences the level of self-regulation skills of secondary education students.

This analysis suggests that SRL can be fostered at primary and secondary school levels (Dignath & Büttner, 2008). Although there is a research about how SRL can be fostered among students, further research on successful implementation of interventions in classroom practices is necessary. We studied whether formative assessment might be an effective intervention to enhance SRL in primary education. Formative assessments are supportive instruments, which can be considered effective in

developing SRL skills in both primary and secondary education. Clark (2012) suggests that formative assessment is a theory of instruction, whereby practices are guided and the learning process is improved by the development of SRL strategies among learners. Formative assessments meet the characteristics of effective SRL interventions given in Table 1. By means of formative assessment, students acquire SRL strategies, stay motivated, improve attainment, and become aware of the importance of SRL strategies (Bandura, 1997; Stiggins, 2002).

However, the need for more research on formative assessments in primary and secondary education is emphasized. It seems worthwhile to examine the impact of formative assessment on self-regulation skills in primary school classrooms. Furthermore, the differential effects of various formative assessments should be explored, as it remains unclear whether peer assessment or self-assessment are more beneficial for students SRL development. In addition, it can be investigated whether or not developing SRL by means of formative assessment in primary education facilitates students during the transition to secondary education. Finally, formative assessment and its influence on self-efficacy and motivation need to be further taken into consideration.

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