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Research paper

Teachers as learners and agents of self-regulated learning: The importance of different teachers competence aspects for promoting metacognition

Yves Karlen*, Carmen Nadja Hirt, Johannes Jud, Amina Rosenthal, Tabea Daria Eberli

University of Applied Sciences Northwestern Switzerland FHNW, School of Education, Switzerland

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ABSTRACT

This study examines the extent to which teachers' competence aspects as self-regulated learners and agents of self-regulated learning (SRL) explain their self-reported and students' perceived promotion of metacognition. One hundred and eighty-five lower secondary school teachers participated in this study. The results reveal positive direct relationships between teachers' knowledge, self-efficacy, intrinsic interest value and the promotion of metacognition. Teachers' own SRL skills and mindsets about SRL were indirectly related to the promotion of metacognition via their self-efficacy and intrinsic interest value. This study provides new evidence of the importance of teachers' dual competence profile for promoting metacognition.

1. Introduction

Self-regulated learning (SRL) is a cycle process, wherein learners are active and reflective agents of their learning. Self-regulated learners become masters of their learning processes by initiating goal-oriented metacognitive, cognitive, motivational, and emotional processes to acquire knowledge and skills (Zimmerman, 2002). They believe that SRL skills can be developed and that the deliberate use of strategies and the activation of metacognitive knowledge are essential to effectively overcome learning challenges (Hertel & Karlen, 2021). Researchers have demonstrated that the metacognitive aspects of SRL can predict academic achievement (Schneider & Preckel, 2017). Metacognition is an essential component of SRL. It helps self-regulated learners assess their strengths and challenges while learning as well as to monitor and regulate their actions to attain their goals (Veenman, Van Hout-Wolters, & Afflerbach, 2006). Metacognition encompasses metacognitive strategies (e.g., planning, monitoring, and evaluating) and metacognitive knowledge related to strategies, tasks, and one's person (Pintrich, 2002). Metacognitive processes are higher-order skills used to regulate cognitive, emotional, and motivational strategies throughout learning and task performance (Veenman et al., 2006). Moreover, metacognitive skills are task-general and can be applied and transferred to various learning contexts and subjects (Donker, de Boer, Kostons, Dignath van Ewijk, & van der Werf, 2014). Unfortunately, learners demonstrate varying competence levels in SRL, especially regarding their metacognitive skills (e.g., Heirweg, De Smul, Merchie, Devos, & Van Keer, 2020; Karlen, 2016a); however, students can benefit from metacognitive strategy training to become successful self-regulated learners (Donker et al., 2014).

Teachers play a significant role in supporting students in becoming metacognitively involved self-regulated learners (Pintrich, 2002). Teachers can support their students' metacognitive development in many ways, such as by designing challenging tasks, providing autonomy in making choices, modelling strategies, and creating opportunities to control and self-evaluate learning (Dignath & Veenman, 2021; Perry et al., 2020). Metacognitive training is most effective when students acquire these skills within their regular classroom contexts (Donker et al., 2014). However, some teachers are ineffective in activating and

* Corresponding author. University of Applied Sciences and Arts Northwestern Switzerland, School of Education, Bahnhofstrasse 6, CH-5210, Windisch, 0041 56 202 83 95, Switzerland.
E-mail address: yves.karlen@fhnw.ch (Y. Karlen).

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supporting their students' metacognitive skills (Pintrich, 2002; Spruce & Bol, 2015; Zohar & Ben-Ari, 2022). They seldom provide students with information regarding where, when, why, and how strategies should be used (Clift, Ghatala, Naus, & Poole, 1990; Zohar & Lustov, 2018), which is an important prerequisite for building metacognitive knowledge about strategies.

Recently, researchers have investigated why teachers do or do not support their students' metacognitive development. Researchers have identified several teacher competences that impact teaching and classroom practices. Teachers' professional knowledge, beliefs, and motivation are brought into focus and contained within the construct of teachers' general professional competences (Blömeke, Gustafsson, & Shavelson, 2015) and competences in SRL (Karlen, Hertel, & Hirt, 2020). Meaningful advancement in research about teachers' professional competences in SRL points to the relevance of teachers' dual roles. Researchers have highlighted the importance of teachers being both successful self-regulated learners and agents of SRL to promote their students' SRL and metacognitive skills (Bembenutty, White, & Vélez, 2015; Karlen et al., 2020; Kramarski & Michalsky, 2009).

To date, researchers have focused primarily on one part of the dual competence profile: teachers as agents of SRL (Bolhuis & Voeten, 2001; Dignath & Büttner, 2018; Perry, Hutchinson, & Thauberger, 2008). Much less attention has been paid to the second part of the competence profile – namely, teachers as self-regulated learners – and, accordingly, to the interplay and shared influence of both parts regarding teachers' instructional practices. This point is where the present study diverges from previous research by examining the impact of teachers' dual role in promoting metacognition. By drawing on research about teachers' competences and SRL, this study aims to explain the variation in teachers' promotion of metacognition by covering several teacher competence aspects.

2. Teachers' professional competences in self-regulated learning

Models on teacher competence provide general frameworks for embedding determinants of teachers' practices. Generic models on teacher competence are multidimensional and emphasize the importance of teachers' knowledge of the content they teach and how to teach that content, their beliefs about teaching and learning, and their motivation. These models describe competence as a prerequisite that helps teachers successfully cope with specific professional requirements (e.g., Blömeke et al., 2015). Teacher competence includes skills, knowledge, beliefs, and motivational competence aspects that form a foundation for teachers to master specific professional situations. Teacher competence is usually understood as context- and subject-specific (Blömeke et al., 2015). It is changeable and can be developed through teacher training (Michalsky, 2021). Teacher professional competence has been found to predict teaching practices in SRL and metacognition (e.g., Depaepe, Corte, & Verschaffel, 2010).

Researchers in the field of SRL have argued that regardless of whether teachers want to cope with the complex dynamics of helping students become self-regulated learners, teachers must undergo important dual processes (Dembo, 2001). Teachers first need to learn to become more proactive and self-regulated learners themselves and then learn how to help students become self-regulated learners (Bembenutty et al., 2015; Kramarski, 2018). Thus, an essential advancement in SRL research concerning teachers' professional competence has been the distinction between teachers' self-regulation of their own learning and their role as agents of SRL (Karlen et al., 2020; Kramarski, 2018). Teachers' actions and considerations as self-regulated learners are considerate of their own SRL, and their actions and considerations as agents of SRL are directed to promote their students' SRL (Karlen et al., 2020).

Further research on teachers' dual roles as self-regulated learners and agents of SRL still needs to be conducted. Taking an integrative perspective on teachers' competence in SRL and simultaneously combining several competence aspects could help develop a deeper understanding of why teachers do or do not promote metacognition. In the following sections, we will present the state of research for each of the four teacher competence aspects in SRL (own SRL skills, knowledge, self-efficacy, intrinsic interest value).

2.1. Teachers' own self-regulated learning skills

As self-regulated learners, teachers use their own actions and considerations in their proactive processes to set learning goals, monitor, regulate, and control their cognition, motivation, and behaviour to achieve their desired goals (Zimmerman, 2002). Teachers as self-regulated learners are aware of their strengths and weaknesses as learners, use different strategies, know when, how, and where to apply those strategies, understand that growth in SRL is tied to effort and practice, and are aware of how SRL can help students succeed in school and beyond (Pressley, Borkowski, & Schneider, 1987). Thus, SRL relies highly upon a teacher's own experiences as a self-regulated learner (Karlen et al., 2020). However, teachers' own SRL is not yet systematically covered in teacher education and is often not developed among pre-service teachers (Van Eekelen, Boshuizen, & Vermunt, 2005).

With the expertise as self-regulated learners, teachers can act as metacognitive role models for their students and explain the strategies being demonstrated (Pintrich, 2002). Furthermore, teachers gain a deeper understanding of their students' learning experiences in SRL and thus can better recognize and cope with the needs, obstacles, and difficulties students face in SRL. Due to their experiences as self-regulated learners, teachers can make SRL visible to their students and make SRL a topic of classroom discussion (Dembo, 2001; Paris & Winograd, 2003).

Researchers have reported eminent variation in teachers' competences as self-regulated learners. For example, some pre-service teachers have insufficient and fragmented knowledge about SRL and metacognition (Glogger-Frey, Ampatziadis, Ohst, & Renkl, 2018; Granström, Härma, & Kikas, 2022; Spruce & Bol, 2015) and use learning strategies at an average level (e.g., Liu, Xiang, McBride, & Chen, 2020). A broad understanding and repertoire of strategies are essential as teachers are likelier to promote strategies they understand and have experienced as effective (Glogger-Frey, Deutscher, & Renkl, 2018). Wilson and Bai (2010) found that in-service teachers' metacognitive knowledge as learners significantly impacts their pedagogical understanding of how to teach metacognitive strategies. In line with this result, Buzza & Allinotte, 2013 reported that pre-service teachers' own SRL skills positively relate to their understanding of concepts about the promotion of SRL. Additionally, Gordon, Dembo, and Hocevar (2007) demonstrated that teachers' own SRL skills influence the extent to which they encourage their students' SRL by supporting a mastery-oriented classroom environment. Overall, it can be assumed that teachers' competences as self-regulated learners are relevant to their pedagogical understanding of SRL.

2.2. Teachers' knowledge about self-regulated learning and metacognition

Teachers' knowledge about SRL has not been positioned in generic models of teacher competence (e.g., Blömeke et al., 2015).

Models on teacher competence in SRL (Karlen et al., 2020; Kramarski & Heaysman, 2021) explicitly integrate SRL knowledge and distinguish different categories by following Shulman (1987). The distinction between knowledge about teaching content (content knowledge [CK]) and knowledge about how to teach content to students (pedagogical content knowledge [PCK]) is widely acknowledged. CK about SRL (CK-SRL) includes teachers' theoretical knowledge and understanding of basic concepts of SRL, which can relate to terminology, theoretical models, strategies, and components of SRL, such as metacognition. Teacher knowledge about promoting SRL and metacognition involves teachers' PCK about SRL (PCK-SRL). This includes teachers' knowledge of the various ways to promote SRL and metacognition and how to help students acquire strategic skills (Karlen et al., 2020). Studies have demonstrated that teachers lack both CK-SRL and PCK-SRL and that knowledge is particularly low regarding instructional practices that can be used to promote metacognition (for overviews see Lawson, Vosniadou, Van Deur, Wyra, & Jeffries, 2019; Zohar & Ben-Ari, 2022). For example, in an early study, Clift et al. (1990) claimed that when teachers are interviewed about strategy instruction, their descriptions mainly focus on teacher-directed activities for learning subject content and not on promoting SRL and metacognition.

Only a few researchers have examined the relationship between teachers' PCK-SRL and their promotion of SRL and metacognition. Spruce and Bol (2015) conducted interviews to assess 10 elementary and middle school teachers' CK-SRL and PCK-SRL. They found that the teachers' knowledge (overall knowledge score) was not consistently aligned with their practices. In line with this result, Dignath-van Ewijk (2016) also reported no significant correlation between primary school teachers' PCK-SRL and their self-reported promotion of SRL. In contrast, in a case study that involved 14 secondary school teachers, Geduld (2017) reported an association between teachers' PCK-SRL and teachers' observed teaching behaviours. Furthermore, Barr and Askell-Williams (2020) discovered substantial variability in the participants' PCK-SRL during a qualitative study that involved four teachers. The increase in teachers' PCK-SRL through teacher training led to increases in the number and quality of strategy instruction sessions. In another recent study, Karlen et al. (2020) found a positive relationship between 106 primary and secondary school teachers' PCK-SRL and their self-reported promotion of SRL. However, did not find this relationship for CK-SRL. Finally, Zohar and Ben-Ari (2022) concluded that it is rather challenging for teachers to take research-based ideas about SRL and metacognition and translate this knowledge into meaningful practice. This might be a theory-praxis-transfer problem, which could explain why the association between PCK-SRL and the promotion of SRL and metacognition is inconsistent.

2.3. Teachers' beliefs about self-regulated learning and metacognition

Fives & Buehl, 2012 described beliefs as being integrated into a belief system that guides an individual's understanding and interpretation of the world. Beliefs impact how individuals perceive their knowledge and skills and ascribe meaning to events (Dweck & Leggett, 1988). Individuals can hold different beliefs, which are not necessarily cohesive (Lawson et al., 2019). For example, Vosniadou et al. (2020) revealed that teachers hold different and even contradictory beliefs about SRL. Some beliefs were consistent with SRL (e.g., beliefs that learning is a constructive activity or that SRL can improve achievement) and positively related to teachers' value of teaching strategies to students. In contrast, some beliefs were inconsistent with SRL (e.g., beliefs that learning cannot be taught) and negatively related to teachers' value of promoting strategies. Researchers who have investigated teachers' beliefs consistent with SRL have reported that these beliefs can directly affect teachers' self-reported promotion of SRL – sometimes even more than their knowledge about SRL (Dignath-van Ewijk, 2016; Lombaerts, De Backer, Engels, van Braak, & Athanasou, 2009). However, non-correlations have also been reported between beliefs and teachers' practices (Dignath & Büttner, 2018; Spruce & Bol, 2015).

Implicit beliefs – so-called mindsets – are core assumptions about personal abilities or attributes located on a continuum that extends from a fixed mindset to a growth mindset (Dweck & Leggett, 1988; Hertel & Karlen, 2021). Different mindsets orient individuals toward distinctive goals and attributions (Dweck & Leggett, 1988). Individuals with growth mindsets about SRL assume that SRL skills can be acquired and improved over time and thus focus on developing their abilities. In contrast, individuals with fixed mindsets believe that SRL skills are unchangeable and relate to a given talent, thus focusing on validating their abilities (Hertel & Karlen, 2021). A growth mindset is consistent with SRL and a fixed mindset is inconsistent with SRL (Vosniadou et al., 2020). Researchers who have studied these mindsets have found that they influence learning trajectories and teaching behaviour and that a growth mindset relates to adaptive motivational and affective reactions and higher SRL (Burnette, O'Boyle, VanEpps, Pollack, & Finkel, 2013; Karlen, Suter, Hirt, & Maag Merki, 2019; Lawson et al., 2019). Mindsets can develop a motivational force that is relevant to the teaching of SRL and metacognition because acquiring and practising SRL and metacognition can be a strenuous and resource-intensive process that requires perseverance and adaptive teaching (Hertel & Karlen, 2021). Through setbacks or the lack of immediate success (e.g., students do not demonstrate the sophisticated use of strategies or students' performance does not raise), teachers may lose interest in teaching SRL and metacognition and lack confidence in their abilities. However, teachers with growth mindsets, more strongly believe that they can improve their teaching and that their students can improve their SRL and metacognitive skills compared to teachers with fixed mindsets (Karlen et al., 2020).

Studies on the importance of mindsets about SRL regarding teachers' SRL practices are rare. Karlen et al. (2020) found that teachers' mindsets about SRL could not directly predict teachers' self-reported promotion of SRL. When looking at mindsets about the malleability of intelligence, some researchers have found a weak association with teachers' instructional practices (e.g., Vosniadou et al., 2020; Yu, Kreijkes, & Salmela-Aro, 2022). Overall, further studies are needed to examine the relationship between mindsets about SRL and teacher practices.

2.4. Teachers' motivation to promote self-regulated learning and metacognition

Teachers' motivation contributes to their teaching behaviours (Richardson, Karabenick, & Watt, 2014). Various researchers have found positive associations between teachers' motivational aspects and their promotion of SRL (e.g., De Smul, Heirweg, Van Keer, Devos, & Vandevelde, 2018; Dignath, 2021; Karlen et al., 2020). Especially teachers' self-efficacy has been identified as an important predictor of the promotion of SRL (De Smul, Heirweg, Devos, & Van Keer, 2019). According to the expectancy and value theory (EVT), teachers are motivated to take action when they not only have a feeling of competence or expect success while teaching but also when they attribute value to teaching (Eccles & Wigfield, 2002). Therefore, in this study, we describe teachers' expectations and values as crucial aspects of teachers' motivation (Richardson et al., 2014).

Success expectations refer to an individual's beliefs about their

ability to successfully perform specific teaching tasks and are often operationalized and assessed as self-efficacy (Bandura, 1997). Teachers' self-efficacy beliefs are domain-specific and can vary between tasks and situations. Self-efficacy in SRL refers to teachers' beliefs about being competent enough to promote SRL (De Smul et al., 2018). Researchers have reported that teachers' self-efficacy in SRL is strongly related to their self-reported SRL practices (Chatzistamatiou, Dermitzaki, & Bagiatis, 2014; De Smul et al., 2019) and are an even stronger predictor than their knowledge about SRL (Dignath-van Ewijk, 2016). Teachers who seldom promote SRL report lower success expectations in stimulating it (Vandevelde, Vandebussche, & Van Keer, 2012).

Value refers to an individual's valuation of a task and contributes to whether they will choose to engage and persist in the task. As an important value, intrinsic interest value refers to the pleasure or expected pleasure that is experienced as a result of performing a task (Eccles & Wigfield, 2002). Intrinsic interest value focuses on enjoyment and interest in a specific activity. Regarding SRL, teachers' intrinsic interest value involves the pleasure they experience by promoting SRL (Hirt, Jud, Rosenthal, & Karlen, 2022). Theoretically, the higher teachers' intrinsic interest value is, the more one can expect teachers to promote SRL and metacognition (Perry & Rahim, 2011). A few researchers have examined this theoretical assumption and found a positive correlation between teachers' value and their self-reported promotion of SRL and metacognition (Chatzistamatiou et al., 2014; Hamman, 1998; Vandevelde et al., 2012). In a recent study, Hirt et al. (2022) found that besides teachers' self-efficacy, teachers' intrinsic interest value correlated positively with their self-reported promotion of SRL. By using a person-centred approach, the researchers identified three motivational teacher profiles (high costs profile, moderate profile, and high success expectations and task values profile). Teachers who fit the "high success expectation and value" profile reported promoting SRL most often. Therefore, based on previous literature, one can assume that teachers' values might be critical to explaining the variability in their promotion of SRL and metacognition.

2.5. The interplay of the different aspects of teacher competence

Combining several teachers' professional competence aspects is important for understanding possible variations in teachers' metacognitive practices more deeply. Based on theoretical assumptions, different aspects of teachers' competence in SRL can be expected to interact (Karlen et al., 2020).

Teachers' actions as agents of SRL might be influenced by their experiences as self-regulated learners (Dembo, 2001; Paris & Winograd, 2003). For example, teachers with higher SRL skills attribute a higher value to SRL and thus teach those skills more often to their students (Hamman, 1998). Moreover, Huang et al. (2020) reported that in-service teachers' metacognitive skills as learners positively related to their teaching motivation and led to improved adaptive instruction. Karlen et al. (2020) reported that teachers' own SRL correlates with their self-efficacy in promoting SRL. These results highlight the importance of how teachers' own SRL skills relate to their self-efficacy and valuation of promoting SRL. Those results also align with Banduras' (1997) suggestion that self-efficacy is determined by personal experiences of success or failure, whose interpretations are closely related to an individual's beliefs and values.

Regarding teachers' knowledge and beliefs, some researchers have suggested that they are not necessarily aligned (Spruce & Bol, 2015), whereas others found strong (e.g., Dignath, 2016) or low-to-moderate correlations (Dignath, 2021; Karlen et al., 2020). A similar picture has emerged concerning teachers' knowledge and self-efficacy to promote SRL. Some researchers have found a correlation between teachers' knowledge and self-efficacy in SRL (Dignath, 2016). In contrast, others have found no correlation between those two variables for SRL (Karlen et al., 2020) or other subjects (Backfisch et al., 2020).

Concerning teachers' motivation and beliefs, several researchers have reported a positive association between teachers' beliefs that are consistent with SRL and their self-efficacy to promote SRL (De Smul et al., 2019; Dignath, 2016; Karlen et al., 2020). Hirt et al. (2022) reported in their study that in-service teachers' growth mindsets about SRL positively correlated with their self-efficacy and valuation of promoting SRL. This result confirms the motivational power of mindsets for SRL as theoretically suggested by Dweck and Leggett (1988) and as empirically reported by other researchers (Burnette et al., 2013; Karlen et al., 2019).

EVT research highlights the positive relations between success expectancy beliefs and values (e.g. Perez et al., 2019). Chatzistamatiou et al. (2014) reported a positive link between primary school mathematics teachers' self-efficacy and their value of mathematics. However, there is little prior research in the field of SRL that has examined the interrelation between teachers' self-efficacy beliefs and their values. For example, Hirt et al. (2022) found that teachers' self-efficacy and intrinsic interest values were moderately positively aligned.

When focusing on teachers' beliefs and their SRL skills, Vosniadou et al. (2021) found a positive association between pre-service teachers' beliefs and their (metacognitive) strategy use. Moreover, Hertel and Karlen (2021) found in their study with pre-service teachers that their growth mindsets and beliefs about the relevance of SRL positively related to their mastery goal orientations, strategy use, and knowledge about SRL.

Altogether, reviewing the literature on teachers' competence in SRL suggests that the different aspects of teachers' competence – their own SRL skills, knowledge, beliefs, and motivation – interact to some extent. However, the empirical findings on the interplay between different competence aspects are inconsistent. This may be because the different teachers' competence aspects have been measured differently or been examined in different groups (e.g., pre- and in-service teachers) or because SRL and metacognition have been linked to different subjects (e.g., mathematics). Overall, further research is needed to explore the interplay of teachers' professional competence aspects in SRL. There is a lack of research that explicitly examines the significance of teachers' dual role as self-regulated learners and as agents of SRL for their classroom practices.

3. The present study: aims and hypotheses

This study aims to provide new insight into the interplay of teachers' professional competence aspects in SRL. While the importance of the dual competence role of teachers as self-regulated learners and as agents of SRL is recognized (Karlen et al., 2020; Kramarski, 2018), few researchers have examined the relevance of teachers' dual roles regarding the promotion of metacognition. Previous researchers have often investigated aspects of teacher competence separately. The investigation of how different aspects of teachers' competences affect their metacognitive practices can help improve the understanding of the teacher-level aspects that support or hinder the implementation of metacognition in class. This insight might provide new findings for concluding teachers' professional development.

The current study explores (1) the extent to which different teachers' competence aspects – especially between teachers as self-regulated learners and as agents – are related to each other. Furthermore, (2) this study examines the extent to which different teachers' professional competence aspects (own SRL skills,

knowledge, self-efficacy, intrinsic interest value) are related to their self-reported and students' perceived promotion of metacognition. The present study tests the following hypotheses.

(1) Evidence of the specific relationships between teachers' competences as self-regulated learners and as agents is still sparse, even though teachers' SRL skills as self-regulated learners might influence their competence development as agents (Dembo, 2001; Gordon et al., 2007). Teachers' own SRL skills are expected to relate positively to their self-efficacy (Hypothesis 1.1) and value (Hypothesis 1.2) as agents. As in-service teachers might build their knowledge on fragmented knowledge about SRL and metacognition as self-regulated learners (Glogger-Frey, Ampatziadis, et al., 2018; Spruce & Bol, 2015), it is unclear to what extent their own SRL skills are related to the PCK-SRL.
(2) Researchers reported that teachers' beliefs consistent with SRL are important for explaining differences in teachers' competence as self-regulated learners and as agents of SRL (Hertel & Karlen, 2021; Vosniadou et al., 2020). Teachers' mindsets about SRL are hypothesized to be positively related to their own SRL skills (Hypothesis 2.1), PCK-SRL (Hypothesis 2.2.), self-efficacy (Hypothesis 2.3), and value (Hypothesis 2.4).
(3) Literature showed that self-efficacy is related to teaching effort, the value of teaching, teachers' openness to new teaching methods, and the tendency to implement SRL and metacognitive practices in classrooms (De Smul et al., 2019; Dignath-; Perez et al., 2019; van Ewijk, 2016). Thus, teachers' self-efficacy is expected to relate positively to their values about promoting SRL (Hypotheses 3).
(4) Although the empirical findings are not entirely consistent, we expect all variables to predict teachers' self-reported and students' perceived promotion of metacognition. However, not all variables are assumed to affect the promotion of metacognition directly. Teachers' PCK-SRL (Hypothesis 4.1), self-efficacy (Hypothesis 4.2), and value (Hypothesis 4.3) are hypothesized to relate to the promotion of metacognition directly and positively. Teachers' own SRL skills (Hypothesis 4.4) and mindsets about SRL (Hypothesis 4.5) are expected to relate to the promotion of metacognition indirectly and positively via their PCK-SRL, self-efficacy, and value.

4. Methods

4.1. Participants

The school principals of several public schools from the German-speaking area of Switzerland were contacted via e-mail. Seventeen lower secondary schools across five states participated in this study. The schools were located in urban and rural areas and covered a broad range of school sizes (from 87 to 480 students). Teachers were encouraged by their principals to participate in this study. However, participation was voluntary, and teachers could withdraw at any time. In total, 280 subject and class teachers (and their classes) filled out the online questionnaire, corresponding to a high response rate of 92.1%.

In our sample, we only included class teachers as they have the main responsibility for monitoring and supporting their students' development. Those class teachers held an extracurricular lesson each week with their supervised classes. Furthermore, we wanted to connect teachers' self-reported promotion of metacognition with their students' perceived promotion of metacognition. Each class was connected to their class teacher. The students' perception of their teachers' instruction offers an additional and valid perspective on the promotion of metacognition since classroom learning is built from the perspectives of teachers and students (Herbert, Fischer, & Klieme, 2022).

The sample used for this study consisted of $N = 185$ class teachers (44.4% female and 55.6% male). On average, the teachers were $M = 44.34$ years old ($SD = 10.82$). The teachers' teaching experiences ranged from 1 to 44 years ($M = 17.78$ years; $SD = 11.54$), with 85.7% of teachers having at least 5 years of experience. All the teachers had a master's degree. The teachers taught classes in their first (35.1%), second (30.3%) or third (28.1%) years of lower secondary school. Out of all the teachers, 6.5% were multigrade teachers. In lower secondary schools, teachers usually teach several subjects. The teachers in our study mainly taught German (53%), mathematics (49.2%), science (28,1%), or a foreign language (17.8%).

4.2. Measures

Teachers' own SRL skills. Teachers' own self-regulation skills consist of four SRL subdimensions (metacognitive awareness, metacognitive, cognitive, and motivational regulation skills). All four subscales were introduced with the following statement: "In a teacher's daily routine, many different tasks must be completed. In addition to their everyday professional tasks, teachers also deal with new content and continuous learning (e.g., familiarizing themselves with a new teaching topic, further teacher training, etc.). The management of all these activities can be approached in different ways. In the following questions, we would, therefore, like to know how you approach your own learning."

Metacognitive awareness was assessed with a validated scale from Schraw and Dennison (1994) that included four items (example item: "I find myself using helpful learning strategies automatically."). This scale was used to assess the teachers' metacognitive awareness about applying strategies effectively (Cronbach's alpha = .796). The three regulation skills have been adapted from Karlen (2016b) that developed those scales for students (see the appendix for the items of those three subscales). Hirt, Karlen, Maag Merki, and Suter (2021) demonstrated that these three SRL skills relate to students' learning outcomes. These three scales comprise metacognitive regulation skills (five items; Cronbach's alpha = .837), cognitive regulation skills (four items; Cronbach's alpha = .849), and motivational regulation skills (four items; Cronbach's alpha = .919). These four subdimensions formed a scale used to represent teachers' awareness and metacognitive, cognitive, and motivational abilities to regulate their own learning.

First, exploratory factor analysis in Mplus (Muthén & Muthén, 1998-2017) with an ML procedure was run. The results revealed that all SRL subdimensions loaded to one overall factor. Second, a confirmatory factor analysis was run. We allowed one correlation between the item residual of metacognitive and cognitive regulation skills due to the wording similarities in the item stems. The analysis of all four SRL subdimensions loading to one factor revealed good model fit indices: χ^2 (1) = 0.704, $p = .402$, χ^2/df = 0.704, CFI = 1.000, TLI = 1.005, RMSEA = 0.000, and SRMR = 0.007. All the items demonstrated significant (all $p < .001$) and substantial loadings on the latent construct ($\beta \geq 0.610$ to $\beta \leq 0.969$).

Mindsets About SRL. A validated scale from Hertel and Karlen (2021) was used to assess the teachers' growth or fixed mindsets about SRL. The scale included three items that incorporated a six-fold scale (sample item: "Everyone has a certain ability to self-regulate their learning, and this … (1) cannot be changed to (6) can be changed."). Higher values represented stronger endorsements of a growth mindset about SRL.

Pedagogical Content Knowledge About SRL: PCK-SRL. We used a validated knowledge test developed by Karlen et al. (2020) to assess PCK-SRL. This test includes four scenarios that describe different situations that address the implementation of SRL in class. The first situation addresses fostering SRL within a class with some experience with SRL. The second situation asks about introducing students to a new learning strategy. The third situation relates to the fostering of metacognitive competencies in class. Finally, the fourth situation introduces learning journals to students. The test includes situations that promote different SRL skills. For each scenario, seven different action options were provided that varied in their degrees of effectiveness and appropriateness for the given situation. Each action option was developed based on existing theoretical and empirical findings about the promotion of SRL. The teachers had to rate the usefulness of each option after considering the scenario-specific initial conditions. Experts' judgments were used as an external benchmark for scoring the tests. They were also used to estimate the relative relationships between all the potential pairs of actions (pair comparison). A paired comparison was scored as correct if a teacher's individual judgment corresponded with the experts' ratings (1 point) and incorrect if a judgment on a paired comparison contrasted the experts' ratings (0 points). The test score represented an overall mean score that ranged from 0 (no pair comparisons solved correctly; low PCK-SRL) to 1 (all pair comparisons solved correctly; high PCK-SRL).

Self-Efficacy for Promoting SRL. We used a scale developed by De Smul et al. (2018). Due to economic reasons, we selected four items out of the original scale of seven items. The four items were used to assess the teachers' self-efficacy regarding promoting strategies (example item: "How well can you encourage your students to use self-regulated learning strategies [for instance, by asking open-ended questions]?").

Intrinsic Interest Value. The teachers' intrinsic interest value regarding the promotion of SRL was assessed with a validated scale (Jud et al., 2023; Hirt et al., 2022). This scale was used to capture teachers' pleasure or expected pleasure that resulted from the promotion of SRL. The scale consists of three items (example item: "I enjoy the promotion of competencies in self-regulated learning.").

Teachers' Self-Reported Promotion of Metacognition. To assess teachers' self-reported promotion of metacognition, we developed a new scale (see the appendix for all the items). The instrument was developed based on a literature review, expert review, and pilot testing to ensure content validity. The item pool was constructed using available literature on the promotion of metacognition. The items include direct and indirect approaches to promoting and activating students' metacognitive skills (Veenman et al., 2006). The participants who took part in the pilot testing were asked to review the items in terms of clarity, potential ambiguity, and bias. The scale consists of five items that cover various instructional practices for promoting metacognition in everyday classrooms. Concerning convergent and discriminant validity, the scale was, as expected, not correlated to teachers' genders, teaching experiences, or teaching-grade levels. The results of the exploratory factor analysis in Mplus (Muthén & Muthén, 1998-2017) revealed that all the items were loaded to one overall factor. The confirmatory analysis revealed good model fit indices: χ^2 (5) = 9.990, p = .076, χ^2/df = 1.998, CFI = 0.978, TLI = 0.957, RMSEA = 0.073, and SRMR = 0.032. All the items demonstrated significant (all $p < .001$) and substantial loadings on the latent construct ($\beta \geq 0.548$ to $\beta \leq 0.795$).

Students' Perceived Promotion of Metacognition. To assess the students' perceived promotion of metacognition, we developed a new scale with five items (see the appendix for all the items). The items correspond to the items that the teachers were presented with to assess their self-reported promotion of metacognition. Students who attend the same classes have a shared perception of the instructional activities of their teachers. Combining students' perceptions as an aggregated perception of a teacher/class level ensures a high density of information (Lüdtke, Robitzsch, Trautwein, & Kunter, 2009). There was substantial classroom-level variance (ICC [1] = 0.24), which indicated that 24% of the total variation found in the student ratings could be attributed to the fact that the students were nested in classes. The ICC(2) value (0.82) revealed acceptable levels of reliability on the teacher/class level. The confirmatory analysis on the students' level with two allowed correlations between item residuals revealed good model fit indices: χ^2 (3) = 4.250, p =.236, χ^2/df = 1.417, CFI = 1.000, TLI = 0.997, RMSEA = 0.011, and SRMR = 0.006. All the items demonstrated significant (all $p < .001$) and substantial loadings ($\beta \geq 0.551$ to $\beta \leq 0.826$) on the latent construct. Individual students' perceptions of their teachers' promotion of metacognition were aggregated on each teacher's level and used for the analyses in this study.

4.3. Analyses

The data were analyzed using descriptive and correlational analyses with SPSS Version 26 and Mplus 8.2 (Muthén & Muthén, 1998-2017). We applied the full information likelihood method (FIML) to include all the available information to estimate the models. The average rate of missing values per item was 3.41% (range: 0.0%–8.09%). The maximum likelihood estimator with standard errors (MLR) was used to ensure robustness with non-normality. Several model fit indicators were used to interpret the quality of the models (Schermelleh-Engel, Moosbrugger, & Müller, 2003). A good model fit is indicated by comparative fit index (CFI; a revised form of normed-fit index) value greater than 0.95, Tucker Lewis index (TLI; non-normed fit index) value greater than 0.95, root mean square error of approximation (RMSEA; index of the difference between the observed covariance matrix per degree of freedom and the hypothesized covariance matrix) value $\leq$ 0.05, and standardized root mean square (SRMR; index of the average of standardized residuals between the observed and the hypothesized covariance matrices) value $\leq$ 0.05. As the χ^2 test is sensitive to sample size and usually exhibits significant results in larger samples, we applied the χ^2/df ratio, in which small ratios ($\leq$ 3) reflect a good fit. To compare different models the Satorra-Bentler scaled chi-square difference test was applied (Satorra & Bentler, 2001). Further, the Akaike information criterion (AIC) and Bayesian information criterion (BIC) were used as additional indicators for the model comparisons, where a smaller number indicates a better model fit. A bias-corrected bootstrapping procedure with 10,000 iterations was used to estimate and validate the indirect effects (MacKinnon, Lockwood, & Williams, 2004). Since bootstrapping is not yet available for MLR estimation in Mplus, the maximum likelihood (ML) was used to estimate the indirect effects.

5. Results

5.1. Descriptive statistics

The internal consistencies, means, standard deviations, and ranges for all the scales and their intercorrelations are displayed in Table 1. All the scales demonstrated satisfying to good internal consistencies with values from Cronbach's alpha 0.75 to 0.93. Overall, the correlational analysis indicated weak to moderate correlations between the variables.

Table 1
Descriptive statistics of all constructs and their intercorrelations.

Variables	1	2	3	4	5	6	7	8
1. Teaching experience	–							
2. Own SRL skills	0.00	–						
3. Mindsets about SRL	−0.06	0.30***	–					
4. PCK-SRL	−0.11	0.08	0.22**	–				
5. Self-efficacy	−0.03	0.49***	0.17*	−0.05	–			
6. Intrinsic interest value	0.00	0.27***	0.34***	0.15*	0.47***	–		
7. Teachers' self-reported promotion of metacognition	0.10	0.17*	0.13†	0.04	0.46***	0.46***	–	
8. Students' perceived promotion of metacognition	0.02	0.17*	0.06	0.14*	0.27***	0.18*	0.27***	–
Cronbach's Alpha	–	0.87	0.79	0.85	0.75	0.93	0.81	0.79
n	185	181	180	185	179	170	185	182
M	17.78	4.76	5.20	0.67	4.12	4.26	2.06	2.46
SD	11.54	0.56	0.66	0.19	0.70	0.92	0.53	0.37
Observed range	1–44	3.56–6.00	3.00–6.00	0.09–0.97	2.25–6.00	1.67–6.00	1.00–3.80	1.39–3.20
Possible range	1–44	1–6	1–6	0–1	1–6	1–6	1–4	1–4

Note. †$p < .10$. *p < .05. **p < .01. ***p < .001.

5.2. Linear Structural Equation Model

Structural equation analyses were conducted to examine the relationship between teachers' professional competence aspects in SRL and the promotion of metacognition. We assumed knowledge, self-efficacy, and intrinsic interest values to predict the promotion of metacognition directly. Furthermore, we expected teachers' own SRL skills and their mindsets about SRL to indirectly relate to the promotion of metacognition via teachers' knowledge, self-efficacy, and intrinsic interest values. However, as the evidence about the investigated constructs allowed for several theoretical assumptions, we tested different models and compared their model fit indices, as summarized in Table 2. Comparing models 4 and 5, the chi-square difference test was not significant. However, model 5 (see Fig. 1) demonstrated slightly better fit indices than model 4.

As illustrated in Fig. 1, the analyses indicated positive associations between the teachers' own SRL skills and their self-efficacy ($\beta = 0.51$, $SE = 0.092$, $p < .001$) and their intrinsic interest value ($\beta = 0.15$, $SE = 0.082$, $p = .038$) but not with their PCK-SRL. As expected, the analyses revealed a positive association between the teachers' mindsets about SRL and their own SRL skills ($\beta = 0.35$, $SE = 0.092$, $p < .001$). Furthermore, the teachers' mindsets about SRL were positively related to their PCK-SRL ($\beta = 0.27$, $SE = 0.090$, $p = .003$) and their intrinsic interest value ($\beta = 0.36$, $SE = 0.088$, $p < .001$).

By focusing on the hypothesized direct associations between teachers' competences and the reported promotion of metacognition, the analysis revealed a positive association between PCK-SRL and students' perceived promotion of metacognition ($\beta = 0.15$, $SE = 0.075$, $p = .049$). The teachers' self-efficacy was related to both teachers' self-reported promotion of metacognition ($\beta = 0.42$, $SE = 0.108$, $p < .001$) and students' perceived promotion of metacognition ($\beta = 0.28$, $SE = 0.089$, $p = .002$). Finally, the teachers' intrinsic interest value was positively associated with teachers' self-reported promotion of metacognition ($\beta = 0.26$, $SE = 0.107$, $p = .015$) but not with their students' perceived promotion of metacognition. This model (see Fig. 1) explained a significant proportion of variance in the dependent variables that the independent variables explain collectively. Model 5 (see Fig. 1) explained significant amounts of variance in teachers' self-reported promotion of metacognition ($R^2 = 0.37$, $p < .001$) and students' perceived promotion of metacognition ($R^2 = 0.11$, $p < .05$).

5.3. Indirect effects of teachers' professional competences on the promotion of metacognition

The indirect effects analyses are reported in Table 3 and are based on our final model, illustrated in Fig. 1. Out of all the tested indirect effects, a few associations were significant (see bold values in Table 3). The estimated effect sizes were small to moderate. The teachers' own SRL skills were significantly positively related to their self-reported promotion of metacognition and students' perceived promotion of metacognition via their self-efficacy. Furthermore, the teachers' mindsets about SRL were positively related to their self-reported promotion of metacognition via their intrinsic interest value as well as via their own SRL skills and self-efficacy. Finally,

Table 2
The goodness of the fit indices of the compared models.

Model	Type	χ2	df	χ2/df	CFI	TLI	RMSEA	SRMR	AIC	BIC	TRd/ Δdf
Model 1	Measurement model	249.575	180	1.387	0.959	0.952	0.045	0.076	6447.159	6679.799	–
Model 2	All professional competence aspects directly predict teachers' promotion	225.513	173	1.477	0.969	0.962	0.040	0.057	6511.965	6760.347	22.654 (7)**
Model 3	All professional competence aspects directly predict teachers' promotion; self-efficacy is predicted by teachers' own SRL skills, PCK-SRL, and mindsets	220.970	172	1.515	0.971	0.964	0.039	0.058	6509.566	6761.174	4.852 (1)*
Model 4	All professional competence aspects directly predict teachers' promotion; self-efficacy, value, and PCK-SRL are predicted by teachers' own SRL skills and mindsets	215.767	171	1.262	0.973	0.967	0.037	0.051	6430.937	6692.657	6.339 (1)*
Model 5	Some professional competence aspects directly predict teachers' promotion; self-efficacy, value, and PCK-SRL are predicted by teachers' own SRL skills and mindsets; mindsets predict teachers' own SRL skills	216.256	175	1.236	0.975	0.971	0.036	0.052	6424.358	6673.154	−1.211 (4)

Note. CFI = comparative fit index; TLI = Tucker-Lewis Index; RMSEA = root mean square error of approximation; SRMR = standardized root mean squared residual; AIC = Akaike information criterion; BIC = Bayesian information criterion; *p*-values are calculated based on the Satorra-Bentler scaled chi-square difference tests.

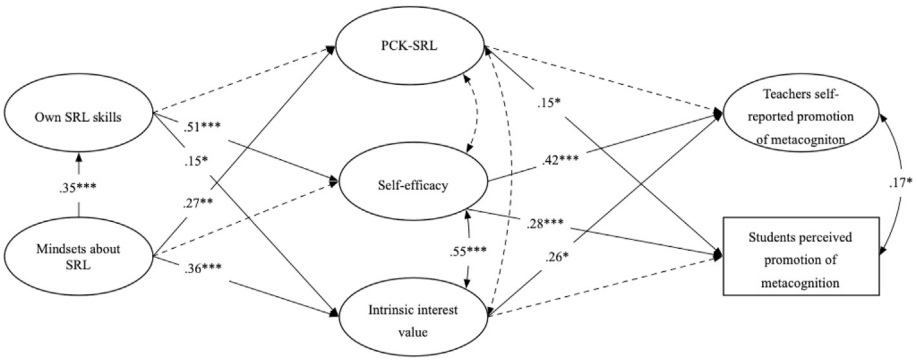

Fig. 1. Standardized Estimated Coefficients of the Linear Structural Equation Model of Teachers' Professional Competences in SRL and the Promotion of Metacognition
Note. Continuous lines represent significant relations, and dashed lines represent insignificant relations. $p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table 3
Standardized results of indirect effects testing.

Hypothesized effects	Observed effects			
	Estimates	SE	95% CI	
			LL	UL
SRL skills > TMeta				
Total effects SRL skills > TMeta	0.251	0.069	0.115	0.387
Total indirect SRL skills > TMeta	0.251	0.069	0.115	0.387
SRL skills > PCK-SRL > TMeta	0.000	0.005	−0.011	0.011
SRL skills > SE > TMeta	0.214	0.069	0.079	0.348
SRL skills > Value > TMeta	0.038	0.028	−0.018	0.093
SRL skills > SMeta				
Total effects SRL skills > SMeta	0.144	0.051	0.043	0.244
Total indirect SRL skills > SMeta	0.144	0.051	0.043	0.244
SRL skills > PCK-SRL > SMeta	−0.005	0.011	−0.029	0.022
SRL skills > SE > SMeta	0.143	0.058	0.030	0.256
SRL skills > Value > SMeta	0.006	0.018	−0.029	0.040
Mindsets > TMeta				
Total effects Mindsets > TMeta	0.204	0.055	0.097	0.312
Total indirect Mindsets > TMeta	0.204	0.055	0.097	0.312
Mindsets > PCK-SRL > TMeta	0.007	0.018	−0.028	0.042
Mindsets > SE > TMeta	0.014	0.044	−0.073	0.101
Mindsets > Value > TMeta	0.096	0.045	0.007	0.185
Mindsets > SRL skills > PCK-SRL > TMeta	0.000	0.002	−0.004	0.004
Mindsets > SRL skills > SE > TMeta	0.075	0.034	0.008	0.141
Mindsets > SRL skills > Value > TMeta	0.013	0.011	−0.009	0.035
Mindsets > SMeta				
Total effects Mindsets > SMeta	0.113	0.040	0.034	0.191
Total indirect Mindsets > SMeta	0.113	0.040	0.034	0.191
Mindsets > PCK-SRL > SMeta	0.038	0.024	−0.008	0.085
Mindsets > SE > SMeta	0.009	0.032	−0.053	0.072
Mindsets > Value > SMeta	0.014	0.037	−0.057	0.086
Mindsets > SRL skills > PCK-SRL > SMeta	−0.002	0.005	−0.011	0.007
Mindsets > SRL skills > SE > SMeta	0.050	0.027	−0.003	0.103
Mindsets > SRL skills > Value > SMeta	0.002	0.007	−0.011	0.015
Hypothesized effects	Observed effects			
	Estimates	SE	95% CI	
			LL	*UL*
Mindsets > SE				
Total effects Mindsets > SE	0.215	0.094	0.032	0.399
Total indirect Mindsets > SE	0.181	0.066	0.052	0.310
Mindsets > SRL skills > SE	**0.181**	**0.066**	**0.052**	**0.310**
Mindsets > Value				
Total effects Mindsets > Value	0.411	0.078	0.258	0.564
Total indirect Mindsets > Value	0.050	0.033	−0.016	0.115
Mindsets > SRL skills > Value	0.050	0.033	−0.016	0.115

Note. SRL skills = teachers' own SRL skills; SE = self-efficacy; Value = intrinsic interest value; TMeta = teachers' self-reported promotion of metacognition; SMeta = students' perceived promotion of metacognition.
CI = confidence interval; LL = lower limit; UL = upper limit.
The bold print represents significant indirect estimates.

teachers' mindsets were positively related to their self-efficacy about promoting SRL via their own SRL skills.

6. Discussion

Metacognition is an essential component of SRL and is highly relevant to students' success in school and beyond. Teachers play a significant role in helping students become metacognitively involved self-regulated learners. However, researchers have reported wide heterogeneity in teachers' promotion of SRL and metacognition (Bolhuis & Voeten, 2001; Dignath & Büttner, 2018; Spruce & Bol, 2015; Zohar & Lustov, 2018). Teachers' professional competences play a significant role in explaining the differences in teachers' classroom practices. In the context of SRL and metacognition, several researchers have highlighted the importance of teachers' competence as self-regulated learners and as agents of SRL (Bembenutty et al., 2015; Karlen et al., 2020). Other researchers have focused primarily on teachers as agents of SRL (e.g., Bolhuis & Voeten, 2001; Dignath & Büttner, 2018). This study expands prior research by including competence aspects of teachers as self-regulated learners and agents and by examining the interrelations between them and their relation to teachers' self-reported and students' perceived promotion of metacognition.

6.1. The relations among teachers' competences as self-regulated learners and as agents

The first research question was used to investigate how teachers' competence as self-regulated learners relates to their competence aspects as agents of SRL. As expected, the teachers who reported being better self-regulated learners were likelier to report higher self-efficacy and intrinsic interest value, which confirmed Hypotheses 1.1. And 1.2. These results are consistent with prior research highlighting the importance of teachers' own SRL skills for their expertise as agents of SRL and metacognition (Gordon et al., 2007; Karlen et al., 2020; Kramarski & Michalsky, 2009; Vandevelde et al., 2012). This finding is also consistent with the theoretical assumption about EVT, which posits that previous experiences (in this case of SRL learners) can positively relate to expectations of success and values (Eccles & Wigfield, 2002).

The teachers' own SRL skills did not relate to their PCK-SRL. One's own SRL skills may be primarily reflected in CK-SRL and not PCK-SRL as previous experiences as learners do not include knowledge about how to instruct others about SRL and metacognition. This assumption would have to be carefully examined in future studies. The non-significant correlation might also be explained by the fact that teachers may use strategies but only have fragmented and poorly organized knowledge about certain strategies (Glogger-Frey, Ampatziadis, et al., 2018). Without relevant and correct knowledge about strategies, teachers might teach ineffective strategies. For this reason, future researchers might want to explicitly assess teachers' metacognitive knowledge about strategies as an essential aspect of their own SRL skills. Finally, asking teachers about the justification of their strategies as learners could provide additional insight into teachers' metacognitive awareness and associated understanding of the effectiveness of different strategies (Granström et al., 2022). It would be interesting for future researchers to analyze how teachers apply their metacognitive knowledge about strategies in their practices to promote SRL and metacognition. As self-regulated learners, teachers have the necessary skills to regulate their own pedagogical practices for teaching SRL and metacognition (Kramarski & Heaysman, 2021). It would thus also be interesting to combine different types of knowledge and teachers' strategies to implement SRL and metacognition in their classrooms.

6.2. The relations between teachers' mindsets about SRL and own SRL skills, knowledge, self-efficacy, and value

We expanded previous work on beliefs and SRL by examining a possible relationship between mindsets about SRL and in-service teachers' own SRL skills. Analogous to the findings reported by Hertel and Karlen (2021) and Vosniadou et al. (2021) regarding pre-service teachers, in our study, in-service teachers' mindsets about SRL also positively related to their own SRL skills, which confirms Hypothesis 2.1. This result is in line with the assumption that mindsets about SRL support engagement and persistence in SRL (Burnette et al., 2013). Engagement in SRL and metacognitive processes can be strenuous and require an adaptive way of dealing with difficulties. For example, learners' use of strategies in the face of challenges is based on the belief that these strategies are necessary for learning, present an effective way of overcoming obstacles, and can be developed. Thus, learners with growth mindsets more frequently engage in SRL and metacognitive processes and thus might gain more experience and knowledge about SRL than learners with fixed mindsets (e.g., Burnette et al., 2013; Hertel & Karlen, 2021). For this reason, it is also not surprising that in this study, teachers' mindsets about SRL positively related to their PCK-SRL, which confirms Hypothesis 2.2.

We found somewhat inconsistent results concerning the motivational power of mindsets. The teachers' mindsets about SRL were indirectly related to their self-efficacy via their own SRL skills instead of directly related (Hypothesis 2.3). However, teachers with growth mindsets about SRL reported higher intrinsic interest value, which confirms Hypothesis 2.4. This result is consistent with prior research on mindsets, which demonstrates that individuals with growth mindsets tend to devote increased effort and value to demanding tasks (Burnette et al., 2013; Karlen et al., 2019). Mindsets create a system of meaning that affects how teachers approach challenging teaching situations. This is important as teaching SRL and metacognition can be demanding and is accompanied by supporting students' transfer of metacognitive skills across various school subjects (Hirt et al., 2022; Stebner et al., 2022). Teachers with growth mindsets understand failures as feedback on their teaching skills, which may not yet be sufficiently developed. Thus, failures to promote SRL and metacognition might not impact teachers' self-efficacy and value. Moreover, teachers with growth mindsets might be more motivated since the possibility of developing their and students' abilities increases the expectation of success and the value of the task (Dweck & Leggett, 1988). Altogether, this study highlights the importance of examining teachers' mindsets about SRL. However, we agree with Vosniadou et al. (2020) that it might be beneficial to examine beliefs not as isolated units but as being connected to other beliefs. This could be an important next step for future studies.

6.3. The relations between teachers' self-efficacy and intrinsic interest value

Motivation is an essential prerequisite for teachers' instructional practices. Previous researchers have demonstrated that teachers' self-efficacy is one of the most influential predictors of the promotion of SRL and metacognition (Dignath, 2021). However, several researchers have also highlighted the multi-dimensionality of motivation as several motivational variables, such as success expectations and values, interact with each other (Eccles & Wigfield,

2002). According to EVT, individuals are motivated when they value a task and expect to solve it successfully (Eccles & Wigfield, 2002). For this study, we focused on teachers' success expectations (self-efficacy) and values (intrinsic interest value) about promoting SRL and metacognition and expected those two variables to be correlated (Hypothesis 3). In confirming our third hypothesis, we found a positive correlation between teachers' self-efficacy and intrinsic interest value. Teachers who feel more competent in promoting SRL and metacognition also assign more value. This result is in line with the findings of Hirt et al. (2022) regarding teachers' motivation using a person-centred approach. They found that teachers in the profile with higher self-efficacy and value reported promoting SRL more often than those with lower self-efficacy and lower value but higher perceived costs. It might be interesting for future researchers to look deeper into the interplay and possible interaction effects of different teachers' motivational competences. To understand why teachers do or do not promote SRL or metacognition, it may be important to interlink EVT and SRL further.

6.4. Teachers' dual role and the promotion of metacognition

The results of our study revealed differences between teachers concerning the promotion of metacognition, which underlines the relevance of the second aim of this study – namely, exploring which competence aspects influence teachers' implementation of metacognition. We expected (Hypotheses 4.1–4.3) to find direct positive correlations between teachers' PCK-SRL, self-efficacy, intrinsic interest value, and the promotion of metacognition, which mainly were confirmed. While the teachers' PCK-SRL did not exhibit a positive correlation with their self-reported promotion of metacognition, it did share a positive relationship with the students' perceived promotion of metacognition. This finding is in line with previous research, which states that teachers' knowledge is not consistently aligned with their practices (Clift et al., 1990; Spruce and Bol, 2015). One possible explanation could be that it is not a question of quantity but quality. Teachers with higher PCK-SRL do not promote metacognition more often than other teachers, but their actions might be of higher quality, which in turn is more likely to be perceived by the students. Even though it is challenging for teachers to translate knowledge into meaningful practices (Zohar & Ben-Ari, 2022), their PCK-SRL might support instructional actions that lead to different perceptions of the promotion of metacognition among their students. To verify this assumption, linking teachers' PCK-SRL to their actual videotaped or observed classroom actions would be necessary.

As expected, the teachers' motivational competence aspects positively related to promoting metacognition. Self-efficacy positively correlated with teachers' self-reported and students' perceived promotion of metacognition. This result confirms previous findings, demonstrating that self-efficacy is one of the most powerful predictors of teachers' promotion of SRL and metacognition (Chatzistamatiou et al., 2014; De Smul et al., 2019; Dignath-van Ewijk, 2016). According to prior research (Vandevelde et al., 2012), teachers who acknowledge the value of SRL are more responsive to promoting metacognition. This finding also follows the EVT as individuals tend to engage in tasks they value (Eccles & Wigfield, 2002). Considering the results of both motivational variables (see Table 1), we found that not all the teachers were fully convinced of the value of SRL or felt self-efficacious enough to promote SRL and metacognition. This finding confirms previous results that some teachers might value SRL but do not simultaneously feel able to support their students (Dignath-van Ewijk, 2016; Perry et al., 2008). For future studies, it might be essential to gain more insight into motivational determinants that stimulate or hamper the implementation of metacognition in classrooms.

Finally, we examined the possible indirect effects of teachers' own SRL skills and mindsets about SRL in relation to promoting metacognition via PCK-SRL, self-efficacy, and value. The results revealed a few significant indirect effects that only partially confirm Hypotheses 4.4 and 4.5. Teachers with higher SRL skills are more inclined to implement metacognition in their classes because they feel more self-efficacious about promoting it. Analogous to findings reported by Gordon et al. (2007) and Hamman (1998), these results emphasize the importance of teachers' SRL skills in promoting metacognition. Teachers need to be capable of self-regulating their own learning; otherwise, it might be difficult for them to be role models and develop these skills among their students (Vandevelde et al., 2012). Teachers' learning approaches might help them understand what strategies they should promote and how often they should promote them in their classrooms. If teachers do not regularly approach their own learning in a self-regulated manner, they are less likely to encourage their students to approach tasks similarly (Hamman, 1998). These results highlight the importance of taking teachers' dual roles as learners and agents into account when studying determinants that influence metacognitive practices (Dembo, 2001; Kramarski & Michalsky, 2009). Due to the parallels between teachers' and students' SRL, future researchers could explore the possibility of transfer effects between teachers' SRL skills and students' development in SRL and metacognition.

In the context of SRL, few researchers have investigated teachers' growth mindsets and their role in teachers' classroom behaviour. We found that self-regulated teachers who exhibited growth mindsets about SRL became teachers who promoted metacognition more often as they reported higher value and self-efficacy. The positive relationship between mindsets about SRL and teachers' implementation of metacognition is in line with the findings of researchers who have reported that teachers' beliefs influence their practices (e.g., Lawson et al., 2019; Yu et al., 2022). A growth mindset is a belief that is consistent with the key assumptions of SRL and aims to improve teachers' teaching and help them master their teaching challenges and value the importance of teaching metacognition (Vandevelde et al., 2012; Vosniadou et al., 2020). The current results suggest that implementing metacognitive practices will be more successful if teachers hold growth mindsets about SRL as this aligns with the assumptions that metacognition can be developed and supported (Hertel & Karlen, 2021). In turn, these practices likely contribute to students' SRL and metacognitive development. For example, teachers' beliefs can support students' strategy development (Heirweg, De Smul, Merchie, Devos, & Van Keer, 2021). Simultaneously, we know that a student's growth mindset about SRL relates to their strategy use and metacognitive knowledge about strategies (Hertel & Karlen, 2021). For future studies, it would be interesting to link teachers' mindsets about SRL to their students' mindsets and strategy use.

6.5. Practical implications

The results emphasize the importance of teachers' dual roles as self-regulated learners and agents of SRL in promoting metacognition. Thus, in (intervention) research, it appears crucial to focus on supporting teachers' knowledge, beliefs, values, and self-efficacy in relation to promoting metacognition and explicitly addressing teachers' SRL skills. The need for effective professional development (PD) programs has been discussed by Desimone (2009), who defined several characteristics of effective PD, such as the specificity of content, active involvement, sufficient duration, and the

explicitness of SRL strategic instruction. Additionally, researchers have demonstrated that it is important to provide teachers with knowledge about SRL and to support their motivation and value to implement strategy instruction in the classroom through pre-structured lesson plans, exercises for students, and checklists (e.g. Heaysman & Kramarski, 2022). Furthermore, some researchers have found positive teacher development with a more situated approach based on collaborative learning between scientists and teachers (e.g., Perry et al., 2008). Our findings provide further ideas for PD training in the field of SRL.

First, PD may need to support teachers in developing their own SRL skills. This development could be facilitated through coaching phases that focus on the observation and emulation of strategy use and allow teachers to try out the exercises for the students themselves or by explicitly encouraging an exchange of experiences about one's own learning (e.g., during a PD training session). Second, teachers' beliefs should be addressed in PD. In line with conceptual change research, change in teachers' mindsets can be achieved by making beliefs explicit and focusing on them during discussions and reflections on learning (Vosniadou et al., 2020). Moreover, instructors could give teachers growth-oriented feedback, explain how to promote growth mindsets in the classroom, and explicitly reflect teachers' mindsets with the exercises that are meant for students. Third, the current study supports teachers' development of PCK. Teachers might need to learn and experience various methods for promoting SRL and metacognition (Dignath & Veenman, 2021) – for example, through videotaped simulation examples, exemplary lesson plans, and the collaborative creation of powerful learning environments (Heaysman & Kramarski, 2022). Fourth, supporting teachers' self-efficacy can be realized in collaborative learning settings where teachers meet as members of a learning community (scientists and teachers). Within the learning community teachers talk about what they consider difficult and receive growth-oriented feedback and first-hand coaching to support their self-efficacy (Perry et al., 2008). Fifth, to increase teachers' value of the promotion of metacognition, value-supporting strategies should be addressed such as supporting successful teaching experiences, giving concrete examples about the benefit of promoting metacognition, and supporting the exchange of experiences with other teachers. Teachers could also be made aware that SRL improves students' performance and achievement in school and beyond. It could also be important to lower the perceived cost of promoting metacognition by providing teaching materials and showing teachers how to integrate SRL and metacognition into regular classroom instruction. Overall, complex learning processes require time to develop. Therefore, it might be important to give teachers enough time to develop their competence as self-regulated learners and as agents of SRL.

6.6. Limitations

Different limitations need to be acknowledged. First, although the model was built based on empirical and theoretical assumptions about the relationships between the studied variables, it is nevertheless based on cross-sectional data, which is why making causal inferences is impossible. Second, as some researchers have indicated that teachers from different school levels (e.g., primary vs. secondary) might promote metacognition differently (Dignath & Büttner, 2018; Spruce & Bol, 2015), it remains unclear whether the results can be generalized. Third, mainly self-reporting instruments were used besides the knowledge test to assess teachers' PCK-SRL. Self-reporting has several disadvantages; for example, it is limited to assessing processes accessible to consciousness and might be subject to social desirability. However, questionnaires are objective and valid approaches for assessing SRL as they are standardized in implementation and interpretation (Dörrenbächer-Ulrich, Weißenfels, Russer, & Perels, 2021). Furthermore, questionnaires remain important for any fine-grained assessment of motivation, beliefs, strategy use, and metacognition during learning and teaching (Pekrun, 2021). For further research on SRL and metacognition, it might be essential to improve the psychometric quality of self-reporting methods (e.g., through context- and task-related assessments) to consider a broad range of different variants of self-reporting. Furthermore, researchers have demonstrated that self-reporting instruments often follow the idea of a maximum view ("the more, the better"). However, including a quality perspective ("the better the fit, the better") could be more appropriate (Dörrenbächer-Ulrich et al., 2021). PCK-SRL was assessed with a scenario-based approach that followed this qualitative perspective. Such a knowledge test consists of several scenarios that relate to a specific domain (e.g., promoting metacognition). The instrument used contains a range of four different scenarios about promoting SRL and metacognition and is simultaneously limited to those four situations. For this reason, we have not been able to assess teachers' comprehensive PCK-SRL concerning various direct and indirect promotion possibilities. The test could and should be expanded to include further scenarios about promoting SRL and metacognition to capture the knowledge more broadly.

We assessed teachers' promotion of metacognition by using self-reports. Real-time methods, such as the recording of school lessons, would add value. Although this study cannot provide data about teachers' actual classroom behaviours, our results highlight that students' perceived promotion can add a different perspective (e.g., Herbert et al., 2022). All instruments offer benefits and shortcomings, whereas combining different approaches could help balance one instrument's weaknesses with others' strengths.

Finally, we focused on the teacher level. Other researchers have reported that the school-level and student-level factors might also influence teachers' practices (Heirweg et al., 2021). Most SRL and metacognition research investigates these relationships at one level. Thus far, few studies have provided insight into the complex interactions of the variables at many levels (e.g. De Smul et al., 2019). Thus, a further important step for future researchers might be to bridge the gap between school-, teacher-, and student-level determinants by studying their complex interplay (for example, by connecting teachers' promotion of metacognition to students' metacognitive skills).

7. Conclusion

In the last few years, an essential advancement in research on teachers' professional competences in SRL has been the distinction between teachers' competences as self-regulated learners and as agents of SRL. However, previous studies have mainly examined the importance of teachers' competences as agents of SRL. So far, teachers' competences as self-regulated learners have rarely been considered. The results of this study emphasize the importance of teachers' dual roles as self-regulated learners and as agents of SRL, which confirms theoretical models of teachers' professional competences in SRL (Karlen et al., 2020; Kramarski & Heaysman, 2021). To become effective in teaching metacognition teachers should also become successful self-regulated learners themselves. Their experiences and skills as self-regulated learners might guide their future professional competences as agents of SRL and, through them, influence their SRL instruction in classrooms. Previous theoretical

models have related these two competence areas, however without explicitly assuming that teachers' own experiences as a learner might be a prerequisite of their competences as agents. This could be a starting point for further research that uses longitudinal studies to examine how the two competence areas relate to each other and whether the development of teachers' competences as self-regulated learners goes hand in hand with the development of their competences as agents. Further, this study revealed the importance of teachers' expectancies and values concerning the promotion of metacognition. Thus far, research on teachers' values and costs regarding the promotion of metacognition is limited (e.g. Hamman, 1998; Hirt et al., 2022). It might be fruitful for future researchers to merge the expectancy-value theory with SRL more strongly and to explore the interactions and effects of various motivational aspects regarding teachers' promotion of SRL and metacognition. In future research on teachers' professional competences in SRL, it might be necessary to take greater account of the fact that different areas of knowledge, motivation, experience, and beliefs come together. Overall, such research could help differentiate existing models and gain relevant insights into factors that influence teachers' actions during class.

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Data availability

Data will be made available on request.

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Appendix

Table A1
Teachers' Self-Regulation Skills: Metacognitive, cognitive, and motivational regulation skills

Items in English	Items in German
Metacognitive regulation skills	
I can judge well my own level of learning.	Ich kann meinen eigenen Lernstand gut beurteilen.
I can make a good judgment of whether I am achieving my goals with the approaches I have chosen.	Ich kann gut einschätzen, ob ich mit den gewählten Vorgehensweisen meine Ziele erreiche.
I can judge well which changes to my approach might be useful.	Ich kann gut einschätzen, welche Änderungen an meinem Vorgehen sinnvoll sein könnten.
I can judge well whether I am on the right track.	Ich kann gut beurteilen, ob ich jeweils auf dem richtigen Weg bin.
I can judge well which strategies I have to use to achieve my goals.	Ich kann gut beurteilen, welche Strategien ich einsetzen muss, um meine Ziele zu erreichen.
Cognitive regulation skills	
I can successfully establish relationships and links between different content.	Ich kann erfolgreich Beziehungen und Verknüpfungen zwischen unterschiedlichen Inhalten herstellen.
I am good at reducing extensive topics to the essentials.	Ich kann umfangreiche Themengebiete gut auf das Wesentliche reduzieren.
I can relate the most important points from different topics to each other.	Ich kann aus verschiedenen Themengebieten die wichtigsten Punkte logisch aufeinander beziehen.
I can link new information well with what I already know.	Ich kann neue Informationen gut mit mir schon bekanntem Wissen verknüpfen.
Motivational regulation skills	
When my stamina for learning wanes, I can still motivate myself to learn again.	Wenn mein Durchhaltevermögen beim Lernen nachlässt, kann ich mich trotzdem wieder für das Lernen motivieren.
When learning becomes tedious, I find ways to motivate myself to continue learning.	Wenn das Lernen mühsam wird, finde ich Wege, wie ich mich für das Weiterlernen motivieren kann.
When my motivation wanes, I can influence myself in a positive way.	Wenn meine Motivation nachlässt, kann ich diese positiv beeinflussen.
I can start learning even though I would rather be doing something else.	Ich kann das Lernen auch dann in Angriff nehmen, wenn ich lieber etwas Anderes machen möchte.

Note. 1 = does not apply at all to 6 = fully applies.

Table A2
Teachers' Self-Reported Promotion of Metacognition

Items in English	Items in German
In my classes, I specifically encourage students to observe and reflect on their learning.	In meinem Unterricht rege ich die Schüler*innen gezielt dazu an, ihr Lernen zu beobachten und zu reflektieren.
In my classes, I encourage students to reflect on their learning experiences after a period of learning and working.	In meinem Unterricht rege ich die Schüler*innen dazu an, nach einer Lern- und Arbeitsphase über die eigenen Lernerfahrungen nachzudenken.
In my classes, students share work and learning experiences (e.g., in groups or in class).	In meinem Unterricht tauschen die Schüler*innen Arbeits- und Lernerfahrungen aus (z. B. in Gruppen oder im Klassenverband).
In my classes, students record important learning experiences (e.g., best practices) in their workbooks or learning journals.	In meinem Unterricht halten die Schüler*innen wichtige Lernerfahrungen (z. B. bewährte Vorgehensweisen) in ihrem Arbeitsheft oder Lerntagebuch fest.
In my classes, I offer students opportunities to reflect on their strengths and weaknesses in learning.	In meinem Unterricht biete ich den Schüler*innen die Möglichkeit, über ihre Stärken und Schwächen beim Lernen nachzudenken.

Note. 1 = (almost) never; 2 = in some lessons; 3 = in most lessons; 4 = in (almost) lessons.

Table A3
Students' Perceptions of Teachers' Promotion of Metacognition

Items in English	Items in German
During class, my teacher often shows me how to observe and improve my learning.	Im Unterricht zeigt mir die Lehrperson oft, wie ich mich beim Lernen beobachten und verbessern kann.
During class, my teacher often encourages me to reflect on my learning experiences.	Im Unterricht ermuntert mich die Lehrperson oft, über meine Erfahrungen beim Lernen nachzudenken.
During class, my teacher often schedules time for us to talk in class or in groups about our learning experiences.	Im Unterricht plant die Lehrperson oft Zeit ein, dass wir in der Klasse oder in Gruppen über unsere Erfahrungen beim Lernen sprechen können.
During class, my teacher often makes sure that we write down important learning experiences (e.g., which approach worked well) in a workbook or learning journal.	Im Unterricht sorgt die Lehrperson oft dafür, dass wir wichtige Erfahrungen, die wir beim Lernen machen (z. B. welches Vorgehen gut geklappt hat), in ein Arbeitsheft oder Lerntagebuch schreiben.
During class, my teacher often asks us to think about our strengths and weaknesses in learning.	Im Unterricht verlangt die Lehrperson oft, dass wir über unsere Stärken und Schwächen beim Lernen nachdenken.

Note. 1 = does not apply; 2 = somewhat does not apply; 3 = somewhat applies; 4 = applies.

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